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INSTRUCTIONAL DATA TEAMS AND DATA LITERACY: LEADERS SUPPORTING THE WORK OF SCHOOL INSTRUCTIONAL TEAMS

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Abstract

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Instructional Data Teams and Data Literacy: Leaders Supporting the Work of School Instructional Teams.

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A multiple case study was designed to examine the components of data literacy used by formal and informal leaders to support the work of Data Teams. Nine formal leaders and ten informal leaders constituted the participants. One overarching central question and seven subquestions guided the research. The answer to the central question, How do leaders' influence the Data Team?, was informed by the seven subquestions: (1) How do leaders initiate discussions about data that create a catalyst for meaningful action?, (2) How do leaders determine the data used to support the work of the Data Team?, (3) How do leaders utilize analytical skills to support the work of Data Teams?, (4) How do leaders build others' capacity to use data effectively?, (5) How do leaders supervise the Data Teams Process?, (6) How do leaders determine the success of a Data Team?, and (7) Why do Data Teams need to have the support of leaders?.

There were three areas of focus in this research; (a) the six step Decision Making for Results Process, or Data Teams Process, developed by the Leadership and Learning Center, (b) The Data Literacy Conceptual Framework by Mandinach and Gummer (2016), (c) and leadership and management. This study found that when engaging in the Data Teams Process, leaders actions aligned with the components and subcomponents of the inquiry cycle for the Data Literacy Conceptual Framework identified by Mandinach and Gummer (2016). Additionally, findings for this study revealed that leaders (a) supported teams in identifying problems and framing questions, (b) utilized multiple sources of data when engaging in the Data Teams Process, (c) supported teams in analyzing data by engaging team members in discussions about data results, (d) created environments where team members felt safe to share data and ask advice of others, (e) considered student academic growth and team collegiality to be indicators of team success, and (f) described actions that provided evidence of behaviors related to transformational leadership, servant leadership, and management. Implications for practitioners and recommendations for future research were also identified in this study and are provided.

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Table of Contents

List of Tables

Table of Figures

Chapter One: Introduction to the Study

School reform has long been at the heart of many legislative actions in the United States. For more than 50 years, schools have been subjected to the demands of federal legislation found in the Elementary and Secondary Education Act (ESEA) and the Individuals with Disabilities Education Act (IDEA). With the reauthorization of ESEA in 2001, schools were held accountable for demonstrating average yearly progress(AYP) as measured by mandatory state testing. With the reauthorization of ESEA in 2016 legislation required that state accountability requirements include the use of results from annual statewide reading/language arts and mathematics assessments (U.S Department of Education, 2017). In addition to following federal legislation, schools have also been subject to other state and federal initiatives such as the state-led Common Core State Standards (CCSS).

The demands of previously mentioned federal and state accountability initiatives have compelled leaders to use data regularly to support their daily practice (Bernhardt, 2013; Earl & Katz, 2006; Knapp, Swinnerton, Copeland & Monpas-Huber, 2006; Piercy 2006). However, the collection or use of data alone does not ensure a leader's ability to utilize the information to inform leadership practice. As noted by Knapp, Copland, and Swinnerton, (2007) and Knapp et al. (2006), the leader's ability to exercise data informed leadership is affected by the data infrastructures that are in place as well as the leader's data literacy. Therefore, it is to the school's advantage to have systems in place that support the use of data, as well as leaders who possess the ability to make logical connections among the many kinds of student data that exist within the school including student achievement results.

To bridge the gap between student data and academic results, educators need to engage in a process of collaborative inquiry (Datnow & Hubbard, 2016; Love, 2009; Love, Stiles, Mundry,

& DiRanna, 2008). To provide the opportunity for educators to collaborate on student data, data teams have been implemented by some schools. A data team is a group of "four to eight teachers, other school faculty, and ideally, their building administrator who work together to use data to improve student learning" (Love, 2009, p. 39). The Data Teams Process combines professional collaboration with data-driven decision making (Besser, 2010). The use of these teams helps "ensure that all students are learning and making progress toward reaching proficiency levels" (Besser, 2010, p. 4).

The work of Data Teams within the school requires the support of school leaders (Ainsley, 2010; Peery, 2011). A review of the related literature identified two leadership roles associated with teams: the team leader, also referred to as the data coach or facilitator (Love, 2009; Love et al., 2008) and the building principal (Campsen, 2010; McNulty & Besser, 2011). A comparison of existing literature revealed that the line separating these two roles is often blurred. In some works, the leadership roles were recognized as being separate (Campsen, 2010; Peery, 2010, 2011). Other works recognized that the principal could also serve as the team leader, or coach (Love, 2009; Love et al., 2008). Regardless of assignment or title, those who lead teams play a critical role in creating a process that can positively impact student academic growth.

At the heart of data teams is the continuous use of data to drive the decision-making process (Allison, 2010; Campsen, 2010; Kamm, 2010, Mandinach & Gummer, 2016a; Mandinach & Jimerson, 2016; McNulty & Besser, 2011; Nielsen & Pitchford, 2010; Peery, 2010, 2011; Ventura 2010). To lead the team decision-making process, leaders must have the ability to examine multiple measures and multiple levels of data, to consider existing research, and to draw sound inferences (Love, 2004; Love et al., 2008). For leaders to effectively use data,

they must be data literate (Earl & Katz, 2002, 2006; Knapp et al., 2006; Ronka, Lachat, Slaughter & Meltzer, 2008). As recognized by Love et al. (2008), "Data literacy is important because, in combination with collaborative inquiry knowledge and skills, it is a core competency for high-capacity uses of data and preventative medicine for abuses and misuses of data" (p. 128). Therefore, leaders who work with teams must have the ability to understand and effectively utilize data to inform instructional decisions.

As noted previously, the knowledge and skills needed to effectively engage in data-driven decision making have been recognized as data literacy (Earl & Katz, 2002, 2006; Gummer & Mandinach, 2015; Jacobs Gregory, Hoppey, Yendol-Hopey, 2009; Knapp et al., 2006; Love, 2004; Love et al., 2008; Mandinach, Friedman, & Gummer. 2015; Mandinach & Gummer, 2016a; Wu, 2009). "Data literacy is the ability to interpret and use multiple data sources to effectively improve teaching and learning" (Love, 2009, p. 31). Collectively, five attributes of data literacy were described. In general, the attributes addressed an ability to evaluate and select appropriate data, as well as to analyze, compare, and share data and data results (Data Quality Campaign, 2014; Earl & Katz, 2006; Gummer & Mandinach, 2015; Hooft, Kratcoski, Cook, Swan, Vahey, et al., 2010; Knapp, Swinnerton, et al., 2006; Jacobs et al., 2009; Lachat Williams, & Smith, 2006; Love et al., 2008; Mandinach & Gummer, 2016a; Schield, 2004; Vahey, Yarnall, Patton, Zalles, & Swan, 2006).

The work of leaders is critical to the success of the team process (Campsen, 2010; Love, 2009; McNulty & Besser, 2011; Ventura, 2010). To support the work of teams, leaders "should have a strong understanding of standards and assessment, know how to analyze various forms of student achievement data, be familiar with research-based instructional strategies, and be able to facilitate meetings well" (Peery, 2011, p. 49). Unfortunately, some leaders may not have the

data skills that are needed to utilize data effectively (Datnow, Park, & Kennedy, 2008; Earl & Katz, 2002, 2006; Stiggins, 2001). Researchers have described a need for the use of data by teams (Allison, 2010; Campsen, 2010; Love, 2009; Kamm, 2010, McNulty & Besser, 2011; Peery, 2010; 2011; Ventura 2010). Those who have described the work of data teams have also recognized that there is a need for school leaders to support the team process (Campsen, 2010; Love, 2009; McNulty & Besser, 2011; Ventura, 2010) and for leaders who work with teams to be data literate (Love, 2009; McNulty & Besser, 2011). Thus, it is apparent that teams are better able to utilize student data to identify and remediate instructional deficiencies and improve student academic growth if leaders of those teams are data literate.

Problem to Be Studied

The literature supports the need for leaders who work with teams to possess knowledge and skills of data literacy (Love, 2009; Love et al., 2008; McNulty & Besser 2011). Data literacy, when used with collaborative inquiry, knowledge, and skills, "is a core competency for high-capacity uses of data and preventive medicine for abuses and misuses of data" (Love et al., 2008, p. 128). Numerous authors indicated that data knowledge and skills of the leader play a critical role in the ability of the team to utilize data in developing plans to guide teaching and learning (Campsen, 2010; Love, 2009; Love et al., 2008; McNulty & Besser, 2011; Peery, 2010). As noted by Cosner (2012), "Organizational context influences collaborative data practices, and a leadership approach of support and press for collaborative data use…" (p. 50). Thus, the logical conclusion is that the leader's data literacy has a direct effect on the team members and their ability to appropriately utilize the data available to them.

Unfortunately, many educators and leaders lack the background, skills, and dispositions needed for data literacy (David, 2008; Earl & Katz, 2006; Earl & Louis, 2013; Hubard, Datnow

& Pruyn 2014; Mandinach & Gummer, 2016a; Schildkamp & Ehren, 2013; Schildkamp & Lai 2013; Schildkamp & Poortman, 2015; Mandinach & Jimmerson, 2016; Wayman, Spikes, Volonnino, 2013). Too many educators, including leaders, lack the training to create, understand, analyze, and interpret data (Creighton, 2001; Earl & Katz, 2002, 2006; Hess & Kelly, 2007; Hubard & Datnow et al., 2014; Jimerson & Wayman, 2015; Mandinach, Honey, & Light, 2006; Mandinach, Rivas, Heinze & Honey, 2006; Mandinach & Gummer, 2016a; Goertz, Oláh, & Riggan, 2010: Lai & Schildkamp, 2013; Means, Padilla, Debarger & Bakia, 2009; Piro & Hutchinson, 2014; Popham, 2009; Stiggins, 2008). Many educators see data use as being synonymous with statistics, focused only on numbers and separate from educational decision-making (Creighton, 2001; Earl & Katz, 2006). The belief that basic statistics courses may not contribute to the fundamental understanding of data accuracy, appropriateness, and completeness raises concern about data skills that educators possess (Mandinach & Gummer, 2016a). While some educators understand the data and content domain represented by certain data, they lack knowledge of what to do pedagogically with the information they have gleaned from that data (Mandinach & Gummer, 2016a). Therefore, it appears that some educators and their leaders may lack data literacy skills and necessary knowledge to successfully implement and support the team process within a school.

Successful implementation of any initiative requires foresight and preparation. "Sustaining an improvement process demands that leaders do more than hope for short term wins" (Dufour & Fullan, 2013, p. 76). Schools can be littered with many failed or incomplete projects. Fullan (2001) recognized that the main problem in schools "is not the absence of innovation but the presence of too many disconnected, episodic, piecemeal, superficially adorned projects" (p.109) that are no longer used or effective. Too often in education, schools take on an

initiative such as Data Teams and fail to provide the type of support that is needed to ensure its success (McNulty & Besser, 2011). As a result, the implementation of a team may be difficult, resulting in staff time and school funding being wasted. If solutions are not quickly developed, staff may become disillusioned with the process of creating teams, and the initiative could fail. If, as indicated within the relevant literature, team success requires the support of school leaders (Campsen, 2010; Love, 2009; McNulty & Besser, 2011; Ventura, 2010), and more specifically, leaders who are data literate (Love, 2009; McNulty & Besser, 2011), then steps should be taken to ensure that leaders who support the work of teams are data literate.

Though various researchers have recognized the need for leaders to be data literate (Earl & Katz, 2006; Love, 2009; Love et al., 2008; Knapp et al., 2006; Knapp et al., 2007; McNulty & Besser 2011; Wu, 2009), the attributes of data literacy that authors have associated with being data literate are varied. The need for leaders to possess or demonstrate the various attributes of data literacy to support the team process was noted by Love et al. (2008). Yet, there was no evidence to indicate which of the attributes of data literacy team leaders possessed. In addition, no evidence was provided to indicate which attributes of data literacy leaders used to support the work of teams. Additionally, there was nothing written to indicate how formal and informal leaders used the attributes of data literacy to support the work of teams. Finally, there was little information found that tied the leader's data literacy to the leader's actions of leadership and management of teams.

Within the existing relevant assessment literature, the need for data team leaders to be data literate is apparent (Ainsworth & Viegut, 2006; Love, 2009; Love et al., 2008; McNulty & Besser, 2011). Yet, no studies reported to date have examined the data literacy of formal and informal leaders who work with Data Teams. Thus, if leaders who work with teams are not

actively involved with the team process, which includes data analysis and data-driven decision making, there exists the possibility for "half hearted implementation at best and total failure of the Data Teams initiative at worst" (Campsen, 2010, p. 125). Therefore, due to leadership issues associated with a lack of fidelity to the data literacy attributes, teams may be unsuccessful in their effort to impact student academic growth and be viewed as ineffective and eventually disbanded.

Purpose of the Study

The purpose of this qualitative multiple case study was to identify how the data literacy of formal and informal leaders in the state of Wyoming contributes to the Data Teams Process. The study also examined the attributes of leadership and management utilized by formal and informal leaders to support the use of data by team members. By examining the data practice of formal and informal leaders who work with teams, this proposed study contributes to the current body of research on data literacy and leadership, leadership and data-driven decision making, and leadership within teams.

Research Questions

This study is guided by one overarching central question and seven subquestions. When considered together, subquestions for the study answer the central question guiding this study. Both the central question and the subquestions emanate from, and are supported in, the literature review.

Central question. The central question for the study is: How do leaders influence the Data Team.

Subquestions. Seven subquestions are utilized to focus the study. These subquestions seek to identify leaders' understanding and use of data when working with Data Teams. To

determine how leaders' data literacy impacts the team process, subquestions include a focus on the leaders' actions of leadership and management when working with teams. The seven subquestions utilized to answer the central question for this study included:

1. How do leaders initiate discussions about data that create a catalyst for meaningful action?
2. How do leaders determine the data used to support the work of the Data Team?
3. How do leaders utilize analytical skills to support the work of Data Teams?
4. How do leaders build others' capacity to use data effectively?
5. How do leaders supervise the Data Teams Process?
6. How do leaders determine the success of a Data Team?
7. Why do Data Teams need to have the support of leaders?

Definition of Terms

For the purpose of this study, the following definitions were used:

Academic Growth. The amount of growth in a student's understanding of measured academic concepts that is "evidenced between two measurement intervals" (Northwest Evaluation Association, 2014, p. 7).

Assessment Literacy. The range of skills and knowledge needed to understand assessment results. Components include data interpretation, data-driven decision making, assessment instruction, assessment evaluation, assessment construction, assessment administration, and data communication (Fulcher, 2012).

Collaborative Inquiry. A process in which educators "work together to identify common challenges, analyze relevant data, and test out instructional approaches" (David, 2008, p. 87).

Common Formative Assessment. An assessment that is designed collaboratively by a grade-level or department team that (a) is administered to all students within a participating team member's classroom, (b) assesses power standards, (c) is designed to be given in pre and post-test form, (d) is collaboratively scored by grade-level or department teams, (e) demonstrates what students know and need to learn, and (f) provides results that can be used to guide instructional planning and delivery (Ainsworth & Viegut, 2006).

Data Coach. A staff member or leader who helps to facilitate the work of data teams by gathering and preparing data and helping to maintain the teams' focus on improving teaching and learning (Love, 2009).

Data Driven Decision Making (DDDM). A process in which multiple forms of data are systematically collected and analyzed in order to guide a range of decisions that are directed at improving the success of students and schools, including input data, demographic data, process data, outcome data, and satisfaction data (Ikemoto & Marsh, 2007).

Data Literacy. The ability of educators "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, etc.) to help determine instructional steps" (Mandinach & Gummer, 2016a, p. 29)

Data Team. Small grade-level, course, or like-content team that utilize a process that combines collaborative inquiry with data-driven decision making to examine school data in order to inform practices of teaching, learning, and leadership (Besser, 2010; McNulty & Besser, 2011).

Decision Making for Results Process. Also referred to as the Data Teams Process. A six-step, systematic, data-driven process that includes (a) collecting and charting data, (b)

analyzing student strengths and obstacles to learning, (c) establishing or revising instructional goals, (d) selecting instructional strategies, (d) determining results indicators, and (e) monitoring and evaluating results (Besser, 2010; McNulty and Besser, 2011).

Formal leader. A formal leader is one who gains authority by assignment. His or her powers or authority are derived through job title or held position (Bass & Bass, 1974/2008; Heifetz, 1994). For the purpose of this research, building principals, vice principals, district curriculum coordinators, instructional facilitators, and data coaches are considered formal leaders.

Informal leader. An informal leader is one whose authority level is not established by title or assignment (Bass & Bass, 1974/2008; Heifetz, 1994). Informal leaders "take action beyond whatever authority they have" (Heifetz, 1994, p. 205). They "experience leadership as an activity performed without authority, beyond expectations" (Heifetz, 1994, p. 206). For the purpose of this research, informal leaders were those with no formal leadership designation who are identified by building administration as leaders of a building level team.

Information literacy. The set of abilities needed by individuals to determine informational needs and to retrieve, evaluate, analyze, and use information in an efficient, effective, ethical and legal manner to accomplish a specific purpose (Association of College and Research Libraries, 2016).

Leadership. The actions used by leaders that influence followers to engage in real change that reflects the mutual purpose of the leader and follower (Rost, 1993).

Management. The authoritative actions used by managers with subordinates to coordinate activities that are used to produce a particular product or provide a particular service (Rost, 1993).

Response to Intervention (RtI). A process used for providing academic intervention which incorporates (a) three tiers utilized to match academic interventions to the assessed needs of an individual student, (b) systematic screening of children using accepted measuring instruments, (c) research based interventions, (d) progress monitoring of students who are at risk for low academic achievement, and (e) decisions or rules that direct the level of support that should be offered within each tier (Sailor, 2009).

Statistical Literacy. The ability to think critically about statistical evidence and to interpret and communicate statistical information (Gal, 2002; Gray, 2004; Schield, 1999, 2004).

Short-cycle review. A two to three week review cycle used by teams for administering and reviewing assessment data and goals (Ahearn, 2012; Peery, 2011; McNulty & Besser, 2011).

Student Data. Student academic and demographic information that includes information from teacher observations, assessments, and student actions that are used to provide a complete picture of student learning (Data Quality Campaign, 2015).

Delimitations of the Study

To narrow the scope of this study, there were several delimitations used. The study included participants from the state of Wyoming who worked in school districts where Data Team training had been delivered. The criteria for participation included formal and informal leaders who

1. Were working in selected schools who supervised or directed the work of Data Teams at the school or district level.
2. Had served in their current position for one full year or more.
3. Engaged with grade-level, course, or like-content teams that regularly examined student data in order to make instructional decisions.

4. Were working within schools or districts in which collaborative teams used a short-cycle review process for examining student data.
5. Were working within schools or districts in which there were at least two certified teachers assigned to each team.
6. Were working within school districts in which Data Team training had been provided by training consultants from Houghton Mifflin Harcourt.

Limitations of the Study

A multiple case study design was utilized to collect data through the use of personal interviews and the description of the various documents, data graphs and other artifacts collected from each site. As a result, there were six limitations of the study. First, the study was limited by the respondent's accuracy in providing information about the teams in which they participated. The study was also limited by the accuracy with which respondents interpreted and self-reported their use of the attributes of data literacy. The third limitation of this study was related to leader's accuracy in providing information about his or her use of leadership and management to support the work of teams. Next, the study was limited by the security measures for technology that were in place at each site that limited the researcher's ability to access participants. The study was also limited by the configuration of the groups described at each site. Finally, this study was limited by the amount and kind of evidence available at each school site that demonstrated the impact of the leader's data literacy on the team and its work.

Significance of the Study

By examining how team leaders share data and ensure the appropriate use of data, the attributes of leadership and management used by leaders who work with teams were identified. Schools seeking to implement the Data Teams Process can use the information provided from

this study to ensure the success of school teams by ensuring that leaders who work with teams are data literate and able to use that data literacy to support the work of teams.

Research has recognized the important role that leadership plays in the success of data teams (Campsen, 2010; Love, 2009; McNulty & Besser, 2011; Schildkamp & Poortman, 2015; Ventura, 2010). Numerous authors have recognized the need for data literacy to support the data team process (Ainsworth & Viegut, 2006; Love, 2009; Love et al., 2008; McNulty & Besser, 2011; Schildkamp & Poortman, 2015). Thus, there is a critical need to understand which attributes of data literacy leaders possess and how those attributes of data literacy are used to support the work of teams. This study provides important information for formal and informal leaders to use within the context of Data Teams. Information from this study provides information to improve the effectiveness of teams and ultimately their positive impact on student achievement.

Developing a working understanding of the leader's capacity for data use and how that data literacy impacts the work of teams provides a foundation for informing leaders who are currently working, or will be working, with teams. Building a greater understanding of the data literacy that is required for the leaders who work with Data Teams aids schools in implementing and sustaining the Data Teams Process. Finally, by examining leaders' data literacy and their use of data literacy to support the work of teams, this research contributes to the current body of research on data literacy, data-driven decision making, and Data Teams.

Chapter Summary

The organization of this introduction to the proposed study began with a discussion on how schools have been impacted by national and state-led accountability measures that require the use of data-driven processes. This discussion included reference to legislation such as the

Elementary and Secondary Education Act and Individuals with Disabilities Act and to initiatives such as Common Core State Standards. At the heart of the issue was the need for schools to utilize a data-driven process to improve student achievement.

Through the use of Data Teams, school staff have been provided the opportunity to engage in a process of data-driven collaborative inquiry. The work of teams has been used to bridge the gap between student data and academic results. For teams to find success, the need for strong leadership was identified (Besser, 2010; Campsen, 2010; McNulty and Besser, 2011; Perry, 2011).

This chapter discussed a need for leaders who work with Data Teams to be data literate. In the chapter it was proposed that there is a need to identify (a) which attributes of data literacy leaders who work with teams possess, (b) which attributes of data literacy leaders utilize to support the work of teams, and (c) how data literacy and actions of leadership and management are used by leaders to support the work of teams. The researcher for this study posited that by identifying how formal and informal leaders utilize data literacy to support the work of teams, the central question for the study would be answered. In the following chapter, the available literature that was reviewed to provide the foundation for this research is presented.

Chapter Two: Review of Related Literature

The literature review informing this study contains four major sections. The first section, The Evolution of Data Use in Educational Leadership, focuses on the need for leaders to utilize data. The second section, Data Literacy, examines data literacy, what it is, its use in education, and how it differs from other literacy practices. The third section, Utilizing Data Teams, presents information on teams, the team process, the use of the team process to improve student achievement, and data skills that leaders of teams should possess. The final section, Leadership and Management, presents the rationale used to define leadership and management as used in this study.

The Evolution of Data Use in Educational Leadership

Since the early 1990s, scholarly literature for the field of education has indicated that there was a growing need for educators to become more adept at utilizing data. Stiggins (1991) addressed the need for educators to become critical consumers of assessment data. Bernhardt (1998) proposed that learning organizations could use data analysis to understand organizational needs and develop a path to achieve desired organizational outcomes. Mandinach, Honey, and Light (2006) demonstrated the need for data use in schools with their presentation of a Framework for Data Driven Decision Making.

As student data became more available, multiple researchers presented a need for data use and the data literacy of teachers and educational leaders (Earl & Katz 2002, 2006; Gummer & Mandinach, 2015; Knapp et al., 2007; Knapp et al., 2006; Love, 2004, 2009; Love et al., 2008; Mandinach, Friedman, et al., 2015; Mandinach & Gummer, 2013, 2016a; Vanhoof, Verhaeghe, Van Petegem, & Valcke, 2013). In 2013, the work of two separate groups of researchers addressed the need to find a means to support and develop the data literacy of educators. The

findings from The School Feedback Project presented by Belgium researchers Vanhoof, Verhaeghe, Van Petegem, and Valcke (2013) sought to find suitable forms of support for schools to develop the data literacy of staff. That same year Mandinach and Gummer (2013) proposed the need for a systemic way to view data literacy within educator preparation programs. In 2015, Gummer and Mandinach expanded their research with a presentation of work being done to develop a conceptual framework of data literacy for teaching. Finally, Mandinach and Gummer (2016a) published a conceptual framework for the data literacy of teachers

The review of the literature pertaining to data literacy completed for this study demonstrates a growing consensus among researchers about the presence of data within the school setting over the past decade (Earl & Katz, 2002, 2006; Gummer & Mandinach, 2015; Hooft et al., 2010; Jacobs et al., 2009; Knapp et al., 2006; Lachat, Williams, et al., 2006; Love, 2004; Love et al., 2008; Mandinach, Friedman et al., 2015; Mandinach & Gummer, 2016a; Schield, 2004; Vahey et al., 2006; Wu, 2009), and the need for educators and educational leaders to have the ability to utilize data (Bernhardt, 1998, 2002, 2009, 2013; Datnow et al., 2008; Earl & Katz, 2002, 2006; Gummer & Mandinach, 2015; Hooft et al., 2010; Jacobs et al., 2009; Knapp et al., 2006; Lachat et al., 2006; Love, 2004; Love et al., 2008; Mandinach, Friedman, et al., 2015; Mandinach & Gummer, 2016a; 2016b; Popham, 2008; Schield, 2004; Vahey et al., 2006; Wu, 2009). Driving the majority of the research on data use in education is the goal of improved student achievement. Much of the recent push for schools to utilize data to improve student achievement has come from federal legislation that has noted the need for schools to utilize data to monitor student progress (Individuals with Disabilities Education Act, 2004). Also noted was the need to measure student progress towards meeting high academic standards using annual statewide assessments (U.S. Department of Education, n.d.). In the subsequent subsection of this

literature review, the federal legislation that has created a need for data use in U.S. schools and what school leaders must understand about data in order to effectively utilize data is presented.

Federal legislation and school data. Since 1995, educational literature has provided documentation of the need for data to be used within schools to drive various school processes. Therefore, this section provides a review of the educational literature that has recognized the need for leaders to understand and use data. It also reviews how federal laws such as the Elementary and Secondary Education Act (ESEA), the Individuals with Disabilities Education Act (IDEA), and state-led initiatives such as the Common Core State Standards (CCSS) have led to a need for school leaders to utilize data. Included in the section is a review of the knowledge and skills needed by leaders for effective use of data. To demonstrate the impact that the demand for data use has had on educational leadership, the section presents information taken from The Professional Standards for Educational Leaders (PSEL), and various summative and formative assessments of leadership that indicate a need for leaders to understand and utilize data.

The need for schools to produce, collect, and utilize data is tied to mandates within federal legislation. Though the federal government does not have direct constitutional authority over education, states must be in compliance with the federal laws to receive federal funds (Wayman, Spikes & Volonnino, 2013). "Strong federal involvement in education has been a relatively recent phenomenon, stemming from civil rights and antipoverty actions of the 1950s and 1960s" (Wayman et al., 2013, p. 137). The reauthorization of ESEA in 2001, also referred to as NCLB, utilized the aims of the original 1965 civil rights legislation to implement high-stakes testing and force schools to improve instructional practices (Wayman et al., 2013). The goals of NCLB were further supported in 2004 when Congress reauthorized IDEA. In

reauthorizing IDEA, Congress made changes to the act that allowed for its alignment with NCLB (U.S. Department of Education, Office of Special Education Programs, 2007). The alignment of the two acts provided for flexibility in IDEA funding to support specific activities and programs identified in ESEA (U.S. Department of Education, Office of Special Education Programs, 2007). With the reauthorization of ESEA in 2015, referred to as the Every Student Succeeds Act (ESSA), the drive to support the needs of struggling learners and schools continued. Under the revised Act, states were expected to develop plans to guide the accountability process established in federal law (The White House, Office of the Press Secretary, 2015). While states were given the authority under the revised act to develop their own state accountability system, the requirement to assess students annually using a standardized assessment remained (The White House, Office of the Press Secretary, 2015). With the reauthorization of what is now known as ESSA, federal legislation continued to be a driving force in school accountability. Thus, the federal legislation of ESSA and IDEA that had worked in tandem for over a decade to hold schools accountable for student achievement by using state assessment data to ensure a school's annual yearly progress continued.

Data demands of ESEA. The mandates presented within the 2002 reauthorization of NCLB sought to evaluate the educational process through the use of school data. Therefore, schools needed to implement data-driven processes, and in doing so, school staff needed to be data literate. Under NCLB all state and school data generated as a result of state-mandated tests was required to be disaggregated by subgroups of students, published, and made available to the public when the number of students included in the subgroup exceeded ten (No Child Left Behind Act of 2001, 2002). Under the data requirements of NCLB, when populations or

subgroups of students failed to meet state-set testing benchmarks, the school would fail to make AYP (No Child Left Behind Act of 2001, 2002).

Starting in March 2010, new legislation that would change the ESEA was proposed. The first proposal was a plan slated to supplant NCLB entitled A Blue Print for Reform (U.S. Department of Education, Office of Planning, Evaluation and Policy Development, 2010). Though the legislation was introduced in 2010, Congress failed to act on A Blueprint for Reform to reauthorize ESEA. In response, President Obama's administration addressed the need for a change in the law by offering states the opportunity to apply for waivers that allowed flexibility from NCLB (The White House, n.d.). State plans completed to secure waivers helped schools gain flexibility from NCLB accountability requirements and provided strong foundations for the changes that would occur when ESEA was reauthorized in 2015.

Under the newly reauthorized ESSA, states were charged with developing state-wide accountability plans to hold school districts and schools accountable for the progress of all students (The White House, Office of the Press Secretary, 2015). According to the ESSA, each plan was to include the assurance that challenging state academic content standards for reading or language arts and math had been adopted. The state's plan was to include the assurance that aligned academic achievement standards that included at least three levels of achievement had been adopted. As part of this statewide accountability system, beginning with the 2017-2018 school year, states are expected to identify schools in need of comprehensive support and improvement. Under the new ESEA plan, schools once identified by the state education agency as needing improvement, would, in partnership with stakeholders, "develop a school improvement plan that provided school-level targeted support designed to improve student outcomes as measured by indicators in the statewide accountability system" (Every Student

Succeeds Act, 2015,). Furthermore, yearly statewide assessments would be maintained for the purpose of determining the progress of each school (The White House, Office of the Press Secretary, 2015). Under the revised act, states were encouraged to use "multiple measures of student learning and progress, along with other indicators of student success to make school accountability decisions" (The White House, Office of the Press Secretary, 2015, para. 8). Consequently, the ESEA continued to enforce the need for states, school districts, and schools to use data to monitor student academic achievement and growth to demonstrate the academic progress of all students.

Data demands of IDEA. As observed in NCLB and ESSA, the need for schools and their leaders to be proficient in the use of data was evident in the 2004 amendment to IDEA. The amendment provided a new educational process designed to prevent inappropriate referrals to special education (Burdette, 2007). Regulations issued through IDEA in 2006 provided further support for the new process (Burdette, 2007). The process explained within the act noted that as part of the evaluation procedures for identifying students with Specific Learning Disabilities, "a process that determines if the child responds to scientific, research-based intervention…" (Individuals with Disabilities Education Act of 2004) may be used. This response to scientific research-based intervention was commonly referred to as Response to Intervention (RtI) (Burdette, 2007). As noted by the Center on Response to Intervention (2010),

> With RtI, schools use data to identify students at risk for poor learning outcomes, monitor student progress, provide evidence-based interventions and adjust the intensity and nature of those interventions depending on a student's responsiveness, and identify students with learning disabilities or other disabilities. (p. 2)

The various components found within the RtI process verified that there was a need for those that used this process to collect, analyze, and utilize data to inform instruction. The use of curriculum-based measures, universal screening of all students at least three times per year, and regular progress-monitoring of student's academic growth were identified as being integral parts of the three-tier RtI model (Gerzel-Short & Wilkins, 2009; Shinn, 2007). The baseline data produced from these measures was identified as being integral to the process used by teams for determining which students need additional instruction or remediation as well as fostering student achievement and growth (Gerzel-Short & Wilkins, 2009). Therefore, to meet the demands of RtI, school staff had to know what information needed to be taught and assessed and how to utilize resulting data to implement appropriate instructional interventions.

Data demands of Common Core State Standards (CCSS). While RtI provided direction on how to support interventions for building student achievement and growth, content standards provided the framework for what should be taught and assessed in schools. Initially, to meet the data demands of NCLB, state assessments were built using state determined standards that established the amount of content that students should master at each grade-level. As a result of "local control," the educational expectations for student achievement were subject to interpretation, and data results could vary from district to district. Therefore, content taught was not the same from school to school or state to state.

In 2009, the plan that identified the content assessed on state tests began to change with the implementation of CCSS. The CCSS, developed by The Council of Chief State Officers and The National Governors Association, was intended to provide continuity between school systems located in the various states and guarantee that all students, regardless of the state in which they lived or the school they attended, had the opportunity to achieve at the same level (Kendall,

2011). The CCSS provided 85% of the total number of standards that could be implemented by States (Kendall, 2011). The overarching goal of CCSS was to "identify for all stakeholders the knowledge and skills that students must acquire to succeed in college or career" (Kendall, 2011, p. 27).

The implementation of the new standards modified the content taught, as well as when content was to be taught. Pushed by the adoption of CCSS, many districts worked to unwrap the standards and identify the "big Ideas" and "essential questions." The big Ideas and essential questions provided targets for student learning, assessment, and evaluation of instruction (McNulty & Besser, 2011). With the reauthorization of ESEA in 2016, Federal legislation established that states must adopt "challenging state academic standards" (Every Student Succeeds Act, 2015). Under the new legislation, states had the option to utilize either CCSS or approved state developed standards. By requiring that all students in America were taught to high academic standards, federal legislation sought to ensure that all students were prepared to succeed at the college and career level (U.S. Department of Education, n.d.). Within the Data Teams Process, the use of learning targets, or priority standards, embedded within the CCSS document provided a roadmap for learning (McNulty & Besser, 2011).

State Accountability Requirements for Wyoming.

In 2012, the state of Wyoming adopted the common core standards as the Wyoming Content and Performance Standards. To measure those standards and meet the mandates of federal legislation, Wyoming established state accountability requirements. Information contained in the Wyoming School Accountability 2017 Wyoming School Performance Rating Model Implementation Handbook (Wyoming Department of Education, 2018), describes the accountability indicators used to measure each public school's level of success in educating the

student population. In Wyoming, each school is measured through the use of indicators that determine performance, equity, and growth in grades three through eight, and performance, equity, growth, graduation, and additional readiness in grades nine through twelve. Based on indicator results, the state issues a yearly accountability report for each school. The reports were established to meet the requirements of the Wyoming Accountability in Education Act. The first reports were issued following the 2012-2013 school year. Reports rate schools in "one of four performance level categories: Exceeding Expectations, Meeting Expectations, Partially Meeting Expectations and Not Meeting Expectations" (p. 1). Included with the report are performance level indicators for each of the measured areas.

Performance level indicators for achievement for grades three through eight are calculated using scores from the state achievement test, Proficiency Assessment for Wyoming Students (PAWS). The test is used to assess reading and math in grades three through eight, and science in grades four and eight. The achievement score for grades nine through twelve is calculated using ACT scores of students in grade eleven.

Performance level indicators for equity describe the growth of at-risk students between two consecutive years. To measure the growth, students in grades four through eight identified as having low performance on the PAWS math or reading test are assigned to a consolidated subgroup. Test scores for the subgroup the following year are compared to the prior year scores. The comparison of scores results in a median growth percentile (MGP) for the school which is used to generate the yearly performance indicator for equity. The equity indicator for high school is based on the growth of a consolidated subgroup identified from the math or reading scores of tenth-grade students on the Aspire test and the same subgroup's scores on the ACT in grade eleven.

Performance level indicators for growth are used to describe the year-to-year change in achievement of reading and math scores for students in grades four through eight. The growth model uses student yearly scores on PAWS to produce a student growth percentile (SGP). To generate the SGP, students' scores are compared to those of their academic peers. Academic peers are those students in the same grade in all Wyoming schools that have a similar test score history. "SGPs range from 1 to 99 with lower scores indicating lower growth and higher scores indicating higher growth relative to the academic peers" (p. 3). The same model is used to produce the growth indicator for high schools. Grade ten growth is determined by comparing scores from the Explore test in grade nine with scores from the Aspire test in grade ten. Grade eleven growth is determined by comparing scores from the grade ten Aspire test to scores on the ACT in grade eleven.

Additional accountability indicators are provided to Wyoming high schools to describe graduation rate and additional readiness. Graduation rate is determined using the indicators for four-year on-time graduation rate as well as extended graduation rate which includes five-year, six-year or seven-year graduates. Additional readiness is calculated using combined indicators for "Hathaway scholarship eligibility level, grade nine credits earned and tested readiness (i.e., based on composite scores on the grade nine Explore, the grade ten Plan, and the grade eleven ACT)" (p. 9).

What Leaders Need to Understand About Data and Data Use.

Throughout the section on Federal Legislation and School Data, the literature revealed that schools under the mandates of Federal legislation were required to continually monitor and assess student academic growth. As posited by Peery (2011), in order to examine and effectively utilize the results of student progress data to address the instructional needs of students, school

staff must have support from the school leader. Also noted, was the need for all individuals using data to have an understanding of the various assessment formats as well as knowledge of how to interpret statistics and knowledge about the various scoring schemes. Similarly, other assessment experts noted the importance of understanding and interpreting data (Deluca & Klinger, 2010; Linn & Gronlund, 2000; Mertler, 2003; Nitko & Brookhart, 2007; Popham, 2007; Rudner & Schaffer, 2002). In addition to their understanding how to utilize measurement data, research indicated that leaders needed to understand how to utilize the vast amounts of quantitative and qualitative data that produce relevant information about students, teachers, curriculum, the school, and community, as well as the learning trends that were occurring within the school or district (Bernhardt, 1998; 2002). Therefore, in utilizing school data and supporting staff in the use of data, leaders needed to demonstrate skills that allowed them to (a) recognize what data were available for access and use; (b) understand how to access, gather, and interpret data; and (c) know when and how to apply data results to the decision-making process.

Data interpretation needs of leaders. Within the school setting, school leaders regularly receive data from school and state assessments, student progress monitoring, psychological testing, and research results for adopted or perspective curriculums. In order to effectively utilize the available data, school leaders must have an understanding of (a) various assessment formats that are used to measure student achievement (Deluca & Klinger 2010), (b) the key statistical concepts used for measurement (Linn & Gronlund, 2000; Mertler, 2003; Popham, 2007: 2008), and (c) the various score interpretation schemes used to report measurement results (Linn & Gronlund, 2000; Mertler, 2003; Nitko & Brookhart, 2007; Popham, 2007; Rudner & Schaffer, 2002). In short, leaders must possess a broad understanding of testing

and measurement to effectively utilize measurement results to inform decisions within the school.

When utilizing results from educational testing, understanding how results from the various types of assessments differ is helpful. To measure student performance, a criterion-referenced or norm-referenced interpretation can be used (Linn & Gronlund, 2000). The results of criterion referenced tests (CRT), also described as standards-based assessments (Berry & Adamson, 2011), are used to determine the extent to which pupils have mastered specific curriculum, content, and skills; while results of norm reference tests (NRT) are used to rank pupil achievement against a nationally representative sample of students (Riddle, 2008). When individuals are interpreting CRT or NRT results, there is an apparent need for them to understand how scores for the assessments are derived, as well as how to mine the data embedded in the test results.

To analyze and interpret the results of any measurement, a leader must possess some knowledge of statistics. Some common statistical concepts that a school leader needs to understand include (a) measures of central tendency, (b) measures of variability, (c) normal distribution, (d) validity, reliability, standard error of measurement, and (e) confidence intervals (Linn & Gronlund, 2000; Mertler, 2003; Popham, 2007; 2008). Being familiar with statistical concepts supports leaders' understanding of the mathematical processes that are behind the data results and what those results mean.

In addition to understanding statistical concepts, leaders must be familiar with the various types of scores or data interpretation schemes used in academic assessment. The data interpretation schemes school leaders need to understand include raw scores, percentiles, grade equivalent scores, and scale scores (Linn & Gronlund, 2000; Mertler, 2003; Nitko & Brookhart,

2007; Popham, 2007; Rudner & Schaffer, 2002). Each of the previously noted score schema is based on the raw score, which reflects the number of items answered correctly by a student on an assessment (Linn & Gronlund, 2000; Popham, 2008). While the raw score provides a numerical summary of the test performance, it does not provide a meaningful indicator of student success when used in isolation (Miller, Linn & Gronlund, 2008). To be meaningful, scores need to be paired with other information and converted to other formats (Miller et al., 2008). Thus, the information appeared to suggest that one must understand what each type of score represents to ensure results will be interpreted accurately.

Categories of school data. While assessment results could be used to guide decisions about student learning, there were recommendations that other types of data also be considered (Mandinach & Gummer, 2016a). Other types of data noted by Mandinach and Gummer (2016a) included behavior data, justice data, health data, attendance data, and data from other systems of student support. Bernhardt (1998, 2002, 2013) posited that there were four categories of data: (a) perceptual data, (b) demographic data, (c) student learning data, and (d) school process data. As Bernhardt (2009) noted, when data from the various categories were used together, school staff were better able to (a) understand where the school is currently, (b) understand how they got to where they are, (c) know if the goals and vision of the school are being achieved, (d) understand why current gaps and undesirable results exist, (e) evaluate what is and is not working, (f) predict and prevent future failures, and (g) predict and ensure future success. Therefore, the various forms of data, when used in combination, were found to support data-driven decision-making practices within the school setting.

Utilizing data for decision-making. Data Driven Decision Making (DDDM) is a process utilized to transform data into actionable knowledge (Mandinach, Rivas, et al., 2006).

As it applies to education, DDDM "refers to teachers, principals, and administrators systematically collecting and analyzing various types of data, including input, process, outcome, and satisfaction data, to guide a range of decisions to help improve the success of students and schools" (Marsh, Pane & Hamilton, 2006, p. 1). The process used in DDDM can be simple or complex. According to Ikemoto and Marsh (2007), the complexity of the process is influenced by the variations of the data along the dimensions of (a) time frame, (b) types of data, (c) source of data, (d) source of collection, and (e) level of detail. The processes used in DDDM have been utilized for many years in industry and manufacturing (Marsh et al, 2006). Practices such as Total Quality Management, Organizational Learning, and Continuous Improvement, which align with the belief that "organizational improvement is enhanced by the corporation's responsiveness to different types of data" (Marsh et al., 2006, p. 2), serve as models to be used in education. Consequently, it is the action response to data results that provides the catalyst to move organizations forward, not the volume of data produced.

The actions of school leaders directly influence the use of DDDM within a school (Mandinach, Honey, et al., 2006; Marsh et al., 2006; Marsh & Farrell, 2015). Marsh et al. (2006) found that school leaders "with strong commitments to DDDM and norms of openness and collaboration fostered data use" (p. 9). Mandinach, Honey, et al. (2006) noted that school leaders who communicated the importance of data use for decision making stimulated data use among faculty. Furthermore, the data skills that school leaders demonstrate provide support to the DDDM process and empower staff to utilize data for decision making.

Standards and practices of data use within educational leadership. There were a number of books and guiding documents found that discussed the need for school leaders to have the ability to utilize data in their practice. The following subsection provides an overview of the

literature on school leadership that addressed the use of data by leaders. Also included in the subsection is information on leadership policy standards and certification requirements for school leaders.

Data use and leadership practices. There were numerous research studies examined that addressed the characteristics of effective school leaders and the relationship that exists between leadership and student achievement. Included were various lists that noted practices, characteristics or standards used by effective leaders. Reviewing this information revealed two purposes for using student data within the school setting. The first purpose was to monitor and evaluate student progress to foster student achievement (Cotton, 2003; Datnow & Park, 2014; Marzano, Waters & McNulty, 2005; Reeves, 2004). A second purpose was to monitor and align curriculum and assessment practices (Cotton, 2003; Datnow & Park, 2014; Marzano et al., 2005; Reeves, 2004).

Information presented in the literature discussed the leader's role in monitoring and evaluating student progress within the school setting. The work of Cotton (2003) noted that school leaders who were actively involved in monitoring and evaluating student progress ensured that there were "systematic procedures for monitoring student progress at the schoolwide and classroom levels" (p. 71). School leaders also ensured that data were "disaggregated to monitor the progress of specific groups" (Cotton, 2003, p. 71). Reeves (2004) identified the actions utilized in monitoring and evaluating student progress as student-centered accountability. He further articulated that student-centered accountability included test scores, stories, case studies, and vignettes (Reeves, 2004). Student-centered accountability was used to promote a balance of quantitative and qualitative student data for use in monitoring and evaluating student progress (Reeves, 2004). Data utilized within a student-centered system were used to provide a detailed

picture of what was working and not working within the instructional program. It was noted in the related literature that individual student progress data used for student-centered accountability included "not only academic achievement scores, but also specific information on curriculum, teaching practices, and leadership practices" (Reeves, 2004, p. 6). The information gained from individual student progress data was therefore linked to decisions about curriculum and assessment.

To guide decisions and foster continuous improvement research indicated that there is a need for leaders to "enable teachers to take lead roles in mapping curriculum, developing assessment and guiding discussions with their colleagues" (Datnow & Park, 2014, p.118). To support the process, school leaders need to be aware of how school practices impact student achievement (Marzano et al., 2005). To support the monitoring of curriculum and assessment practices, Marzano et al. (2005) posited that leaders must have an understanding of what represents effective practice. To identify curriculum and assessment practices that are effective, student assessment results must be reviewed. Assessment results "help measure whether the curriculum is meeting the needs of all learners" (Mooney & Mausbach, 2008, p. 20). In monitoring the school's teaching and learning practices, leaders can utilize student outcome results to find the strengths and weakness of the curriculum. While results from national and state assessments provide a big-picture view of the efficacy of the curriculum, data results from locally developed assessments provide information that helps pinpoint specific parts of the curriculum that need more attention (Mooney & Mausbach, 2008). Thus, the monitoring and revision of curriculum and assessment is a continuous process, guided by student learning outcomes and informed by data.

The information presented in this review regarding the purpose for data use, demonstrates the need for leaders to utilize data to monitor all aspects of the school program and use the analysis from the data to make modifications to curriculum and instruction. The leadership practices presented were best summarized in work published by the National Association of Elementary School Principals (NAESP) (2008). Within NAESP, Standard Five recognized that effective leaders "manage data and knowledge to inform decisions and measure the progress of student, adult and school performance" (p. 93). Leadership actions associated with the NAESP Standard Five included (a) using "multiple measures of summative data over time" (p. 93) to demonstrate student growth and encourage progress; (b) collecting, analyzing and discussing multiple sources of data to assess student performance, teacher performance, principal performance, and school performance; (c) "focusing on the most important data and bringing it to the forefront so it can be analyzed to inform changes that make sense for the school's staff and community" (p. 97); and (d) presenting "complex data in ways that are fair and actionable" (p. 105). The recommendations for data use found in Standard Five of NAESP (2008) were evident in other guiding leadership documents.

Data use and leadership policy standards. The expectation that leaders will possess data skills was evident in the standards that guide educational leaders. Within the Professional Standards for Educational Leaders (PSEL), a framework was provided that detailed what effective leaders should know and be able to do (National Policy Board for Educational Administration, 2015). Element B and D of Standard One indicated a need for leaders to utilize data within a cycle of inquiry to develop, implement, monitor, and evaluate instructional and organizational practices to promote and ensure a shared vision of student learning. Standard Four Elements F and G recognized the need for leaders to utilize assessment data to monitor

student progress and improve the instructional system. By meeting the requirements of Element G of Standard Nine, leaders' use of data to support school operations and resources contributed to the academic success and well-being of students. Finally, Standard Ten, Elements D and G, showed that there was a need for leaders to collect analyze, use, and manage data to support school improvement efforts that contribute to the academic success of students.

In the review of the PSEL standards, the need for leaders to understand and utilize data to guide instruction was also apparent. Standards One, Four, Nine, and Ten described the need for leaders to collect, analyze, manage, and use data to monitor and evaluate student progress and the instructional and organizational practices of the school. The four standards also recognized the need for the use of data to support the development and support of the school's mission and vision. In each reference to data use noted in PSEL, the overarching purpose was to promote the academic success and well-being of each student through the use of leadership practices.

Data use and the assessment of school leaders. The research on leadership skills and the PSEL standards provided a powerful framework for what leaders should know and be able to do. However, for one to truly understand a school leader's knowledge of data, the leader's skills must be assessed. Within the field of education, the measures of leadership take two forms: standardized tests used by states for certification purposes and formative measures that are used by colleges and universities preparing school leaders for evaluation purposes (Condon & Clifford, 2010).

Summative assessments of leadership. To work within the public-school system, leaders must first meet the state requirements for teacher licensure. As part of a study completed by Mandinach, Friedman, and Gummer (2015), licensure documents from 49 states and the District of Columbia were analyzed to identify the data literacy skills and knowledge required by each

state for teacher licensure. Excluded from the analysis was licensure documentation for the state of Wyoming, which researchers noted could not be found. However, that information was available from the Wyoming Professional Teaching Standards Board (PTSB). The results of the analysis, which listed Wyoming but did not include any information on the state, revealed that the documentation from twenty states did not mention data or mentioned data in a limited manner, whereas documentation from thirty states and the District of Columbia explicitly dealt with the concept (Mandinach, Friedman, et al., 2015; Mandinach & Gummer, 2016a). Furthermore, the authors noted that two states did not mention assessment in their regulations (Mandinach, Friedman, et al., 2015; Mandinach & Gummer 2016a). Eight of the states that did not mention or barely mentioned data were found to have a data standard (Mandinach, Friedman, et al., 2015; Mandinach & Gummer 2016a). In 23 of the licensure documents, data literacy skills were explicitly addressed, while 37 of the documents articulated assessment literacy skills (Mandinach & Gummer, 2016a). Information obtained from the Wyoming PTSB online site indicated that state licensure requirements did not require an understanding of data or data use. The data standards that exist in state licensure requirements for teachers carry through to requirements for administrators in states where applicants are expected to have a current teaching license.

Some states, like Wyoming, require that prospective school leaders first hold a teaching license before they can obtain an administrative license. In other states, the licensing process for administration requires principals to demonstrate their understanding of leadership by passing a leadership proficiency exam. Mandinach and Gummer (2016a) cited information from a self-report survey of state data directors posted on the Data Quality Campaign website in 2014 (web link unavailable), which identified the states that had certification or licensure processes that

required applicants to demonstrate data skills. The researchers noted that 13 states required superintendents to demonstrate data skills, 18 states required principals to demonstrate data skills, and 22 states required teachers to demonstrate data skills.

Another measure that provided evidence of the data skills that leaders must possess was the School Leaders Licensure Assessment (SLLA). The assessment offered through the Educational Testing Service site was required for licensure in eighteen states, Guam, the District of Columbia, and the Virgin Islands (Educational Testing Service, 2016a). The study companion for the assessment provided an overview of topics tested on the SLLA. Many of the indicators listed under each topic referred to the need for leaders to analyze and utilize multiple sources of data, to monitor and evaluate various aspects of the educational program and educational environment, and to facilitate student achievement (Educational Testing Service, 2016b). The SLLA, while a powerful tool, is just one measure that can be used to provide evidence of the need for leaders to understand and utilize data.

The need for leaders to utilize data to monitor and evaluate the educational program was also evident in the fact that this topic is covered in various state-developed assessments of leadership. The assessments required for licensure in the states of New York (New York State Certification Examinations, 2013) and Arizona (Arizona Department of Education, 2013) are examples of assessment information included in state assessments that addressed the need for leaders to possess data skills. Study guides and reference documents available for these two state leadership exams revealed that the assessments provided a measure of a leader's understanding of data and ability to analyze data. These summative licensure exams provide the opportunity to screen candidates at the state level. To measure leadership at the district level, formative assessments can be used.

Formative assessments of leadership. Formative assessments have been used by some districts to evaluate leaders and "identify areas of needed improvement of leadership practice" (Goldring, Porter, Murphy, Elliott & Cravens, 2009, p. 3). An example of a formative assessment of leadership used by some school districts is the Vanderbilt Assessment of Leadership in Education (VAL-Ed). Research documentation of the Val-Ed project revealed that the data skills measured included how leaders plan for data, communicate data, and monitor data (Goldring et al. 2009).

The assessments used to measure leaders' understanding and use of data reflect the need for leaders to be data literate. In the previous section, Data Use in Leadership, the need for leaders to utilize data was supported using information from legal documents, PSEL, and other guiding documents on leadership assessment and practice. This ability to understand and utilize data has been referred to as data literacy (Data Quality Campaign, 2014; Earl & Katz, 2002, 2006; Gummer & Mandinach, 2015; Knapp et al., 2007; Knapp et al., 2006; Love, 2009; Love et al., 2008; Mandinach, Friedman, et al., 2015; Mandinach & Gummer, 2016a; Mandinach, Parton, Gummer & Anderson, 2015; Schield, 2004; Wu, 2009).

Data Literacy

The ability to understand and apply basic data concepts was described as data literacy (Love et al., 2008). To explain what data literacy is, this section begins with a brief look at literature that describes data literacy. A description of the characteristics and process associated with data literacy follows. Presented next is information on the relationship that exists between data literacy and other related data processes and forms of literacy. Included in the section are references to studies and literature that describe how data literacy has been used to support the academic performance of students and the instructional practices of teachers and educational

leaders. The information provided within this section, when considered with the information provided in the section on Data Use in Leadership, provides a foundation for understanding data use and the attributes of data literacy that contribute to the work done by leaders of school Data Teams.

In a data-rich educational environment, school leaders need more than just the ability to read and interpret data in order to influence student achievement within a school (Data Quality Campaign, 2014; Earl & Katz, 2002, 2006; Gummer & Mandinach, 2015; Mandinach, Parton, et al., 2015; Marzano et al., 2005, Means, Chen, DeBarger & Padilla, 2011). Researchers have posited that in order to effectively utilize the vast amounts and different forms of data to inform instruction, educators need to be data literate (Data Quality Campaign, 2014; Earl & Katz, 2002, 2006; Knapp et al., 2007; Knapp et al., 2006; Gummer & Mandinach, 2015; Mandinach, Parton, et al., 2015; Mandinach & Gummer, 2012, 2016a; Piro & Hutchinson, 2014). When writing about data literacy, researchers presented individual perspectives about what it means to be data literate (Data Quality Campaign, 2014; Earl & Katz, 2002, 2006; Gummer & Mandinach, 2015; Knapp et al., 2006; Knapp et al., 2007; Love, 2009; Love et al., 2008; Mandinach, Friedman, et al., 2015, Mandinach & Gummer, 2016a; 2016b; Mandinach, Parton, et al., 2015; Means et al., 2011; Piro & Hutchinson, 2014). While earlier research identified components of data literacy, there was a lack of clarity regarding the specific knowledge and skills that comprised the construct. Information published after 2012 was more explicit in describing the data literacy needs of educators.

In 2012, a group of "researchers, professional development providers (in both data and assessment), funders, government representatives, policymakers, and other experts" (Mandinach & Gummer, 2012, p. 6) came together to analyze existing information on data use and develop

an operational definition of data literacy. In analyzing the information, these experts explored various texts to identify definitions and processes associated with the inquiry process, assessment, data, data analysis, instructional and programmatic planning, understanding research, and evidence categories (Mandinach & Gummer, 2012). Though participants involved with this project "were unanimous in their agreement on the need to provide conceptual and operational frameworks related to what it means for educators to be data literate" (Mandinach & Gummer, 2012, p. 25), the group identified only 95% of the elements of data literacy (Mandinach & Gummer, 2012). As a result of the research, vast amounts of information about data literacy and data driven decision-making were gained (Mandinach & Gummer, 2012). In addition, information gaps that existed in the field were identified (Mandinach & Gummer, 2012). Building on research from previous work, Gummer and Mandinach (2015) constructed a conceptual framework for data literacy that demonstrated the complex nature of the construct. As noted by the researchers, the framework was designed to "undergird research, development, and capacity building around data literacy for teaching" (Gummer & Mandinach, 2015, p. 1). The emerging framework developed by Gummer and Mandinach supported the understanding of what it "means for teachers to be data literate" (p. 1). The following year, Mandinach and Gummer (2016a) published additional information on the work that was done to create a working definition of data literacy and develop the framework of data literacy for teaching.

While research completed by Mandinach and Gummer (2016a) did not specifically address the data literacy of school leaders, the need for strong leadership to support the data literacy needs of educators within the school was emphasized. Mandinach and Gummer (2016a) noted,

> It is important for principals to model data use, use evidence when speaking, set a vision that provides a rationale for data use, make clear that data are expected to be used, and provide the necessary resources to make possible data use within the school. (p. 22)

Principals must, therefore, demonstrate data literacy to foster data use and build the data literacy skills of school staff in order to support student academic growth.

To explain how data literacy has been used to support student academic growth, the following section provides a review of the relevant literature on data literacy within the field of education. The section first provides a list of processes and characteristics associated with data literacy. Following is a presentation of the processes and characteristics of data literacy as well as a review of information on other data practices and forms of literacy that are related to data literacy. The section concludes with a review of research studies that have addressed data literacy within the educational setting.

Processes and characteristics associated with data literacy. As noted earlier in this review, there was a limited amount of information available regarding the knowledge and skills that comprise data literacy (Mandinach & Gummer, 2012). Information within the related literature made it evident that only a few researchers had defined the term for the field of education. Knapp et al. (2006) and Knapp et al. (2007) noted that data literacy described what and how much a leader was able to do with data. Love (2009) posited that data literacy was "the ability to interpret and use multiple data sources to effectively improve teaching and learning" (p. 31). Mandinach and Gummer (2013) defined data literacy as "the ability to understand and use data effectively to inform decisions" (p. 30). Gummer and Mandinach (2015) interpreted data literacy as the "collection, examination, analysis, and interpretation of data to inform some

sort of decision in an educational setting" (p. 2). In 2015, Mandinach, Friedman, and Gummer defined data literacy as it specifically applied to teaching:

> 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, etc.) 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. 3)

Though various researchers have defined the term data literacy, there is a limited amount of information regarding data literacy. Only a minimal number of authors provided a descriptive list of the attributes of data literacy (Earl & Katz, 2002, 2006; Gummer & Mandinach, 2015; Knapp et al., 2006; Knapp et al., 2007; Love, 2009; Mandinach, Friedman, et al., 2015; Mandinach & Gummer, 2016a; 2016b). Some of the earliest references to data literacy appeared in work published by Earl and Katz (2002, 2006). The work of Earl and Katz (2002, 2006) provided a list that described the attributes of data literacy as well as a list that provided the thinking processes associated with data literacy. The attributes associated with the thinking process of data literacy noted by Earl and Katz (2006) included

- standing back and deciding what you need to know and why;
- collecting or locating the necessary data;
- finding ways to link key data sources;
- ensuring that the data are worth considering;
- being aware of their limitations;
- thinking about what the results mean, and finally;

- systematically considering an issue from a range of perspectives so that you really feel that you have evidence to explain, support, and also challenge your point of view. (p. 45)

When describing the specific characteristics of data literacy, Earl and Katz (2006) noted that a data literate leader (a) "Thinks About Purpose(s)" (p. 19), (b) "Recognizes Sound and Unsound Data" (p. 19), (c) "Is Knowledgeable About Statistical and Measurement Concepts" (p. 19), (d) "Recognizes Other Kinds of Data" (p. 19), (e) "Makes Interpretation Paramount" (p. 20), and (e) "Pays Attention to Reporting and to Audiences" (p. 20).

In describing data literacy, Knapp et al. (2006) acknowledged the attributes identified by Earl and Katz (2002). In addition, when discussing data literacy of leaders, Knapp and colleagues (2006) noted,

> The challenge is more than a technical one limited to the assembling and manipulation of information, but rather it extends to what Fullan (2001) calls "knowledge building," the capacity to extract and share useful meaning from organizational experience. Thus subsuming the capacity of leaders and others to assemble and use data responsibly in their daily practice, data literacy presumes more than trial-and-error experience with data. It presumes an accumulating facility with the interpretation of data, not to mention a familiarity with data sources and creativity in assembling relevant data quickly and efficiently. (p. 13)

Thus, the observations made by Knapp et al. (2006) supported the belief that the skills and knowledge associated with data literacy were not static. It also supported a belief that a data literate leader works collaboratively to build the data literacy skills and knowledge of others within the organization.

The need to utilize collaborative and comparative processes when working with data was also emphasized by other researchers (David, 2008; Dunn, Jaafar, Earl, & Katz, 2013; Downey & Kelly, 2013; Halverson, Grigg, Prichett & Thomas, 2007; Lachat et al., 2006; Love, 2004; Love et al., 2008; Mandinach & Gummer, 2016a; Schildkamp & Lai, 2013; Spikes & Volonnino, 2013). The list of data literacy knowledge and skills presented by Love et al. (2008) noted that educators should "understand what kinds of data are used in collaborative inquiry, why and how frequently, and use each effectively and accurately" (p. 128). Furthermore, Love et al. (2008) posited that educators should "understand what different levels of student-learning data (aggregated, disaggregated, strand, item, and student work) are used in the drill-down, what can and cannot be learned from each, and how to use each effectively and accurately" (p.128). Love et al. (2008) therefore, as did others, identified the need for collaborative inquiry processes.

The importance of collaboration was also described in the data literacy framework for teaching presented by Gummer and Mandinach (2015) and Mandinach and Gummer (2016a). Within this framework, data use was tied closely to the collaboration and the inquiry process needed to drive school data teams. In the documentation for the framework, researchers noted that the construct contained three domains: content knowledge, data use for teaching, and pedagogical content knowledge (Gummer & Mandinach, 2015; Mandinach & Gummer, 2016a). At the heart of the data literacy framework for teaching was the inquiry cycle, which identified components of data literacy.

The number of components of data literacy identified by Mandinach and Gummer varied between the research published in 2015, and that published in 2016. Results of the original analysis of information produced seven components, originally called elements, of data literacy (Mandinach & Gummer, 2016a). Work published in 2015, presented only six components of

data literacy (Gummer & Mandinach, 2015). In 2016, there were five components of data literacy presented (Mandinach & Gummer, 2016a) (see Figure 1).

.Figure 1. Organization of the Data Literacy Conceptual Framework

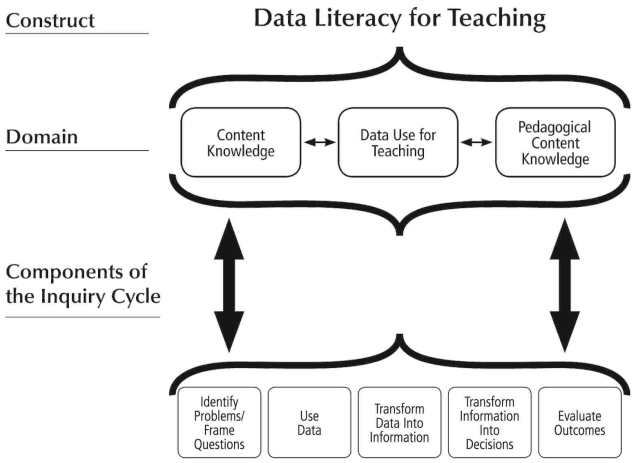

Figure 1. From Data literacy for educators; Making it count in teacher preparation programs (p. 60), by Mandinach, E. B. & Gummer, E. S., 2016, New York: WestEd. Copyright 2016, Reprinted with permission of Dave Kimmis

In addition to identifying the components of data literacy, Gummer and Mandinach (2015) and subsequently Mandinach and Gummer (2016a), identified the various subcomponents, elements, and subelements associated with each of the components. Within the work of Mandinach and Gummer (2016a), the components and subcomponents of the inquiry cycle for data literacy of teaching were displayed together in the figure Domain of Data Use for Teaching (see Figure 2). The five components, with subcomponents, included

1. Identify Problems and Frame Questions
    - Articulate and Communicate the Problem/Question,
    - Involve Other Participants,
    - Understand Student Privacy, and
    - Understand Contextual Issues.

2. Use Data
    - Identify Possible Sources of Data,
    - Understand How to Generate Data,
    - Understand Data Properties,
    - Understand Data Quality,
    - Understand How to Access Data, and
    - Understand How to Analyze Data.
3. Transform Data Into Information
    - Consider Impact and Consequences (Intended and Unintended),
    - Generate Hypothesis,
    - Test Assumptions, and
    - Understand How to Interpret Data.
4. Transform Information Into Decision
    - Determine Next Instructional Steps, and
    - Understand Context for the Decision.
5. Evaluate Outcomes,
    - Consider Need for Iterative Decision Cycles, and
    - Re-examine Original Question or Problem.

These components of data literacy were inclusive of the attributes of data literacy previously described by other researchers. When attributes of data literacy from all sources examined in the review of literature were synthesized, and categorized, results revealed that the components of data literacy identified within the relevant literature aligned with the five components of data literacy identified by Mandinach and Gummer (2016a).

Figure 2. Data Literacy Conceptual Framework Inquiry Cycle

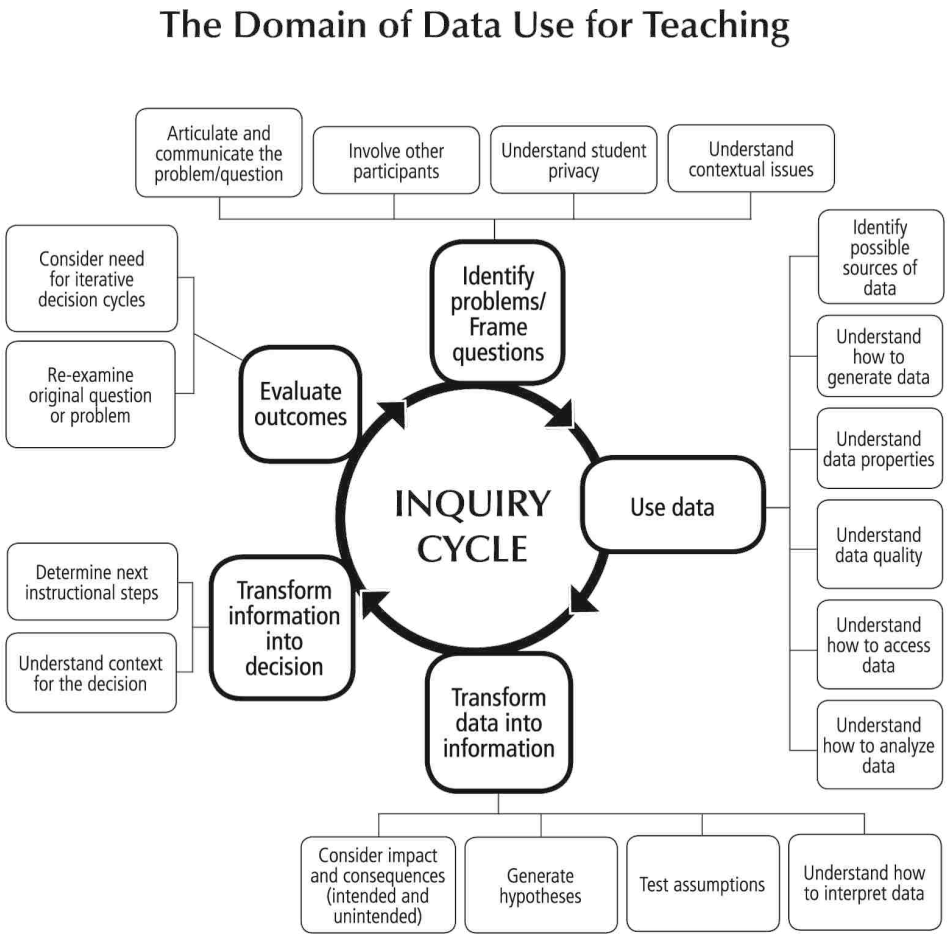

Figure 2. From Data literacy for educators; Making it count in teacher preparation programs (p. 63), by Mandinach, E. B. & Gummer, E. S., 2016, New York: WestEd. Copyright 2016, Reprinted with permission of Dave Kimmis.

Though the components of data literacy identified by Mandinach and Gummer (2016a) were found to be inclusive of the attributes of data literacy noted in the relevant literature, only the data literacy for teaching was addressed by the Data Literacy Conceptual Framework. As Mandinach and Gummer (2012) posited when examining data literacy as applied to teacher education, "Data literacy is multifaceted. It is role-based, and it interacts with content knowledge as well as with assessment, developmental, pedagogical, and administrative knowledge" (p. 24). Within the emerging framework presented by Mandinach and Gummer

(2016a), evidence of the complexity of data literacy was seen in relationships between the three domains, five components, multiple subcomponents, elements of knowledge, and skills that were included. While the framework provides a detailed description of what is understood regarding data literacy, the authors noted that "there are still a number of components still to be methodically explored" (p. 139). These were not identified.

Exploring data literacy extends to understanding how the construct is similar, and different from, other forms of literacy. Researchers who defined and described data literacy recognized the challenges that existed in differentiating data literacy from other forms of literacy (Mandinach & Gummer, 2012, 2016a; 2016b). A comparison of the attributes of data literacy to the attributes of DDDM and other forms of literacy revealed the similarities and differences that existed between each.

Differentiating data literacy from other data practices. There were various data and literacy practices documented that either were supported by identified components of data literacy or contributed to the components found within data literacy. Practices included Data Driven Decision Making (DDDM), statistical literacy, information literacy, and assessment literacy (Table 1). Within this section, each of the aforementioned practices, or forms, of literacy are presented along with the acknowledgment of the attributes of data literacy that the practices share.

Table 1. The components of data literacy shared by related literacies or data practices.

Components of Data Literacy	Statistical Literacy	Information Literacy	Assessment Literacy	Data Driven Decision Making
Identify Problems/Frame Questions	X	X	X	X
Use Data	X	X	X	X
Transform Data Into Information		X	X	X
Transform Information Into Decision			X	X
Evaluate Outcomes				

Note. Other data practices that share or include each of the five components of the Data Literacy Conceptual Framework. (See also Appendix Table A1)

Data literacy and data-driven decision making. As noted earlier in this chapter, to transform information into actionable knowledge, the use of a DDDM process was required (Mandinach, Rivas, et al., 2006). Ikemoto and Marsh (2007) described DDDM as a process in which multiple forms of data were systematically collected and analyzed to guide a range of decisions directed at improving the success of students and schools including input data, demographic data, process data, outcome data, and satisfaction data. Mandinach and Rivas, et al. (2006) posited that there were three sets of skills included in DDDM. Those skills included the data skills of collecting and organizing, information skills of analyzing and summarizing, and knowledge skills of synthesizing and prioritizing. While skills associated with DDDM described actions for skillful data use, data literacy described the attributes of an individual who was skillful at using data.

Research conducted by Wu (2009) posited that the characteristics of data literacy described by Earl and Katz (2002) aligned with parts of two separate frameworks for DDDM. The first framework identified by Wu was one developed by Datnow, Park, and Wohlstetter (2007). In the Datnow et al. framework, there were four areas of the DDDM process identified as contributing to student performance. In reviewing the research of Datnow and colleagues, Wu (2009, p. 26) posited that each of the five characteristics of data literacy proposed by Earl and Katz contributed to the area of DDDM described by Datnow et al. as data systems. In other words, (a) developing an assessment and evaluation system required one to have purpose and recognize sound data; (b) translating data into action required one to have skills for understanding and analyzing as well as interpreting the data; and (c) having the ability to utilize data sharing allowed one to communicate data effectively.

The second DDDM conceptual framework that Wu (2009) examined was that of Mandinach, Honey, et al. (2006). As noted previously in this chapter, the Framework for Data Driven Decision Making presented a six-step process that described how data moved from data to information to knowledge, with knowledge informing decisions that were implemented and assessed for impact before being fed back as data. In comparing the framework presented by Mandinach, Honey, et al., and the five characteristics of data literacy identified by Earl and Katz (2006), Wu explained that (a) the category of organizing and collecting data reflected having purpose and recognizing sound data; (b) the category of summarizing, analyzing, synthesizing, and prioritizing data reflected understanding and analyzing data as well as making interpretations; and (c) the category that described the impact and feedback of decisions made through the use of data was related to one's skill in communicating data. Therefore, in comparing data literacy and DDDM, Wu (2009) identified common qualities that existed between the Framework for Data Driven Decision Making and the five characteristics of data literacy identified by Earl and Katz (2006). However, where DDDM described a process for using data, data literacy described the level to which an individual understood and made meaning of the data in order to engage in the DDDM process.

Data literacy and statistical literacy. Like DDDM, statistical literacy also had characteristics and processes associated with data literacy. Statistical literacy was defined as the ability to think critically about statistical evidence as well as to interpret and communicate statistical information (Gal, 2002; Gray, 2004; Schield, 1999, 2004). To describe the qualities of the literacy, Schield (1999) posited that statistical literacy included the ability to read statistics and utilize inductive reasoning and inductive arguments to make decisions. In the description of

statistical literacy posed by Gal (2002) there were five parts to statistical knowledge that were noted:

> (1) knowing why data are needed and how data can be produced, (2) familiarity with basic terms and ideas related to descriptive statistics, (3) familiarity with basic terms and ideas related to graphical and tabular displays, (4) understanding basic notions of probability, [and] (5) knowing how statistical conclusions or inferences are reached. (p. 10)

Gray (2004) added to Gal's list by noting that statistical literacy also included the ability to understand what type of analysis would best serve each situation and apply that analysis.

When examining the qualities of statistical literacy against the processes and characteristics of data literacy, the information presented in the literature made it apparent that data literacy included some of the components of statistical literacy. Those describing statistical literacy addressed the need for individuals to understand the principles that underlie statistical and measurement concepts and to consider the purpose for the use of the data in order to choose appropriate measures (Gal, 2002; Gray, 2004; Schield, 1999, 2004). Descriptions did not include the need for using data to engage in collaboration, make comparisons, address organizational needs, or to report results in meaningful ways. Therefore, statistical literacy did not include all of the components of data literacy noted in related works.

Data literacy and information literacy. Like statistical literacy, information literacy also shared some of the processes and characteristics of data literacy. Information literacy was explained as the skills needed by individuals to locate, evaluate, and use information (Association of College and Research Libraries, 2016). The Presidential Committee on

Information Literacy best summarized the skills and understandings that were needed to be information literate in a final report that noted:

> Ultimately, information literate people are those who have learned how to learn. They know how to learn because they know how knowledge is organized, how to find information, and how to use information in such a way that others can learn from them. They are people prepared for lifelong learning, because they can always find the information needed for any task or decision at hand. (Association of College and Research Libraries, 1989, para. 3)

When the skills associated with information literacy were compared with the processes and characteristics of data literacy, the similarities that were found made it apparent that information literacy skills were needed for one to be data literate. Within information literacy and data literacy, there was a shared need for those who were data literate or information literate to select relevant data sources to support an identified purpose, to evaluate the quality and worth of data, and to recognize and utilize different forms and sources of data. Though the skills needed to be information literate were the same as some of the elements of data literacy, the skills noted were not inclusive of all elements of data literacy.

Data literacy and assessment literacy. Another form of literacy identified as being mistaken for data literacy was assessment literacy (Mandinach & Gummer, 2016a; 2016b). Assessment literacy was described as "the range of skills and knowledge that stakeholders need in order to deal with the new world of assessment into which we have been thrust" (Fulcher, 2012, p. 115). Assessment literacy was found to include components of data interpretation, data-driven decision making, assessment instruction, assessment evaluation, assessment construction, assessment administration, and data communication (Fulcher, 2012; Popham, 2009; Stiggins,

1991, 1995, 2001). In the school setting, assessment literacy was found to address specific skills and understandings that allowed individuals to gather dependable and quality assessment information and use that information to maximize student achievement (Stiggins, 2001).

When assessment literacy and data literacy were compared, the results of the comparison made it evident that the two mirror one another in several ways. The work of Mandinach and Gummer (2012) demonstrated the varying opinions of experts who compared the two. In a project conducted in 2012 and described by Mandinach and Gummer (2012), participants developed 24 separate diagrams that compared data literacy and assessment literacy. A summarization of the depictions resulted in three diagrams, which suggested that (a) there was a great deal of uniqueness in each construct, and overlap between the two constructs was small; (b) the overlap that existed between the two constructs was significant; and (c) the construct of data literacy subsumed the construct of assessment literacy (Mandinach & Gummer, 2012).

Though the literature demonstrated that there were varying opinions that existed regarding the similarities and differences between data literacy and assessment literacy, it also supported the notion that there was a close relationship that existed between the two. While data literacy was found to address an overall understanding of how to effectively gather, utilize, and present various types of data, assessment literacy was more specific to generating, utilizing, and understanding assessment data only. Therefore, each form of literacy was found to have qualities that supported the other. When the understandings and skills associated with assessment literacy were compared to the understandings and skills associated with data literacy, it appeared that there was some alignment between them, in that each provided individuals with (a) an understanding of the different types of assessments that could be utilized to support an identified purpose, (b) the ability to utilize academic information about students to determine the

quality and worth of an assessment, and (c) the ability to evaluate and communicate assessment data based on an understanding of the different types of assessments and their uses. Inversely, the elements of data literacy supported the assessment literacy processes of gathering data, analyzing data, interpreting data, and utilizing data for decisions. Therefore, while data literacy and assessment literacy represented two separate concepts, the two shared many of the same attributes. As noted by Mandinach, Friedman, and Gummer (2015), "Assessment literacy refers to the ability to use assessment results appropriately and to understand the basic psychometric properties of the measures. Data literacy goes beyond assessment results to include other sources of data" (p. 38). Assessment literacy was therefore considered to be a component of data literacy (Mandinach & Gummer, 2016a).

The review of the literature revealed that the attributes shared between data literacy and other forms of literacy made defining data literacy difficult to do. Though "multiple researchers have identified the knowledge and skills and the processes or components that undergird data literacy" (Mandinach & Gummer, 2013, p. 31), only one theoretical framework that addresses the construct has been created. When developing the framework, researchers recognized that "the theoretical frameworks that have been developed to inform research, capacity building, and policymaking related to data use are complex and multilayered" (Mandinach & Gummer, 2016a, p. 53). The focus of data literacy for the framework was therefore narrowed to address the data literacy of teachers (Mandinach & Gummer, 2016a). Yet, teachers are only one group that utilizes data within the school to affect student academic growth. As Mandinach and Gummer (2016a) noted,

> We need to understand the role-based nature of data literacy: Are there skills specific to teachers, principals, superintendents, and other administrators? How does the construct

> for teachers . . . generalize to other educators? Many of the different domains pertain only to teachers, but are there similar domains that lay out the knowledge for administrators? (p. 140)

The questions raised by Mandinach and Gummer (2016a) suggested a need for further research on data literacy, especially as it applies to leaders. The fact that only a limited number of books, articles, and studies reference or describe data literacy or its components demonstrates a need for continued research on the construct. In the next section, information on the need for data literacy within the educational setting is presented.

Applying data literacy. As accountability measures have become more prevalent, the list of educational staff that must use and understand data in schools has grown. Literature that addressed data literacy was found in the related literature for three different groups. These groups included students, teachers, and school leaders.

Figure 3. Literature That Described Attributes of Data Literacy.

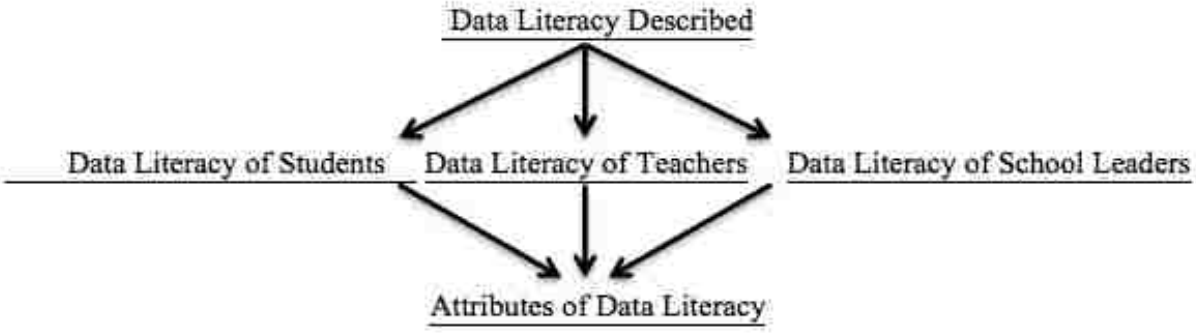

Figure 3. Groups in the educational setting for which the attributes of data literacy was described.

In the following section, the literature and research that addressed the data literacy for each of the previously noted groups is reviewed. That review is followed by an analysis of the components of data literacy. The section begins with a review of literature that addresses the data literacy of students.

Data literacy of students. A limited number of books and articles were found that addressed the data literacy of school-aged students. While the purpose for developing the data literacy of students differed from that of developing such a literacy in school leaders, the attributes of data literacy described aligned with the use of the construct for other groups. Attributes of data literacy included the ability to (a) ask and answer "context questions" about a set of data; (b) utilize appropriate data, technology, software, and representations to support the learning of data analysis; (c) utilize math skills to extend beyond incomplete or imperfect data; (d) develop and evaluate the legitimacy of data-based inferences and explanations; and (e) collect, organize and interpret data to answer particular questions and communicate solutions (Hooft et al., 2010; Rubin, 2005; Vahey et al., 2006). The research on the data literacy of students described some of the attributes of data literacy. Other attributes were found in the literature on teachers' data literacy.

Data literacy of teachers. Just as the literature noted a need for students to possess data literacy skills to expand learning, it also noted a need for teachers to be data literate. Various researchers posited that teachers needed to be data literate to effectively support student learning (Jacobs et al., 2009; Love, 2004, 2005). Others noted that teachers needed to be data literate to support school reform initiatives (Lachat et al., 2006).

The results of research on teachers' use of data provided information to describe and define data literacy. As defined by Love (2008), data literacy was the ability demonstrated by an individual to collect, analyze, interpret, and use multiple sources of data to effectively improve teaching and learning (Love et al., 2008). The research described by Love (2005) noted that the data literacy of teachers and administrators was developed through engagement in collaborative

inquiry processes that encouraged participants to "raise questions, examine student learning and other data, test their hypothesis, and share findings with their colleagues" (p. 11).

To understand the factors and conditions that facilitated or impeded data use, Lachat, Williams, and Smith (2006) identified three practices for developing teachers' data literacy. The practices included "(a) organizing data use around essential questions, (b) using technology that allows purposeful data disaggregation, [and] (c) using a data team and a data coach" (p. 17). When integrated into existing school structures, the three practices fostered data literacy and supported a culture of inquiry and accountability, purposeful data driven decision-making, and continuous improvement (Lachat et al., 2006).

In the research presented by Jacobs et al. (2009), six conceptions that contributed to teachers' use of data and the relationship that existed between each of those conceptions were described. As Jacobs and colleagues (2009) noted:

> To begin using data to inform instruction, teachers engage in ongoing attention to multiple sources of data. Attention to these multiple sources of data supports the teachers' focus on the individual needs of students. As teachers begin to focus on their individual students and see their different needs, a sense of urgency develops, serving as a catalyst for action. Finally, the most sophisticated act of using data is actually to use data in a way that leads to action and changes in professional practice (Jacobs et al., 2009, p. 51).

In presenting their hierarchical process, Jacobs et al. (2009) posited that a teacher's level of data literacy could impact how data were used and consequently the effectiveness of the process. To better support the process, these researchers noted a need to uncover conditions that allowed

teachers to move from just thinking about quantitative data to utilizing that data qualitatively to inform instruction.

Researchers suggested that to build teachers' data literacy, there was a need for schools of education to provide related coursework (Gummer & Mandinach, 2015; Mandinach, Friedman, et al., 2015; Mandinach & Gummer, 2013, 2016a; 2016b). Some research examined what schools of education were doing as far as course offerings to prepare pre-service teachers to use multiple types of data effectively and responsibly (Mandinach, Friedman, et al., 2015; Mandinach & Gummer, 2016a). To justify the need for coursework that addressed the data literacy of pre-service teachers, references to data use embedded in the documentation for state licensure or teacher certification was also explored in the research (Gummer & Mandinach, 2015; Mandinach, Friedman, et al., 2015: Mandinach & Gummer, 2013, 2016a).

To support the findings from the research on teacher data literacy, Gummer and Mandinach (2015) developed a conceptual framework of data literacy. The final version of the data literacy framework presented by Mandinach and Gummer (2016a) included three domains, five components of the inquiry cycle, eighteen sub-components, and multiple elements and sub-elements that described the various skills and knowledge associated with data literacy. As the framework was supported by research presented by Mandinach and Gummer (2012) that sought to define the construct of data literacy, its components and subcomponents were found to align with the various attributes of data literacy embedded in the professional literature on leadership.

Data literacy of educational leaders. Researchers posited that the leader's data literacy contributed to conditions that facilitated effective use of data within the school (Earl & Katz, 2002, 2006; Fuseralli, 2008; Knapp et al., 2006; Love et al., 2008; Mandinach & Gummer, 2016a; 2016b; Wu, 2009). Some researchers (Earl & Katz, 2002, 2006, Love et al., 2008; Wu,

2009) identified data literacy as a competency or prerequisite needed for data driven practices. In the work of Earl and Katz (2002, 2006), data literacy was identified as one of three competencies needed by leaders in a "data rich world" (Earl & Katz, 2006, p. 17). In the work of Love et al. (2008) data literacy was listed as one of four core competencies needed by leaders for high capacity data use.

In a qualitative study conducted by Wu (2009) that explored the data literacy capacities and needs of school leaders, the characteristics of data literacy were identified as a prerequisite for DDDM. Knapp et al. (2006) also supported the belief that data literacy of leaders was needed for DDDM. However, when DDDM was associated with leadership, Knapp et al. noted that the better term to use was data-informed leadership since this appropriately described the depth of understanding about data, data sources, and data use needed by leaders in order to be considered data literate. Researchers also implied that data literacy included the ability to build others' capacity to utilize data effectively (Knapp et al., 2006; Love et al., 2008; Wu, 2009). As noted by Knapp et al. (2006), "The capacity for data-informed leadership—embodied in leaders' values, expertise, theories of action, and availability of data—sets the stage for particular leadership activities that bring systematic information into consideration by leaders and others" (p. 84).

The act of "turning information into actionable knowledge" was described by Fullan, Cuttres, and Kilcher (2005) as a "social process" (p. 56). The literature described that some schools had implemented data teams to provide a platform for examining student data and turning that data into actionable knowledge that could be used to inform daily instructional practice (Campsen, 2010; Córdova, 2010; Kamm, 2010; Mandinach & Gummer, 2016a;

Mandinach & Jimerson, 2016; Ventura, 2010). In the next section, Data Teams and the application of the leader's data skills in leading teams is discussed.

Utilizing Data Teams

The use of data to drive instructional decisions is a key component of the work of Data Teams. In this section, information on teams and the team process is provided. The section begins with a historical account of the origin of Data Teams. Provided next is a review of the five-step data-review process utilized by teams. The section concludes with a review of the leadership positions that are needed to support the work of teams. The review includes information on duties assumed by leaders of teams as well as the data knowledge and skills that leaders of teams must possess in order to ensure the successful implementation of the team process.

For data to have a meaningful impact on student learning, it should be used for more than just satisfying policy or compliance; it should be used to address student needs (Ventura, 2010). According to Ventura (2010), "Data must not only inform what students in the school system are doing, but help pave the way to monitor teaching and leadership practices as well" (p. 141). Data should be used to support an integrated, holistic system that informs daily decisions about student acquisition of learning outcomes, including such decisions as what should be taught, how it should be taught, how it should be assessed, and how to assure that the strategies used are working (Ainsley, 2010). In some schools, Data Teams were implemented to address the need for an integrated, holistic process for utilizing data. The term "data team" has been used by multiple researchers (Ahearn, 2012; Ainsley, 2010; Allison, 2010; Campsen, 2010; Love et al., 2008; Love, 2009; Mandinach & Gummer, 2016a; Mandinach & Jimerson 2016; McNulty & Besser, 2011; Peery, 2010; Piercy, 2006; Ventura, 2010). The Leadership and Learning Center's

concept of *Data Teams* originated in 2000 (Besser, 2010; McNulty & Besser, 2011). However, other authors not associated with the center have since used the term in writing about teacher teams that utilize a collaborative process to examine data in order to identify and implement practices that positively impact student academic growth (Love et al., 2008, Love, 2009; Mandinach & Gummer, 2016a). Some authors (Ainsley, 2010, Besser, 2010, Campsen, 2010, Kamm, 2010; McNulty & Besser 201l) have even associated the term Data Teams with Professional Learning Communities (PLC) (Besser, 2010; Love et al., 2008; McNulty & Besser, 2011). According to Besser (2010) "'Professional Learning Communities are what we are; Data Teams are what we do'" (p. 2).

Authors who described the Data Teams Process noted that Data Teams combine professional collaboration with data-driven decision making (Besser, 2010; McNulty, 2010: McNulty & Besser, 2011). As Ainsley (2010) explained, the Data Teams Process was designed to use the collective wisdom of educational professionals that worked within a school to help identify instructional strategies that would address student academic needs revealed within school data. Thus, the Data Teams Process was used to provide educators with an opportunity to explore, implement, and measure instructional strategies used with all students within a classroom. The overarching goal of the process was to "improve student learning by improving teaching and leadership" (Besser, 2010, p. 3).

The work of Love et al. (2008) described the purpose and responsibilities of data teams as identified in research from the Using Data Project. In describing the process, Love et al. (2008) noted a need to use collaborative inquiry to analyze school data to identify improvement needs, develop plans, and take action. The team responsibilities noted by Love et al. (2008) included various practices for (a) supporting the collaborative work of the team, (b) using data and

research to drive decisions, (c) sharing results and gaining insight and commitment from a wide range of stakeholders, and (d) developing the team's "knowledge and skills in data literacy and collaborative inquiry; content knowledge, pedagogical content knowledge, and generic pedagogical knowledge; cultural proficiency; and leadership and facilitation" (p. 41).

While the list of team responsibilities noted by Love et al. (2008) presented an overarching view of the actions of teams, others provided a more in-depth look at the various levels of teams that might exist within a school system and the role that each level plays. McNulty and Besser (2011) posited that three levels of teams could exist within a school system. The three levels of teams included the district team, the building team, and the instructional team. At each level, the goal to "establish and maintain a focus on high-quality instruction" (McNulty & Besser, 2011, p. 69) was to be modeled and supported by school leaders. The work of each team supported the work of the others.

At the instructional level, teams consisted of small groups of grade-level, department-level or like-content area teachers who met regularly to examine cause and effect data at the student level (McNulty & Besser, 2011, Ventura, 2010). Within the Data Teams Process, McNulty and Besser (2011) identified cause data as information on specific adult actions, such as instructional programs, strategies, and processes that were used to impact student achievement results. The researchers described effect data as the scores or progress results obtained from common student assessments (McNulty & Besser, 2011). Researchers noted that within Data Teams the use of cause and effect data provided a way for group members to continuously examine the impact that the various components of the educational system had on student growth and make corrections to actions as needed (McNulty & Besser, 2011; Ventura, 2010). When using student data to identify instructional strategies that met student needs, teams utilized a five-

step sequential process (Ahearn, 2012; Peery, 2010; Piercy, 2006). In using the five-step process, teams first collected and charted formative or summative assessment data. The teams then analyzed the data for strengths, weaknesses, and obstacles. During the next step, short-cycle student achievement goals, or SMART goals, were set and established. Instructional strategies were then selected for use by all members to support the goals. The teams then determined the result indicators that would signal when the established goals had been met. Though the cycle was referred to as a five step process, a sixth step that was used for monitoring and evaluating results for each of the five primary steps was included (McNulty & Besser, 2010; Peery, 2011).

The use of the Data Teams Process allowed team members to analyze data to identify groups of students who were demonstrating skills and understanding at various proficiency levels (Cordova, 2010; Doubek, 2010; Ventura, 2010). Within this process, data generated from common formative assessments administered every two to three weeks provided teams with the opportunity for "short-cycle" review of data and goals (Ahearn, 2012; McNulty & Besser, 2011; Peery, 2011). As a result, teams were able to monitor student achievement, decide on what was working or not working, and implement instructional strategies at the classroom level that addressed identified concerns (Cordóva, 2010; Doubek, 2010; Ventura, 2010). Peery (2011) suggested that the use of the five-step Data Teams Process might also be used to reveal individual students or groups of students that had unique strengths or those that needed extra RtI support that was separate from the classroom interventions decided upon by the team.

The continual use of action research allowed Data Teams to get to the heart of student learning (Peery, 2011). Through a process of inquiry, teams identified information and skills that students were lacking and used that information to identify the instructional strategies that

would be implemented by all teacher members at the classroom level (McNulty & Besser, 2011; Peery, 2010, 2011). In order for teams to thrive, each needed to embrace a shared inquiry orientation while using the five-step process (Peery, 2010, 2011). The support of leadership was identified as necessary to ensure (a) the implementation of an inquiry orientation, (b) the use of the five-step Data Teams Process, and (d) implementation of identified strategies by all team members (Campsen, 2010; McNulty & Besser, 2011; Peery, 2011)

Leadership support of data teams was tied to the work of the data coach and the school principal. The role of the coach was often filled by "instructional, assessment or school improvement coaches or coordinators; principals or assistant principals; or team leaders" (Love, 2009, p. 35). While principals could serve in the role of data coach, the two roles could also be separate (Love, 2008).

Within the data team process, the coach, when serving as a team leader, supports the work of the team in various ways. The team leader helps to facilitate the work of teams by gathering and preparing data and helping to maintain the team's focus on improving teaching and learning (Love, 2009). In working with the team, the leader helps members to "develop and apply critical knowledge and skills needed for effective use of data" (Love, 2009, p. 11). During team meetings, skilled team leaders "challenge assumptions [presented by team members], separate debate and discussion from dialogue, and provide intervention if the group is headed in the wrong direction" (McNulty & Besser, 2011, p. 145). The team leader utilizes his or her individual data skills to activate collaborative knowledge to guide teams through a systematic, data-driven, decision-making process (McNulty & Besser, 2011). In summation, as Love (2009) articulated, the data coach plays three major roles. First, the coach models and spreads data literacy among all of the team. Next, the coach serves as a facilitator. As the facilitator, a coach

will "convene the data teams, plan team meetings, facilitate dialogue, and guide the team through collaborative inquiry" (Love, p. 32). Finally, coaches "provide leadership for sustainability of the practice of collaborative inquiry to continuously enhance student learning" (Love, p. 33).

While noted that Data Team leaders or coaches lead the team, the implementation and success of a team was reported to be dependent on the principal's ability to monitor and guide the team process (Peery, 2011). The observation was made that the full support and active involvement of building administrators contributed to the success of Data Teams (Peery, 2011). Principals of buildings where the implementation of Data Teams had been successful studied meeting minutes and provided feedback to teams (Peery, 2011). Principals also conducted frequent classroom visits and frequently met with team leaders (Peery, 2011). Therefore, to effectively guide and support the Data Teams Process, experts suggested a need for principals to be actively involved in team organization, program, and instruction implementation at all levels. It was posited that principals needed to be actively involved in data analysis to support the process (Campsen, 2010). Principals also needed to engage staff in discussions about non-proficient students (Campsen, 2010). Finally, principals needed to support the development of strategies and assignment of resources, both human and material (Campsen, 2010). As Campsen (2010) articulated,

> A principal must know what challenges are occurring, who needs more support (student or teacher), what additional resources are needed, how current ones are being allocated, and when to be ready to intervene before any potential roadblocks become an obstacle to implementation. Delegating this responsibility to others who lack the inherent power of the office of the principal is a recipe for half-hearted implementation at best and total failure of the Data Teams initiative at worst. (pp. 124-125)

Leadership and Management

To provide a lens through which the work of Data Team leaders can be observed, the final section provides a foundation for examining the leadership and management of teams. The section begins with a brief history of the words *leadership* and *management*. The definition of leadership and management used for this study is then presented. To provide support for the definitions of leadership and management used in the study, the Leadership and Management section includes a discussion on Management, Servant Leadership, and Transformational Leadership. The section concludes by comparing the characteristics of leadership and management with the activities and actions required of team leaders.

If we want to understand the actions of leaders and managers, we must first understand the meanings of the words leadership and management. The work of Rost (1993) provided a thorough review of literature written between 1930 and 1993 on the topic of leadership and as a result defined leadership and management. From his analysis of 587 books, book chapters, and journal articles that addressed leadership, Rost (1993) identified 221 accounts of the definition of the word leadership. The literature reviewed by Rost (1993) represented "every academic discipline that has had some interest in the subject of leadership: anthropology, business administration, educational administration, history, military science, nursing administration, organizational behavior, philosophy, political science, public administration, psychology, sociology, and theology" (p. 45). Findings from the review revealed that while the term "lead" and "leader" appeared in eighteenth century literature, the word leadership did not appear until the nineteenth century. The review revealed that the term leadership did not become widely recognized until the 20th century.

During the 20th century, various definitions of leadership emerged. As noted by Rost (1993), historical accounts of leadership gave the impression that the understanding of the term leadership was ever growing and changing into something more sophisticated and advanced. He wrote:

> These summaries are frequently boiled down to the great man theory that was popular in the early part of this century, group theory in the 1930s and 1940s, trait theory in the 1940s and 1950s, behavior theory in the 1950s and 1960s, contingency/situational theory in the 1960s and 1970s, and excellence theory in the 1980s. (Rost, p. 17)

While Rost's description gave the impression that the understanding of leadership was growing, there was no growth. Instead, there was an accumulation of different theories. Once theories were in place, each remained in the behavioral habits and practice of practitioners long after being discredited by researchers (Rost, 1993). Therefore, no definitive agreed upon definition for the term leadership was developed.

The continued use of the various theories of leadership makes distinguishing between practices of leadership and practices of management difficult. As noted by Rost (1993), the lack of an agreed-upon definition allows for all kinds of activities, processes, and persons to be included when practitioners and scholars describe leadership. Research and practice demonstrate that the definitions of leadership and management have become intertwined. Hanson (2003) posited, "The terms leader and manager can be conceptualized as two lines with an intersecting axis" (Hanson, 2003, p. 155). One end of each line represents leadership or management strength while the other represents weakness. Thus, there potentially can be strong leaders that are weak managers or weak leaders that are strong managers (Hanson, 2003). The link between leadership and management researched by Simonet and Tett (2012) suggested "one cannot speak

about leadership without at least implicitly speaking about management, and vice versa. Theories that claim to be 'leadership' theories, but that include dominant dimensions identifiable as management, are not simply 'leadership' theories; they are leadership/management theories" (p. 209). The complexities of directing people and organizations must be acknowledged when examining these overlaps (Simonet and Tett, 2012). As Simonet & Tett (2012) explained,

> Leadership experts or management educators focusing on the unique elements of one position may do so at the expense of losing sight of the fuller spectrum of intermediate competencies, nuanced organizational realities, or interpersonal gradations defining the overlap between the two domains. (p. 209)

In addition, Rost (1993) observed that "leadership scholars are dealing with socially constructed reality, which cannot be seen or touched, but only inferred through the actions of human beings" (p. 14). Consequently, Rost (1993) identified a need for an agreed upon definition of leadership and management.

Defining leadership and management. For the purpose of this study, the definition of leadership and management proposed by Rost (1993) was used. As Rost (1993) noted, "Leadership is an influence relationship among leaders and followers who intend real changes that reflect their mutual purposes" (p. 102). In Rost's (1993) definition of leadership, there were four essential elements needed to identify a phenomenon as leadership, as follows: "(a) the relationship is based on influence, (b) leaders and followers are the people in this relationship, (c) leaders and followers intend real change, and (d) leaders and followers develop mutual purposes" (p. 104).

Conversely, Rost (1993) defined management as "an authority relationship between at least one manager and one subordinate who coordinate their activities to produce and sell

particular goods and or services" (p. 145). Rost's (1993) definition of management listed four essential elements, as follows: "(a) management is an authority relationship, (b) the people in this relationship include at least one manager and one subordinate, (c) the manager(s) and subordinate(s) coordinate their activities, and (d) the manager(s) and subordinate(s) produce and sell particular goods and/or services" (p. 145).

Comparison of the definitions of leadership and management revealed a striking difference between the two constructs. Rost (1993) identified leadership as an influence relationship with followers, while management was identified as an authoritative relationship with subordinates. Furthermore, leadership occurred when the work served the mutual purpose of the leader and follower and was focused on creating an intended change, while management utilized coordinated activities to produce a product (Rost, 1993). By using the words influence and authority to differentiate between leadership and management, Rost (1993) was able to describe how the leader or manager was able to get others to engage in the work. According to Rost, when governed by authority, individuals were commanded or coerced to do the work; when governed by influence, individuals were drawn by an emotional appeal to the work.

There is a distinct difference between actions of influence and actions of authority. For that reason, the definition of leadership and management proposed by Rost (1993) was used as a lens for examining the related literature on data teams. The review of relevant literature revealed that while the collaborative nature of teams fostered the need for leadership, there was also a need for leaders to engage in management. Next, a review of the literature addressing the leadership and management of teams is presented.

Leadership of Data Teams. Within the various books and articles describing Data Teams, evidence that supported the phenomenon of leadership as defined by Rost (1993) was

found embedded in the process of collaborative inquiry. The influence relationship that leaders had with followers was apparent in the various ways leaders engaged and collaborated with the teams. Within the formal meeting structure of the Data Team, leaders were considered to be participants (Peery, 2011). However, in addition to being participants, leaders (a) functioned as skilled facilitators that challenged assumptions and guided conversation; (b) served as instructional leaders though modeling strategies, discussing instructional practice, and referring team members to helpful resources; and (c) created an "inquiry orientation" by activating team members' collaborative knowledge and use of data (McNulty & Besser, 2011; Peery, 2011). Thus, leaders working with Data Teams had an influence on the work of the team. By serving as both facilitator and participant, leaders engaged collaboratively with followers in a process that served a mutual purpose that was intended to create real change.

The changes in teaching and leadership practices that were fostered by a collaborative focus on data were addressed by multiple researchers (Ahearn, 2012; Ainsley, 2010; Allison, 2010; Campsen, 2010; McNulty & Besser, 2011; Love et al., 2008; Love, 2009; Peery, 2010; Piercy, 2006; Ventura, 2010). These changes in practice seemed to occur as a result of a mutual purpose shared by the leader and team members. The mutual purpose described by researchers was to analyze data and conduct action research to determine student's academic strengths and weaknesses in order to make team decisions about what would be taught, what strategies would be used to teach it, and how it would all be assessed and reviewed (Ahearn, 2012; Ainsley, 2010; Allison, 2010; Campsen, 2010; Love, 2009; Love et al., 2008; McNulty & Besser, 2011; Peery, 2010; Piercy, 2006; Ventura, 2010). Briefly explained, the Data Teams Process allowed teachers and administrators to work collaboratively within the context of the teaching-learning cycle to plan for the learning of all students (Ahearn, 2012).

Formal and informal leadership. Leaders contribute to the collaborative work of a team. As noted by Love et al. (2008), "Every member of a collaborative school community can act as a leader, dramatically impacting the quality of relationships, the school culture, and student learning" (p. 7). These leaders were identified as either formal leaders or informal leaders (Smylie, Conley & Marks et al., 2002; Spillane & Zuberi, 2009; Sun, Frank, Penuel & Kim, 2013). Formal leaders were described as those given formal authority by the organization to lead (Pielstick, 2000; Smylie et al., 2002; Spillane & Zuberi, 2009; Sun et al., 2013). Principals, department chairs, and instructional coaches were identified as formal leaders (Smylie et al., 2002; Spillane & Zuberi, 2009; Sun et al., 2013). Informal leaders were identified as those that were not formally designated as leaders but were identified by colleagues as having an influence on others' teaching practices (Pielstick, 2000; Spillane & Zuberi, 2009; Sun et al., 2013). As noted by Sun et al. (2013), each leader serves a purpose: "Formal leaders provide teachers with opportunities to learn about new practices, whereas informal leaders can be instrumental in helping implement those practices" (p. 612). In this study, formal leaders included building principals and vice principals. Informal leaders were those with no formal leadership designation who were identified by building administration as leaders of a building level team.

The work of school leaders within the data team process was observed to contribute to "systemness" (Dufour & Fullan, 2013, p. 18). As Dufour and Fullan (2013) explained, when there is "systemness," everyone in the organization does his or her part by "being as good as one can be during individual and collaborative work, and being aware that everyone needs to make a contribution to improving the larger system" (p. 18). "The specifics of all this work are grounded in a solid foundation of common purpose, shared vision, collective commitments, and

goals that shape the culture of the school" (Dufour & Fullan, 2013, p. 16) or what Rost (1993) called a mutual purpose. Consequently, within a collaborative culture, the work of the leader must "ignite a shared commitment throughout the school or district" (Eaker & Keating, 2012, p. 23) that mobilizes team members to engage in conversations and tasks that result in student learning.

Within the related leadership literature, two leadership platforms were identified that addressed the need for leaders to mobilize the commitment of people to a task. The first was transformational leadership. The second was servant leadership. While the two forms of leadership share many of the same attributes, the primary difference identified between the two was "the extent to which the leader is able to shift the primary focus of leadership from the organization to the follower" (Stone, Russell & Patterson, 2004, p. 349). As noted by Stone et al. (2004), "The transformational leader's focus is directed toward the organization, and his or her behavior builds follower commitment toward organizational objectives, while the servant leader's focus is on the followers, and the achievement of organizational objectives is a subordinate outcome" (p. 349).

These two leadership platforms were found to mobilize the commitment of people to a task. However, to build the capacity of workers and ensure productivity, the use of management was described as being necessary (Drucker, 1974/1999). In the following sections the attributes of servant leadership, transformational leadership, and management are discussed.

Attributes of servant leadership. Servant leadership was built on a philosophy of leaders as servants first and leaders second (Greenleaf, 1977/2002). According to Spears (1996), Robert K. Greenleaf first coined the term "servant leadership" in his 1970 essay entitled the Servant Leader. In describing servant leadership, Greenleaf (1977/2002) noted,

> The natural servant, the person who is servant-first, is more likely to persevere and refine a particular hypothesis on what serves another's highest priority needs than is the person who is leader-first and who later serves out of prompting of conscience or in conformity with normative expectations. (p. 28)

Servant leaders, therefore, do not focus on results, but they focus instead on the needs of followers whom they "trust to undertake actions that are in the best interest of the organization" (Stone et al., 2004, p. 355). As noted by van Dierendonck (2011), "A servant-leader works toward building a learning organization where each individual can be of unique value" (p. 1231).

While Greenleaf wrote extensively about servant leadership, he never provided an empirically validated definition to support the concept (van Dierendonck, 2011). Without a formal definition, the attributes of servant leadership were left undefined. As Russell and Stone (2002) observed, while "the literature regarding servant leadership is rather indeterminate, somewhat ambiguous and mostly anecdotal" (p. 145), there is enough consistency within the many different types of literature that address the concept to discern the attributes or characteristics that are common.

Using the existing literature that addressed servant leadership, Russell and Stone (2002) identified 20 distinct attributes of servant leadership. Nine of the attributes were classified as functional attributes. Eleven attributes were classified as accompanying attributes. The nine attributes identified as functional attributes included the following: (a) vision, (b) honesty, (c) integrity, (d) trust, (e) service, (f) modeling, (g) pioneering, (h) appreciation of others, and (i) empowerment (Russell & Stone, 2002). The eleven attributes classified as accompanying attributes included: (a) communication, (b) credibility, (c) competence, (d) stewardship, (e) visibility, (f) influence, (g) persuasion, (h) listening, (i) encouragement, (j) teaching, and (k)

delegation (Russell & Stone, 2002). The work of Russell and Stone (2002) clearly identified attributes that were characteristic of leaders that focus on the needs of their followers to create organizational achievement. The relationship between leader and follower helps to define servant leadership. This was also found to be true for transformational leadership. In the next section, the attributes of transformational leadership are presented.

Attributes of transformational leadership. Transformational leadership was linked to the leader's ability to foster leader-follower relationships that led to transformational change (Bass & Riggio, 2006; Burns, 1978/2012). The earliest description found for transforming leadership was in *Leadership*, a book by James MacGregor Burns (1978/2012). Burns (1978/2012) suggested that transforming leaders "induce people to be aware or conscious of what they feel—to feel their true needs so strongly, to define their values so meaningfully, that they can be moved to purposeful action" (Burns, 1978/2012, p. 44). Burns noted that transformational leadership, which was separate from power-holding leadership, "occurs when one or more persons engage with others in such a way that leaders and followers raise one another to higher levels of motivation and morality" (p. 20). Many of the examples provided by Burns to explain the phenomenon of transformational leadership described multiple individuals that had been recognized historically as leaders. The examples put forth by Burns linked the actions of each historical leader to the values and enduring principles of a group of people.

Building on the work of Burns, Bass (1990) defined transformational leaders by examining the impact of the leader's action on followers. Bass noted that transformational leaders

> broaden and elevate the interests of their employees, when they generate awareness and acceptance of the purposes and mission of the group, and when they stir their employees

> to look beyond their own self-interest for the good of the group. Transformational leaders achieve these results in one or more ways: They may be charismatic to their followers and thus inspire them; they may meet the emotional needs of each employee; and/or they may intellectually stimulate employees. (Transformational Leadership section, para 1)

In brief, transformational leadership occurs when leaders "stimulate and inspire followers to both achieve extraordinary outcomes and, in the process, develop their own leadership capacity" (Bass & Riggio, 2006, p. 3).

According to Bass and Riggio (2006), transformational leadership had four components. The component of Idealized Influence addressed the charismatic convictions of the leader and the trusting relationship built between leader and follower (Bass & Riggio). The component of Inspirational Motivation addressed the leadership actions of enthusiasm and optimism that built team spirit and team commitment to the shared vision and goals of the group (Bass & Riggio). Under the component of Intellectual Stimulation, the leadership actions that stimulated follower creativity for solving problems by creating environments free of criticism were described (Bass & Riggio). Finally, the concept of Individualized Consideration described how leaders individualized interactions with followers and personalized the support they provided to each (Bass & Riggio). As a whole, the components described a transformational leader as someone that was charismatic, enthusiastic, optimistic, encouraging, non-judgmental and supportive of individuals at a personal level. The four components revealed the attributes of leadership that were utilized to inspire followers to do the work of the organization.

While actions of leadership can be used to support the work of an organization, actions of management can also be used. Drucker (1974/1999) noted, "Nothing better prepares the ground

for such leadership than a spirit of management that confirms in the day-to-day practices of the organization strict principle of conduct and responsibility, high standards of performance, and respect for individuals and their work" (p. 371). The next section examines the attributes of management and the management of Data Teams.

Management of Data Teams. Within the literature on Data Teams, evidence that supported the phenomenon of management as defined by Rost (1993) was found rooted in activities of staff evaluation, scheduling, training, and resource distribution. Some researchers noted that leaders of teams were responsible for (a) setting agendas, (b) convening meetings, (c) scheduling time for teams to meet, (d) providing resources and tools for data analysis, (e) providing points of contact or training to address instructional problems, (f) conducting regular classroom observations to monitor teaching practices in order to ensure that staff utilize agreed upon teaching strategies, and (g) providing individual members and team leaders with feedback (McNulty & Besser, 2011; Peery, 2011). Though some activities allowed the leader to coordinate with team members, other activities forced leaders to act with authority. McNulty & Besser (2011) posited that "to be an effective leader you must create a degree of discomfort or some form of dissonance between where the system is now, and where it needs to be as a school or district" (p. 34). Campsen (2010) stated that "the principal must be bold enough to develop a list of non-negotiables that teachers are directed to follow, provide extensive professional development, closely monitor implementation, and employ consequences for noncompliance" (p. 131). Campsen (2010) further noted that "the principal must be willing to make hard and sometimes unpopular decisions to ensure that all purchases and scheduling of staff time are driven by student achievement data" (p. 132). Therefore, school leaders, when acting as

managers, act with authority to support a process that produces a product called student growth and achievement.

Attributes of management in a knowledge society. Within the school setting, the work that is required to produce the product, student achievement, is carried out by those that Drucker (1995/2009) referred to as "knowledge workers." In the educational setting, the workers are subordinates of the school principal, who operate within what Drucker (1995/2009) described as a "knowledge society." According to Drucker (1995/2009) in the knowledge society, the primary resource is knowledge and "the essence of management is to make knowledges productive" (p. 211). As noted by Drucker (1995/2009), within a knowledge society, all organizations require management. While the focus of management is typically on the needs of the enterprise, the organizational structure "needs to be both task-focused and person-focused and to have both an authority axis and a responsibility axis" (Drucker, 1974/1999, p. 439). Thus, the job of management is to develop the capacity of its workers to ensure productivity within the organization. As Drucker (1974/1999) noted,

> The objectives of the manager who heads the units include what he himself has to do to help subordinates attain their objectives. The vision of a manager should always be upwards-towards the enterprise as a whole. But his responsibility runs downwards as well - to the people on his team. Seeing his relationship as duty towards them and as responsibility for making them perform and achieve rather than as "supervision" is a central requirement for organizing the manager's unit effectively. (p. 326)

A manager, therefore, must always maintain a focus on the organizational objective while at the same time providing support to subordinates. In doing so, management supports not only the work of the individual but also that of the unit or team.

To work with teams instead of individuals is a necessity within a knowledge society where each worker possesses a special skill. As the work of the knowledge worker is specialized, a formal education is generally required (Drucker, 1995/2009). While the organization owns the tools that are needed to perform the work, the knowledge worker possesses the knowledge needed to run the tools (Drucker, 1995/2009). Thus, within the knowledge society, the organization and worker need each other. "With knowledge work being the more effective the more specialized it is, teams become the actual work unit rather than the individual himself" (Drucker, 1995/2009, p. 202). With each team or member possessing a specialized skill, the business becomes "an organization of equals, of colleagues and associates" (Drucker, 1995/2009, p. 65). Regardless of the various specialty areas represented, the organization has to remain single-minded and focused on a common mission (Drucker, 1995/2009) or measure of success. Failure to do so will result in a loss of the organization's credibility and consequently a loss of the organization's ability to attract the type of individuals that are needed to support the work of the organization (Drucker, 1995/2009).

The workforce within a school is predominately comprised of "Knowledge Workers" as access to teaching jobs can only be obtained through formal education. While all teachers must have a teaching endorsement to be employed by a public school, the degrees and special certifications that teachers possess vary. Given the varying educational backgrounds of staff, differences in the final product, student achievement, are likely to occur between classrooms and teachers if opportunities for collaboration and sharing are not available. As Fullan (2014) noted, "Teaching is not the kind of profession where staying cloistered will often bring one to personal mastery or end up having much collective impact" (p. 85). Furthermore, "High-yield strategies become more precise and more embedded when developed and deployed in teams that are

constantly refining and interpreting them according to their impact on students across the school" (Fullan, 2014, p. 85). Consequently, schools, like other organizations within the knowledge society, are better able to produce a quality product when individuals work together in teams.

Ensuring that teams remain single-minded and focused on the common mission of the organization requires management. As Drucker (1995/2009) explained,

> There have to be people who make decisions or nothing will ever get done. There have to be people who are accountable for the organization's mission, its spirit, its performance, its results. Society, community, and family may have "leaders," but only organizations know a "management." (p. 67)

At the school level, teams must focus on what Dufour and Fullan (2013) call "the right work." In schools, the principal's job is to ensure that the "right work" happens by enforcing those things that have been established as non-negotiables (Dufour & Fullan, 2013). To do so requires strong managerial skills (Fullan, 2014). In the end, if principals neglect management skills, student instruction will suffer (Fullan, 2014).

Chapter Summary

The review of the related literature was broken into four major sections. The first section, The Evolution of Data Use in Educational Leadership, addressed the need that exists for leaders to utilize data. The section provided a review of the research literature, laws, initiatives, and various leadership documents that reference the need for data use by schools or school leaders. Furthermore, the section referenced Federal regulations found in the Elementary and Secondary Education Act (ESEA) and Individuals with Disabilities Education Act (IDEA), as well as state-adopted practices such as Common Core State Standards (CCSS) to support the need for data use. The section also provided a reference to research that indicated a need for

leaders to utilize data. Additionally, the Professional Standards for Educational Leaders (PSEL), School Leaders Licensure Assessment (SLLA) and various other formative measures of leadership were cited in order to provide the rationale for why leaders need to be data literate.

To narrow the focus of the review, the second section, Data Literacy, provided information on the various aspects of the construct. Included in the section was information that described the skills and attributes of data literacy. Information that tied data literacy to other data practices and related literacies was also provided. Also included were descriptions of research that incorporated data literacy or sought to build data literacy skills.

The third section of the literature review, Utilizing Data Teams, provided information on a formal process that was founded on the use of student data to drive instructional decisions. In this section, Data Teams, the origin of teams, and the five-step team process were described. Also described were the duties of team leaders and school leaders in implementing and sustaining the Data Teams Process.

Finally, the last section of the review discussed Leadership and Management. The section began with a brief history of the development and use of the words leadership and management. The definitions of leadership and management used for this study were then provided. The section ended with a description of how leaders utilize leadership and management to support the work of Data Teams. Included in the descriptions was information on transformational leadership and servant leadership.

The review of related literature for this study provides information about the leader's role within the Data Teams Process. The review indicates a need for leaders to be data literate in order to support the work of the teams. Also indicated is a need for leaders to engage in leadership and management to support the work of teams. The work of teams and their leaders

was particularly important to this research as that work provides a formal structure, or process, within which the impact of leader's data literacy, leadership, and management can be observed. In the next chapter, the research method utilized for the study is presented. The methodology includes the method that was used to identify (a) the attributes of data literacy utilized by leaders of teams, (b) how the data literacy of leaders supports the work of teams, and (c) the actions of leadership and management that help to make leader's data literacy meaningful to the team process.

Chapter Three: Methodology

This study seeks to identify how the leader's data literacy contributes to the Data Teams Process. A qualitative case study research method was used to address questions posed by this study. The case study format was chosen for this study because this format was the most appropriate method for answering the central question. As noted by Merriam (1988), "The selection of a particular design is determined by how the problem is shaped, by the questions it raises, and by the type of end product desired" (p. 6). In this study, the problem was shaped by a need to understand how the leader's use of data literacy, leadership, and management supports the use of data by the team and its members. The questions raised by this study seek to identify (a) how various leaders demonstrate data literacy, (b) how some leaders use data literacy to support the Data Teams Process, (c) how leaders use leadership and management to support the team process, and (d) how the support of the leader influences team results.

The questions supporting this study are predominately "how" questions. As Yin (2009) noted, '"How' and 'why' questions are more explanatory and likely to lead to the use of case studies, histories, and experiments as the preferred research methods" (Chapter 1, When to Use Each Method, para 3). Case studies include contemporary evidence such as "direct observation of the events being studied and interviews of the persons involved in the events" (Chapter 1, When to Use Each Method, para. 10). The use of the case study method is also recommended when relevant behaviors being studied cannot be manipulated (Yin, 2009). Consequently, an important aspect of a case study is that the research occurs within a bounded system (Creswell, 1998; Merriam, 1988; Stake, 2006; Yin, 2009). Creswell (1998) explained that "the bounded system is bounded by time and place, and it is the case being studied—a program, event, an activity, or individuals" (p. 61). Hence, information gathered is limited by the boundaries of the

locations from which information is gathered and the time in which information was collected. Within a bounded system, the information gathered provides a snapshot of a larger phenomenon. This study is bounded by time and place, as each case describes the data activities as well as the leadership and management actions utilized by formal and informal leaders to support the work of Data Teams at nine preselected school sites in the state of Wyoming during the 2016-2017 school year. As the study includes more than one case, a multiple case study research format was followed. Stake (2006) noted,

> In multiple case study research, the single case is of interest because it belongs to a particular collection of cases. The individual cases share a common characteristic or condition. The cases in the collection are somehow categorically bound together. They may be members of a group or examples of a phenomenon. (pp. 5-6)

One of the first steps needed when conducting multiple case research is to identify the quintain (Stake, 2006). "A quintain (pronounced kwin'ton) is an object or phenomenon or condition to be studied—a target but not a bull's eye. In multiple case research, it is the target collection" (Stake, 2006, p. 6). To better understand the quintain, the sites or manifestations of the single cases are studied (Stake, 2006). Within multiple case research there is "a move away from holistic viewing of the cases toward constrained viewing of the cases—a viewing constrained by the dominion of the quintain over the cases" (Stake, 2006, p. 6). Within this multiple case study, the condition to be studied was the data literacy of leaders and how that data literacy contributed to the Data Teams Process. Included in this study was an examination of the attributes of leadership and management that leaders utilized to support the work of Data Teams.

In the following sections a description of research questions, participants, and procedures that were used for the study are presented. First, the central question and subquestions are

presented. Next, a description of participants and justification for participant selection is provided. Following the description of participants, a description of the cases is presented. Next, data collection procedures utilized for the study are described. Information on how sites were contacted is then noted, followed by a review of how the interview questions were developed. A description of the trustworthiness of the data, which includes information on processes and protocols that were used to ensure trustworthiness of the data, as well as the research process, and strategies were used to ensure that data were accurate and verified, is presented next. The anticipated data analysis process that was used is then described. Finally, the chapter concludes with a summary of information presented within the chapter.

Research Question

This proposed study is guided by a central question and seven subquestions. In a qualitative study, the central question is a single overarching question that restates "the purpose of the study in more specific terms" (Creswell, 1998, p. 99). As Creswell (1998) noted, the central question is the broadest question that could possibly be posed about the study. The central question for this study is presented next followed by a presentation of subquestions and then a description of interview questions.

Central Question.

The central question for this study was: How do leaders influence the Data Team? There were seven subquestions proposed to answer the central question for this study. As indicated by Creswell (1998) there are two types of subquestions that can be used in qualitative research, as follows: (a) topical subquestions and (b) issue subquestions. Topical subquestions "cover the anticipated needs for information" (Creswell 1998, p. 101). Issue subquestions address the problems, conflicts, or concerns that are identified and require resolution (Creswell, 1998; Stake,

1995). As Stake (1995) described, issue questions "draw us toward observing, even teasing out, the problems of the case, the conflictual outpouring, the complex backgrounds of human concern" (Stake, 1995, p. 17). The seven subquestions used in this study are presented below. Questions one–six are topical questions and question seven is an issue question.

Subquestions

The seven subquestions for this study are:

1. How do leaders initiate discussions about data that create a catalyst for meaningful action?
2. How do leaders determine the data used to support the work of the Data Team?
3. How do leaders utilize analytical skills to support the work of Data Teams?
4. How do leaders build others' capacity to use data effectively?
5. How do leaders supervise the Data Teams Process?
6. How do leaders determine the success of a Data Team?
7. Why do Data Teams need to have the support of leaders?

Each of the subquestions was developed to align with the components and subcomponents of data literacy, leadership, and management identified within the scholarly literature. Subquestion one, "how do leaders initiate discussions about data and create a catalyst for meaningful action?" was developed to address how leaders identify the problems and frame the questions to be addressed through the Data Teams Process. Subquestion two, "how do leaders determine the data used to support the work of the Data Team?" was used to explore leaders' understanding of data and data use. Subquestion three, "how do leaders utilize analytical skills to support the work of Data Teams?" was used to identify the basic statistical principles, indicators, and measurement concepts that leaders use to analyze data. Subquestion four, "how do leaders build

others' capacity to use data effectively?" examined how leaders and their Data Teams transform data into information and decisions and evaluate outcomes. Subquestion five, "how do leaders supervise the Data Teams Process?" sought to identify the leadership and management actions that were used by leaders to support the work of the Data Team. Subquestion six, "how do leaders determine the success of a Data Team?" sought to identify the artifacts and data evidence that leaders utilized to demonstrate Data Team success. Subquestion seven, "why do Data Teams need to have the support of leaders?" is intended to draw out the historical, political, social, and personal contexts that surround the work of formal and informal leaders in the Data Teams Process.

To identify the information that was used to answer each subquestion, interview questions were developed. The questions were then aligned with the components and subcomponents of data literacy. Clarifying information from the supporting literature was then added to each question to demonstrate alignment of the question to the literature (see Chapter Three, Development of Interview Questions). The researcher anticipated that when interview questions were used at each site, participant answers to those interview questions would reveal information that could be used to answer the aligned subquestion and, ultimately, the central question.

Participants

Prospective participants for the study were purposely selected from nine separate schools belonging to two separate school districts in the state of Wyoming. Schools selected for the study were located within school districts where Data Team training had been provided by consultants from the Leadership and Learning Center, division of Houghton Mifflin Harcourt. Schools selected were also those identified as having a formal district meeting schedule that

designated specific meeting times each month during the school year for grade-level or content specific Data Team or PLC meetings. Participants in the study included formal and informal leaders of school Data Teams that have been employed in their identified position for at least one full year. Participants at each school site included one formal leader and one informal leader. The formal leaders were school principals or vice principals, at each site. The informal leaders were those with no formal authority who had been identified by the building principal as leading individual teams or groups of teams at each site. Access to all participants was gained through permission granted by each school district's superintendent.

Case Descriptions

For this study, the focus of each case was a school in the state of Wyoming that had been purposely selected by the researcher. Cases include two high schools, one middle school, four elementary schools and two K-12 schools. School populations at each site were between 50 and 1200 students. Each school in the study had two to ten grade-level, cross-grade-level, department level, or content specific Data Teams. Each Data Team at each school selected for the study had at least two members who were certified teachers. Schools selected had a schedule in place that provided time for Data Teams to meet every one to six weeks in order to review student data and make instructional decisions. In selected schools, consultants from Houghton Mifflin Harcourt had previously provided training on the Data Teams Process. The Decision Making for Results Six-Step process provided to teams through training included (a) collecting and charting data, (b) analyzing student strengths and obstacles to learning, (c) establishing or revising instructional goals, (d) selecting instructional strategies, (e) determining results indicators, and (f) monitoring and evaluating results (Besser, 2010; McNulty & Besser 2011).

Information for each case was provided through participant descriptions and collection of publically available information. For each case, the various Data Teams and team processes used at each site were described. The descriptions provided a reflection of how teams functioned and how each was implementing the Data Teams Process. Also described were the documents, forms, and charts that were used to provide evidence of the work and accomplishments of each team. The information that was gathered from formal and informal leaders through interviews was used to examine leaders' capacity for data use. Interview information was also reviewed to reveal the indicators of leadership and management that were present in leaders descriptions. Finally, publically available information regarding school demographics and school accountability were retrieved for each site. Demographics information was used to provide a description of the teacher and student populations for each site. State accountability information was used to provide a visible measure of student academic achievement and growth for each site.

Data Collection Procedures

The data collection for this study consists of open semi-structured interviews from formal and informal leaders who worked with Data Teams; descriptions of documents such as agendas, notes, memos, or data reports from Data Team meetings; and picture artifacts and data graphs from each school. The face-to-face interviews were conducted at the school site or a public venue at a time that was convenient for each participating formal or informal leader. In some instances, interviews of formal and informal leaders were conducted through video conferencing. The semi-structured interviews were used to gather demographic information about the leader and each school's Data Teams, as well as the data literacy of team leaders and the actions of leadership and management used by leaders to support the work of teams.

To identify evidence of each leader's influence on the team or Data Teams Process, the researcher requested that participants describe any documents, data reports, picture artifacts, and data graphs that demonstrated the Data Teams Process or outcomes of the Data Teams Process at the site. The information recorded did not include identifying information about students or staff. Upon request, participants in the study were provided with a final report in the form of an executive summary of the research.

Before any data were collected, the design of the study, including interview questions, was examined and approved by the Institutional Review Board (IRB) at the University of Montana. The IRB's oversight was used to ensure that any risk to participants is either minimized or eliminated.

Contacting the sites. To begin the research process, formal approval to conduct the research was gained from the (IRB). Following IRB approval to conduct the research, the district superintendent in charge of each school, previously identified by the researcher as having grade-level or content area teams that use the Data Teams Process, was formally contacted to gain consent to conduct research in the district. Once access to conduct research in a district was granted by the superintendent, the formal leader of each school identified as having the Data Teams Process in place was contacted and invited to participate in the study. Formal leaders who responded and agreed to participate in the study were then asked to provide the name and contact information for one or more informal leader(s) at the site. An invitation to participate in the study was then extended to the informal leader(s) identified at each site who met the inclusion criteria. Once invitations to participate in the study were accepted by formal and informal leaders, interviews were scheduled.

Development of Interview Questions. The questions used to guide each interview were supported by information found in the related literature on data literacy, Data Teams, leadership, and management. Data collection was divided into three sections. The questions in the first section provided demographic information about leaders and Data Teams. The questions in the second section were aligned with the five attributes of data literacy identified by Mandinach and Gummer (2016a). The questions in the third section were aligned with definitions of leadership and management posited by Rost (1993).

To ensure that the study addressed variables that might impact study results, section one included questions for collecting demographic information. Demographic information on leaders was focused on the leader's years of experience, the position currently held, and the number of years they had served in their current position. Demographic information provided by the formal leader at each site was used to describe and understand the specific nuances of the leaders participating in this study.

The questions for Section Two were developed in stages. Before the questions in Section Two were developed, the attributes of data literacy found within the related literature were identified. The attributes were then recorded in a researcher-created table. Within the table, cited evidence from the various publications on data literacy was aligned with each of the five components of the Data Literacy Conceptual Framework described by Mandinach and Gummer (2016a) (see Table A2). The information contained in the table was used to develop interview questions for the study. To ensure that some questions addressed the data literacy of team leaders, the literature on data teams was also reviewed to find descriptions of leadership actions that aligned with each of the attributes of data literacy.

The definitions of leadership and management that best fit the needs of the study were then identified. As the study focused on leaders' influence on the work of Data Teams and the impact of those teams on student growth, related literature on servant leadership, transformational leadership, and management were reviewed. The work of Rost (1993) was also examined. For the purpose of this study, the definitions of leadership and management proposed by Rost (1993) were used. The definition used for leadership recognized that "leadership is an influence relationship among leaders and followers who intend real changes that reflect their mutual purposes" (Rost, 1993, p. 102). The definition for management recognized that management was "an authority relationship between at least one manager and one subordinate who coordinate their activities to produce and sell particular goods and or services" (Rost, 1993, p. 145). The definitions noted by Rost (1993) were chosen because each was (a) founded on the researcher's critique of literature from the 1900s through the beginning of the 1990s, (b) provided identifiable elements that were specific to leadership and management; and (c) identified a relationship that existed between the leader and others that was observable as either an influence relationship or an authoritative relationship.

When the researcher determined that the definitions of leadership and management proposed by Rost (1993) would be used for the study, the next set of interview questions were developed. First, the literature on data teams was reviewed to identify information that described the leadership or management actions of leaders of data teams. The information on leadership actions was then used to write questions that aligned with the definitions of leadership and management used in this study.

To gather evidence of team success and reveal why data teams need the support of leaders, a final section of questions were written. To support the questions, the literature on data

teams was reviewed to identify information that was specific to formal and informal leaders of data teams. Also to identify the types of actives data team leaders engage in to support the work of the team.

To ensure that all questions for the study were relevant and could be used to describe data literacy, leadership and management, and leadership of data teams a table was created by the researcher to demonstrate the interview question alignment process and design (see Table A3). In the table, interview questions were aligned with the components and subcomponents of data literacy as well as the subquestion for the study. The researcher used the table when coding, analyzing and interpreting information to ensure that the purpose for this study was met.

Included next are the subquestions that were used to inform the study and the interview questions that were used for the study. Subquestions one through four are aligned with the components and subcomponents of the Data Literacy Conceptual Framework identified in the work of Mandinach and Gummer (2016a, Figure 3.4). The interview questions under subquestion five are aligned with the definitions of leadership and management. Interview questions under subquestion six addressed the need to identify the artifact and data evidence collected by leaders of Data Teams. Interview questions under subquestion seven address historical, political, social, and personal contexts that surround the work of leaders in the Data Teams Process. Finally, a short explanation was included after each question to describe the purpose for the question and how the question was supported in the related literature. The subquestions, components, subcomponents, and interview questions were:

1. **Subquestion One.** How do leaders initiate discussions about data that create a catalyst for action?
    - **Component.** Identify Problems and Frame Questions.

- *Subcomponent.* Involve Other Participants.

- **Interview Question #1**. How do you involve other stakeholders in the use of data to support the decision-making process within the school?

The question was used to identify the school or district stakeholders with whom leaders' shared data results. Stakeholders recognized by leaders were those involved in data discussions or those who were consumers of data information that was provided by the leader or team members. In the relevant research, the need for data to be used by a data coach and data team was noted (Lachat et al., 2006; Mandinach & Gummer, 2016a). Also noted was the need to use data with various members of the learning community (Gummer & Mandinach, 2015; Knapp, Swinnerton, et al., 2006; Mandinach & Gummer, 2016a). As noted by Mandinach and Gummer (2016a) "teachers take their cues from leadership. Teachers see that their building leaders use data, modeling their commitment to the use of data when communicating to stakeholders, teachers, and parents" (p. 22).

- *Subcomponent*. Articulate or communicate the problem or the question.

- **Interview Question #2.** Would you describe the process that is used by you and/or your team to identify each problem or question to be addressed through the data team process?

  Follow up to interview question #2. How is that problem or question communicated out to other stakeholders?

The question was used to gather information on the steps that were taken by leaders to guide teams in their use of data in order to reveal students' learning needs. The question was also used to gather information about how leaders communicated and identified problems to others working with the students. The ability to frame questions, identify

problems, and communicate the resulting information was identified by multiple researchers (Gummer & Mandinach, 2015; Hooft et al., 2010; Lai & Schildkamp, 2013; Mandinach & Gummer, 2016a; Vahey et al., 2006). There was also a need for what Fullan (2001) called "knowledge building" noted by Knapp, Swinnerton, et al., (2006). When describing knowledge building, Fullan (2001) noted, "Effective leaders understand the value and role of knowledge creation, they make it a priority and set about establishing and reinforcing habits of knowledge exchange among organizational members" (p. 87).

- *Subcomponent*. Understand Student Privacy.

- **Interview Question #3.** What expectations have been discussed with staff and established in your school regarding data privacy?

  Follow up to interview question #3. How are expectations put into practice and monitored?

In working with student data, schools have a responsibility under the Family Rights and Privacy Act (FERPA), the Protection of Pupils Right Amendment (PPRA), and the Health Insurance Portability and Accountability Act (HIPPA) to ensure the security and confidentiality of student data (Krueger & Moore, 2015; Mandinach & Gummer, 2016a; Schneiderman, 2015). Thus, as Mandinach and Gummer (2016a) noted, there is a need for school staff to understand data security from multiple perspectives. Therefore, the question was asked to identify how expectations for data privacy were communicated or carried out by school leaders.

- *Subcomponent*. Understand Contextual Issues.

- **Interview Question #4**. What types of data sources do you and your Data teams use to better understand the contextual factors surrounding an issue (include factors within and outside of your control)?

  Follow up to interview question #4. Would you describe how you or your teams have addressed contextual factors that were found to be impacting student growth?

The question was used to gather information regarding the contextual issues that were considered by leaders when reviewing student data. The question was supported by a common understanding that issues such as demographics, school process, schedules, assessment calendars, language acquisition, individual academic plans, have the potential to impact student performance and consequently, data results. As noted in the research, various contextual issues should be considered when examining data outcomes (Lai & Schildkamp, 2013; Mandinach & Gummer, 2016a: Vahey et al., 2006; Vanhoof et al., 2013). Contextual issues to be considered include "the nature of the student body, the number and types of initiatives, and the authority structure of the school or district" (Mandinach & Gummer, 2016a, p. 64).

2. **Subquestion Two**. How do leaders determine the data used to support the work of the data team?

   - **Component**. Use data.
     - *Subcomponent.* Identify possible data sources.
   - **Interview Question #5.** When implementing a new intervention, curriculum, instructional strategy, assessment (summative or formative), or data-

generating program, how do you ensure that each will provide support for an identified purpose?

Follow up to interview question #5. Would you describe a time when you put this into practice?

This question was used to gather information about how leaders' utilized their data skills to review program information and identify the programs or resources to be used by teams. Research has recognized that the use of data results for this purpose can serve as the catalyst for tailoring instruction that matches students to programs and practices (Data Quality Campaign, 2014; Earl & Katz, 2006; Knapp et al., 2006; Gummer & Mandinach, 2015; Jacobs et al., 2009; Lachat et al., 2006; Love et al., 2008; Mandinach & Gummer, 2016a).

- *Subcomponen*t. Understand How to Generate Data

- **Interview Question #6**. Would you describe the assessment design and implementation process that is used by your data teams?

  Follow up #1 to interview question #6. What types of formative and summative assessments are used to guide instructional decisions?

  Follow up #2 to interview question #6. What do you and your data team consider when choosing and developing assessments?

  Follow up #3 to interview question #6. What is considered when reviewing each measurement instrument and the scores produced through the use of each instrument?

The question was used to gather information on leaders' understanding of the various assessments and assessment processes used at their site. In addition, the question helped

to identify how leaders and their teams used the various assessments to measure student academic growth and support student learning. In the relevant literature, the types of assessments used to support student learning were described. The various levels of assessment noted were (a) external or state assessments (Earl & Katz, 2006; Gummer & Mandinach, 2015; Lachat et al., 2006; Love et al., 2008; Mandinach & Gummer, 2016a), (b) Standardized tests (Lachat et al., 2006), (c) schoolwide assessments or common assessments (Earl & Katz, 2006; Gummer & Mandinach, 2015; Lachat et al., 2006; Love et al., 2008; Mandinach & Gummer, 2016a), (d) classroom assessments, and (e) diagnostic assessments (Lachat et al., 2006). While the importance of assessment results was noted, so was the need to use other categories of data such as grades, attendance, discipline, socio-economic status etc. to paint an accurate picture of student academic growth (Earl & Katz, 2006; Gummer & Mandinach, 2015; Lachat et al., 2006; Mandinach & Gummer, 2016a).

- *Subcomponent*. Understand Data Properties.

- **Interview Question #7.** What data sources do you access or gather to support your daily practice, school decisions, and the data team process?

  Follow up to interview question #7. How do you evaluate the relevancy of the data for addressing an identified question or problem?

The question was used to gather information about the various sources of data that leaders utilized and to reveal how leaders determined the relevancy of the various sources that were used. The need to use relevant data was noted within multiple works (Data Quality Campaign, 2014; Gummer & Mandinach, 2015; Knapp et al., 2006; Love et al., 2008; Mandinach & Gummer, 2016a; Schield, 2004). Scholars posited that an

understanding of data properties was required to use data effectively (Gummer & Mandinach, 2015; Love et al., 2008; Mandinach & Gummer, 2016a). Understanding data properties was described as "knowing what data are appropriate in a given context and which are not" (Mandinach & Gummer, 2016a, p. 66). In general, the need to use various kinds of data, quantitative and qualitative, for decision making was noted (Earl & Katz, 2006; Gummer & Mandinach, 2015; Jacobs et al., 2009; Knapp et al., 2006; Love et al., 2008; Mandinach & Gummer, 2016a).

- *Subcomponent*. Understand Data Quality.

- **Interview Question #8.** What do you consider when determining the quality, validity, value, appropriateness, and completeness of data results?

  Follow up to interview question #8. How do you apply your judgments for each indicator to the data team process?

Researchers posited that while multiple types of data may be available, the quality of the data and the appropriateness of the data for the purpose at hand must be considered (Earl & Katz, 2006; Gummer & Mandinach, 2015). Mandinach and Gummer (2016a) linked data quality to understanding data accuracy, appropriateness, and completeness. Love et al. (2008) described data quality as the need to "understand the limitations of tests and the importance of reliability validity, fairness and multiple measures" (p. 128). The question was used to reveal leaders' understanding of data quality, validity, value, appropriateness, and completeness of data and gather information about how leaders used that understanding to support the Data Team.

- *Subcomponent.* Understand How to Access Data.

- **Interview Question #9**. Describe the various data systems and processes you use to locate, access, and retrieve data.

  Follow up to interview question #9. Would you describe the programs that are used to generate data and the recording documents or data tools you use when working with that data?

The question was used to gather information regarding leaders' understanding of how to access data. The related literature indicated that a need existed for educators to understand how to access data results from state and local systems (Data Quality Campaign, 2014). Research also indicated a need to "understand a wide variety of tools for accessing, converting and manipulating data" (Schield 2004, p. 8). Additionally, to support the use of data, practitioners needed to understand how to use technology, or technology-based systems (Gummer & Mandinach, 2015; Knapp et al., 2006; Lachat et al., 2006; Mandinach & Gummer, 2016a).

3. **Subquestion three**: How do leaders utilize analytical skills to support the work of data teams?

   - **Component**. Use data.
     - *Subcomponent*. Understand How to Analyze Data.
   - **Interview Question #10.** What formal training have you received on statistics, psychometrics or research methods?

     Follow up to interview question #10. How extensive was that training?

The question was used to reveal whether or not leaders had received formal data training. In the related literature, various researchers identified a need for those that use data to have statistical skills (Earl & Katz, 2006; Gal, 2002; Gummer & Mandinach, 2015; Love

et al., 2008; Mandinach & Gummer, 2016a). As Mandinach and Gummer (2016) pointed out, the depth of statistical understanding needed for data literacy is still an open question. However, as stated by Earl and Katz, "If leaders are going to use data to enhance rather than distort educational decisions, they have a responsibility to understand the principles that underlie statistics" (p. 19).

- **Interview Question #11.** How do you utilize results from descriptive statistics (measures of central tendency and variability, i.e., mean, median, mode, standard deviation) when examining and reporting student scores? *Follow up to question #11*. How do you apply this practice to your work with data teams?

The question was used to reveal leaders' understanding of the various scoring schemes and how each was used to support their analysis of student data. The question was supported by the research on statistical literacy, a type of literacy embedded within data literacy. As noted by scholars, individuals who work with data need to be familiar with "the basic terms and ideas related to descriptive statistics" (Gal, 2002, p. 11) and possess the ability to think creatively about statistics (Shield, 2005).

- **Interview Question #12.** How do you and your teams use data analysis to guide decisions about strategies, programs, and processes?

The question was used to gather information on the practices and process used by leaders to analyze data in order to reveal their understanding of how to analyze data, and to reveal how leaders utilized analysis practices to guide team decisions. The need for data use to guide decisions about instructional strategies, programs, and processes was noted by multiple researchers (Bernhardt, 2013; Earl & Katz, 2006; Knapp et al., 2006; Love,

2009; Love et al., 2008; Mandinach & Gummer, 2016a; McNulty & Besser, 2011). Others (McNulty & Besser, 2011) recognized that data could be used to provide information about effective and ineffective adult actions as well as the teacher, student, and learning supports that were needed. Others also recognized that data could provide information about the effectiveness of programs and practices as demonstrated in the research of Hattie (2009) and research results available on Web sites such as the What Works Clearing House (ND).

- **Interview Question #13**. What types of comparative process do you or your data teams use to drill down into data?

  Follow up to interview question #13. How and when do you use aggregated and disaggregated data?

The question was used to reveal leaders' understanding of how to use data analysis to drill down into data, as well as to understand what leaders looked for when drilling down into data. According to Love et al., (2008) "Drilling down into student-learning data is the process of looking more and more deeply at one student-learning data source to derive the greatest possible amount of information" (p. 131). Going deeper into the data requires analyzing the various layers of each data source. In a drill down process, analysis moves "from the aggregate level, to the disaggregate level, to the strand level, to the item level, and ultimately, to analysis of student work" (Love et al., 2008). Multiple researchers identified the need for drill down processes, or disaggregation of data, to support decision making (Bernhardt, 2002, 2013; Datnow et al., 2008; Knapp et al., 2006; Lachat et al., 2006; Love, 2009; Love et al., 2008; Wayman, Stringfield and Yakimowski, 2004).

- **Interview Question #14.** What are the systematic, systemic processes that you or your teams use, or have used, for managing data (examining data, prioritizing data, organizing data, blending and manipulating data)?

The question was used to identify practices and process that were consistently used by leaders to analyze data and support the Data Teams Process. Processes that were expected to be systematic were those that followed the steps of the Data Teams Process. Processes or practices that were expected to be systemic were those described by leaders as being used or required of all teams at a site or within a district. The related literature provided multiple references to the various steps or processes that should be used for collecting, analyzing, discussing, and acting on data (Earl & Katz, 2006; Love, 2009; Love et al., 2008; Mandinach, Honey, et al., 2006; McNulty and Besser, 2011). While most described cycles for data use, some (Bernhardt, 2013; Love et al., 2008) provided explicit steps on what data to review and how to organize and drill down or triangulate that data.

4. **Subquestion Four**: How do leaders build others' capacity to use data effectively?
    - **Component.** Transform Data Into Information
        - *Subcomponent.* Consider Impact and Consequences (Intended and Unintended).
    - **Interview Question #15**. How do you and your team typically address questions or concerns about various concepts, claims, and arguments that have potential to impact the results of your work?

Follow up to interview question #15. Could you describe a time when this has happened?

The question supported the understanding that to extract usable information from data results, leaders needed to keep teams focused on the data and help them to carefully scrutinize other information that could impact the findings. In the work of McNulty and Besser (2011), the data literate leader was observed to be one who could "activate collaborative knowledge and use data" (p. 145). Others also observed the need for the collaborative process in the use of data (Earl & Katz, 2006; Gummer & Mandinach, 2015; Hooft et al., 2010; Knapp et al., 2006; Lai & Schildkamp, 2013; Love et al., 2008; Mandinach & Gummer, 2016a; Schield, 2004; Vahey et al., 2006). When engaging in conversations about data, the leader must understand what data to use, why to use the data, and how frequently to use the data (Love et al., 2008). Furthermore, when using the data, leaders need to guide discussions to evaluate and interpret inferences, explanations (Vahey et al., 2006), concepts, claims, and arguments (Schield, 2004). As Fullan (2008) noted, "When peers interact purposefully, their expectation of one another create positive pressure to accomplish goals important to the group" (p. 63).

- *Subcomponent*. Generate hypothetical connection to instruction

- **Interview Question #16**. What types of questioning or thinking processes do you and your teams use when attempting to identify the root cause of an academic concern?

  Follow up #1 to interview question #16. How is this questioning or thinking process used to identify areas of greatest need within each core area at both the class level and individual student level?

Follow up #2 to interview question # 16. How do you utilize information from the root cause analysis to guide your team's instructional decisions?

The question was used to reveal leaders understanding of how to identify the root cause of a problem. The question was also used to identify how leaders used root cause analysis to guided team decisions regarding instructional practices. While the root cause of a particular problem may be considered, the nature of that causal reasoning may not be examined when generating hypothetical connections to instruction (Gummer & Mandinach, 2015; Mandinach & Gummer, 2016a; Mandinach and Jimerson, 2016). To create meaningful connections between data results and instruction, data must be interpreted within the context of the issue to be addressed (Gummer & Mandinach, 2015; Hooft, et al., 2010; Lachat et al., 2006; Lai & Schildkamp, 2013; Mandinach & Gummer, 2016a; Vahey et al., 2006).

- *Subcomponent*. Test Assumptions.

- **Interview Question #17.** Provide a description of the process you and your team use to test assumptions about why a particular problem may be occurring.

  Follow up to interview question #17. What impact does this process have on instructional practice?

The question was used to identify the steps that were taken by leaders and their teams to test assumptions about why identified problems were occurring. In describing the thinking process for data literacy, Earl & Katz (2006) noted a need for "systematically considering an issue from a range of perspectives so that you really feel that you have evidence to explain, support, and also challenge your point of view" (p. 45). In the work

of Jacobs et al. (2009), the use of multiple data sources and triangulation of data provided validation of a perceived concern.

- *Subcomponent*. Understand How to Interpret Data.

- **Interview Question #18.** When presenting data results to stakeholders, how do you determine what information will be presented and what format or data displays will be used for the presentation?

The question examined how leaders organized and presented data results to create meaning for stakeholders. The researcher anticipated that leaders' descriptions of the information presented and presentation format would reveal their understanding of data interpretation. Information in the related literature recognized, that while processes for accessing and analyzing data are generic across disciplines, interpreting data requires the customization of information within the context of the specific content area represented (Mandinach & Gummer, 2016a). Presentations must also be customized for each audience. Earl and Katz (2006) noted that the data literate leader "makes interpretation paramount" (p. 20) and "pays attention to reporting and to audiences" (p. 20). As posited by Knapp et al. (2006), the use of data with various stakeholders requires leaders to use "different kinds of data-informed leadership. For example, leaders may frame conversations about data differently with teachers seeking to identify instructional gaps than with community leaders interested in tracking the schools' progress over time" (p. 24).

- ***Component***. Transform Information Into Decision.
  - *Subcomponent*. Determine Next Instructional Steps.

- ***Interview Question #19***. How are the instructional strategies used to support student growth at the classroom and individual levels determined?

The question was used to gather information on how leaders used data to guide team decisions regarding instructional strategies used to address identified problems. The question examined the process used by leaders to identify strategies as well as resources used for supporting the process. As noted by Lachat et al. (2006), a focus on a set of essential questions is needed to guide the work of data teams as they review data and set targets for learning. When teams are working under an RTI framework, interventions that are implemented must be research and evidence-based, and the nature and intensity of the intervention must be based on the student's response to the intervention (Center on Response to Intervention, 2010). Thus, the use of a data-team process provides a means for examining student data and turning the data into actionable knowledge that can be used to inform daily instructional practice (Campsen, 2010; Córdova, 2010; Kamm, 2010; Mandinach & Gummer, 2016a; Mandinach & Jimerson, 2016; Ventura, 2010). The knowledge that team members have regarding learning objectives, content and curriculum, pedagogy and pedagogical content knowledge also play a key role in determining instructional steps (Mandinach & Gummer, 2016a). As noted by McNulty and Besser (2011) the causes of student success and student obstacles provides the focus for dialogue regarding the instructional strategies that are most likely to impact student learning.

  - *Subcomponent.* Understand Context for the Decision.

- **Interview Question #20.** How do you support data team members in implementing strategies and interventions that are aligned to learner

characteristics, content, pedagogy, educational purpose, and the academic goals of the team and the school?

The question was used to gather information regarding the various contexts that were considered by leaders when making data-based decisions. The question was also used to gather information about how leaders guided teams in identifying and implementing strategies and interventions that were aligned to learner characteristics, content, pedagogy, educational purpose, and the academic goals of the team and the school. Researchers noted that to turn information into decision, one must understand the context for the decision (Gummer & Mandinach, 2015; Mandinach & Gummer, 2016a; 2016b). Scholars further recognized that data skills "need to be informed by teachers' knowledge of their domain, students' expected learning trajectories, and teachers' knowledge of what to do with the data within the context of the content to transform the information into actionable instructional knowledge" (Mandinach & Gummer, 2016a, p. 93).

Component. Evaluate Outcomes.

- *Subcomponent.* Re-examine Original Question or Problem.

- **Interview Question #21.** Explain how you and your data team examine the effectiveness of strategies and interventions that have been implemented.

  Follow up #1 to interview question #21. How often does this practice occur?

  Follow up #2 to interview question #21. What evidence do you have available that could be used to verify the process you described?

Follow up #3 to interview question #21. What evidence do you have available that could be used to demonstrate the impact this process has had on work being done by the team?

The question was used to collect information about the processes that were used by leaders to guide teams in examining the impact of their work on student growth. The question was also used to gather information on the frequency with which results were reviewed as well as leaders perceptions of the impact that the teams work had on student growth. Those contributing to the research on data use in education recognized that when examining data on student progress, teams must utilize results to diagnose student needs (Center on Response to Intervention, 2010; Gummer & Mandinach, 2015; Mandinach & Gummer, 2016a; Vanhoof et al., 2013). In examining the need for instructional adjustments, consideration must be given to whether to reteach a concept or move a student ahead to a new lesson (Mandinach & Gummer, 2016a). Scholars also noted that, when administering and reviewing assessment data and goals, Data Teams should utilize a two to three-week short-cycle review process (Ahearn, 2012; McNulty & Besser, 2011; Peery, 2011).

- *Subcomponent*. Consider Need for Iterative Decision Cycles

- **Interview Question #22.** How do you and your team proceed with the work when strategies and interventions are found to be effective and ineffective?

The question was used to reveal the decision making process that was used by leaders and teams at the end of a cycle to determine if the work on a problem should be continued. The question also was used to provide information about leaders' understanding of how to evaluate data outcomes. The need for the use of an inquiry

cycle was identified in the related literature (Gummer & Mandinach, 2015; Mandinach & Gummer, 2016a; Vanhoof et al., 2013). As Mandinach and Gummer (2016) noted,

> The inquiry cycle refers to the recursive way that practitioners identify problems or issues of practice, formalize questions that help specify ways to examine a particular issue, Identify and collect data to inform those questions, act on the data to identify potential antecedents or causes of the problem or issue, and then decide how to act on solutions that emerge. (p. 55)

At the end of this inquiry cycle is the evaluation of the original problem and a continuation of the process (Data Quality Campaign, 2014; Mandinach & Gummer, 2016a).

5. **Subquestion Five**. How do leaders supervise the data team process?

    - **Interview Question #23.** What processes or data tools do you use to help you monitor the work of data teams and provide meaningful feedback to the team and its individual members?

      Follow up #1 to interview question #23. When and how often is feedback provided?

      Follow up #2 to interview question #23. What type of feedback is typically provided?

The question was used to gather information about how leaders monitored the work of the teams and provided feedback. The question was also used to identify the tools that were used by leaders to support the work of Data Teams. As noted by Peery (2011) "Monitoring and evaluation are critical to the work of Data Teams" (p. 41). As noted by McNulty and Besser (2011) "feedback provides teams with information on the

effectiveness of their work. Teams need to receive feedback on the effectiveness of their collaboration and the way in which they are using data—both cause and effect—to improve teaching learning and leadership (p.168). Researchers recognized that feedback should be provided frequently (McNulty and Besser, 201; Perry, 2011). To collect agendas, meeting notes, assessments and other documents, leaders and their team either maintain a Data Team binder or store information of the school server (Perry, 2011).

- **Interview Question #24.** How was the school's culture of data use established, and what was your role in creating and maintaining that culture?

This question was used to gather information about whether practices of leadership or management were used to influence the culture of data use at each site. Leadership as defined by Rost (1993) "is an influence relationship among leaders and followers who intend real changes that reflect their mutual purposes" (p. 102). Management is "an authority relationship between at least one manager and one subordinate who coordinate their activities to produce and sell particular goods and or services" (Rost, 1993, p. 145).

- **Interview Question #25.** Would you share your perceptions of staff commitment to the data team process and the work needed to foster student growth?

The question was used to reveal how deeply rooted the Data Teams Process had become at each site and the importance of leaders in maintaining that process. Staff commitment to the Data Teams Process reflects what Dufour and Fullan (2013) called "systemness" and Rost (1993) called "mutual purpose." As Dufour and Fullan explained, when there is "systemness," everyone in the organization does his or her part by being as

good as he or she can be and contributes to the improvement of the larger system. The work that is carried out is "grounded in a solid foundation of common purpose, shared vision, collective commitments, and goals." (Dufour & Fullan, 2013, p. 18).

- **Interview Question #26.** How do you work with your teams to elicit goals and gain team members' commitment to take action?

The question was used to reveal the practices of leadership and management that were used by formal and informal leaders of Data Teams. More specifically, the question was used to reveal actions that reflected the use of management, transformational leadership and servant leadership. The literature noted that leaders could function as facilitators or participants in the Data Teams Process (McNulty & Besser 2011, Peery, 2011). Also noted was that a collaborative focus on data by team members fostered changes to teaching and leadership practices (Ahearn, 2012; Ainsley, 2010; Allison, 2010; Campsen, 2010; Love et al., 2008; Love, 2009; McNulty & Besser, 2011; Peery, 2010; Piercy, 2006; Ventura, 2010). In examining leader-follower relationships, Greenleaf (1977/2002) identified the traits of those that were servants first and leaders second. He noted, "A servant-leader works toward building a learning organization where each individual can be of unique value" (p. 1231). Alternately, the work of Burns (1978/2012) described transformational leadership and how the actions of leaders and followers raised one another to higher levels of motivation and morality.

- **Interview Question #27.** What are some of your successes and challenges in working with data team?

The question was used to reveal the successes and challenges that the leaders faced in their work with Data Teams. The researcher for this study anticipated that

leaders would provide an account of their experiences in working with Data Teams. As Stake (2006) posited, the study of situations reveals experiential knowledge which is important to understanding the "quintain" (p. 12).

6. **Subquestion Six**. How do leaders determine the success of a data team?
    - **Interview Question #28.** Describe the documents, data reports, picture artifacts, and data graphs that you collect to determine the success of data teams.

The question was used to reveal the artifacts and evidence that were collected by leaders that demonstrated the success of the team in fostering student academic growth.

- **Interview Question #29.** Describe how each of the artifacts collected demonstrates the growth and success of the data teams you lead.

The question was used to draw out information about how each of the artifacts described the team's growth and success. As noted by Stake (2006), "The power of a case study is its attention to local situation" (p. 8). The researcher for this study anticipated that the various artifacts and evidence collected from each site would provide unique information on its teams and the processes that were used by leaders and teams.

7. **Subquestion Seven**. Why do data teams need to have the support of leaders?
    - **Interview Question #30**. How does the work of leaders provide support for the data team process in your school?

The question was used to gather additional information about how leaders at each site supported the Data Teams Process. Numerous authors indicated that data knowledge and skills of the leader play a critical role in the ability of the team to utilize data in

developing plans to guide teaching and learning (Campsen, 2010; Love, 2009; Love et al., 2008; McNulty & Besser, 2011; Peery, 2010).

- **Interview Question #31.** What do you believe the impact to teams would be if formal leaders were not involved in the data team process?

The question was used to gather information to reveal why Data Teams need formal leaders. Peery, (2011) recognized "If building level administrators are not tightly connected to the Data Teams Process, then Data Teams will not work" (p. 37). The work of leaders is critical to the success of the data team process (Campsen, 2010; Love, 2009; McNulty & Besser, 2011; Ventura, 2010). Formal leaders monitor and guide Data Teams by studying meeting notes, conducting classroom visits, meeting with team leaders, and providing feedback, (Peery, 2011). When formal leaders model data use and communicate the rationale or importance for its use, they stimulate the data use of others (Mandinach & Gummer 2016a; Mandinach, Honey, et al., 2006; Mandinach & Jimerson, 2016). Leaders "also communicate and emphasize the importance of implementing and monitoring the strategies deeply on a school-wide basis, and they report to the staff on a regular basis, on both the level of implementation and the impact on student learning" (McNulty & Besser, 2011, p. 88). Additionally, to support others in their use of the process, the formal leader can allocate resources (Peery, 2011; Mandinach & Gummer, 2016a)

- **Interview Question #32.** What do you believe the impact to teams would be if informal leaders were involved only as teacher participants?

The question was used to gather information to reveal why Data Teams need informal leaders. McNulty & Besser (2011) posited that informal Data Team leaders are

> needed to carry out the day to day work with Data Teams. The informal leader serves as the meeting facilitator and in that capacity convenes meetings, plans meetings, and gathers and prepares data for team use (Love, 2009). As the team facilitator, the team leader guides data-driven discussions by fostering meaningful dialogue that is free of debate and excessive discussion (McNulty & Besser, 2011). The team leader fosters collaborative inquiry that keeps teams focused on the goal of improving teaching and learning (Love, 2009). "Behind every successful Data Team is an effective Data Team leader. This person is pivotal in the sustainability of the Data Teams model" (McNulty & Besser, 2011, p. 144)

The use of the literature to develop interview questions insured that information gathered through interviews was relevant and supported the purpose of the study. In the next section, the trustworthiness of the data will be addressed. The section describes why the data collected is considered accurate and how the data collected was verified.

Trustworthiness of the Data

The information presented in this study was considered trustworthy. Trustworthiness of the data was accomplished in two ways. First, the study used protocols and processes that ensured the accuracy of data. Next, the study used established data analysis practices and verification procedures for sorting, checking, and analyzing the information.

Accuracy. In this study, the accuracy of data was ensured in three ways. First, all interviews were recorded following a prescribed interview protocol. As recommended by Creswell (2003), the components used for the written protocol included "a heading, instructions to the interviewer (opening statements), the key research questions, probes to follow key questions, transition messages for the interviewer, space for recording the interviewer's

comments, and space in which the researcher records reflective notes" (p. 190). Next, to ensure the accuracy of interview notes, the audio portion of all interviews were digitally recorded and transcribed word by word by the researcher. A final step to ensure the accuracy of data was to utilize an established process for handling the raw data. The process included the use of an identifying code for all information gathered as well as storing all identifying information in a locked area separate from the data. By adhering to the process and protocols described above, the researcher ensured that data used for the study was accurate.

Verification. In this study, research data were verified through the use of specific verification procedures or strategies. According to Creswell (1998, 2003), eight separate verification procedures can be used in qualitative research. Creswell (1998) recommends that "qualitative researchers engage in at least two of them in any given study" (p. 203). In this study, five of the procedures noted by Creswell (1998, 2003) were used. Procedures used included (a) triangulation; (a) rich, thick description; (c) member checks; (d) clarifying researcher bias, and (d) external audits.

Throughout the study, there was a use of triangulation to analyze the information that was gathered for each case. As Creswell (2003) noted, the process typically involves "corroborating evidence from different sources to shed light on a theme or perspective" (p. 202). Merriam (1998) associated triangulation with "using multiple investigators, multiple sources of data, or multiple methods to confirm the emerging findings" (p. 204). Stake (2006) explained that triangulating data meant, "Being redundant and skeptical in seeing, hearing, coding, analyzing, and writing" (p. 77). In this study, the data were triangulated by reflecting on interview transcripts and descriptions of documents, pictures, data reports, and other relevant artifacts from

each school. Triangulation allowed the researcher to make assertions about study findings and create a strong descriptive narrative.

Rich, thick descriptions were used for describing recorded observations and interviews in this study. As Creswell (2003) noted, the detail included in rich, thick descriptions allows readers to be transported to the setting of the study and share the experience. Providing such detail allows the reader "to transfer information to other settings and determine whether the findings can be transferred" (Creswell, 1998, p. 203).

Member checking is a strategy recommended by Creswell (2003) that was used to verify that descriptions provided in the research narrative were presenting an accurate picture for the reader. In this study, member checks were used to verify interview transcriptions, as well as research findings and interpretations. Member checks occurred when participants were asked to clarify information during the interview process (Creswell, 1998, 2003).

Within qualitative research, the assumptions, world views, theoretical orientations, prejudices, and past experiences of the researcher have the potential to shape the interpretations and chosen approach for the study (Creswell, 1998, 2003; Merriam, 1998). Therefore, an important and needed verification strategy for any study is the clarification of the researcher's biases. Clarifying biases allows the reader to understand the researcher's position and any assumptions that may impact the inquiry (Merriam, 1998). To clarify and disclose any possible biases held by the researcher that could impact the inquiry process for this study, the researcher acknowledges her past and present employment as an elementary principal within schools that utilize the Data Teams Process with grade-level teams. Furthermore, the researcher acknowledges that she has received formal training in leadership at the masters and doctoral level as well as training in the implementation of the Data Teams Process. While the previously

noted experiences of the researcher have helped to shape the study, the researcher recognizes and believes, as Merriam (1998) noted, "There are multiple interpretations of reality" (p. 22). In acknowledging this view, the researcher was guided by the findings of the study instead of past experience.

To ensure the appropriateness of information utilized to guide the study, and to verify the data and data process within the study, an external auditor was used. The external auditor was responsible for reviewing the entire project and providing an assessment of the project throughout the research process. Being that the researcher has undertaken the study in order to complete a doctoral dissertation, the external auditors of this study were the dissertation chair and the four other members of the dissertation committee.

Data Analysis

In this qualitative instrumental multi-case study, multiple sources of information were examined to explore how the leader's data literacy and actions of leadership and management contribute to the Data Teams Process. As noted by Creswell (1998), "A case study involves the widest array of data collection as the researcher attempts to build an in-depth picture of the case" (p. 123). "The most important advantage presented by using multiple sources of evidence is the development of converging lines of inquiry, a process of triangulation and corroboration" (Yin, 2009, chapter 4, Triangulation, para. 3). Yin (2009) recommended that evidence utilized in case study research can come from six sources. Sources include, "documentation, archival records, interviews, direct observation, participant-observation, and physical artifacts" (Yin, 2009, chapter 4, para. 1). The five data sources used for this study were (a) pre and post-interview communications; (b) individual participant face-to-face, phone, or webcam, interviews; (c) field

notes; and (e) descriptions of school documents and reports. An analysis of the data collected during the study is presented in Chapter Four: Data Analysis.

The research process described by Stake (1995) was used for working with individual cases. Stake (1995) posited that the "two strategic ways that researchers reach new meanings about cases are through direct interpretation of the individual instance and through aggregation of instances" (p. 74). He noted both "depend greatly on the search for patterns" (p. 78). In this study, subquestions prepared in advance served as an initial framework for identifying patterns for analysis. However, not all patterns were known in advance. As Stake (1995) noted, "Sometimes, the patterns will emerge unexpectedly from the analysis" (p. 78). When looking for patterns, the researcher searched for what Stake (1995) called "correspondence." To identify where correspondence existed, the researcher looked for "consistency within certain conditions" when observing, interviewing, and reviewing documents (Stake, 1995, p. 78). Patterns were also identified through the coding of records and aggregating the frequency of conditions. Through coding, the researcher took the data apart and put it back together again. As Stake (2010) wrote,

> Research involves both analysis (the taking things apart) and synthesis (the putting things together). We gather data. We increase our experience. We look closely at the patches of collected data, the parts of our experience; that is, we analyze. And we put the parts together, often in different ways than before. We synthesize. (p. 133)

An important reason for doing the multi-case study is to examine how the program or phenomenon performs in different environments (Stake, 1995). In this instrumental multi-case study, data were collected to first understand each case in depth or as Stake described, "to generate a picture of the case" (Stake, 2006, p. 3). Each picture represents an integrated system

that has working parts and is purposive (Stake, 2006). In a multi-case study, each case is a specific thing (Stake, 2006).

As noted by Stake (1995), instrumental case studies are those that "help us understand phenomena or relationships within" a case. Creswell (1998) explained that in an instrumental case study the focus is on "a specific issue rather than the case itself" (p. 250). To understand the case, the researcher must "forego attention to the complexity of the case to concentrate on relationships identified in [the] research" (Stake, 1995, p. 77). In this instrumental multi-case study, the relationship to be studied was the leader's data literacy as it relates to the work of Data Teams.

To provide a description of the cases and answer the research questions for this study, the researcher completed a final report. As Stake (2010) wrote, when writing the final report "content is more important than style" (p. 183). Following the recommendations of Stake (1995), the report for this study presented a naturalistic representations of each case. In describing cases, the researcher provided a narrative account of each leader's data literacy and its role in their work with Data Teams. The report was specific to time and place and included "stories, chronological presentations and personalistic descriptions" (Stake, 1995, p. 86).

To ensure high-quality analysis occurred throughout the study, the researcher followed four principals noted by Yin (2009). First, all of the evidence was considered. Second, all major rival interpretations were addressed. Third, the most significant aspect of each case study was addressed. Finally, the researcher utilized her "own prior, expert knowledge by demonstrating an awareness of current thinking and discourse about the case study topic" (Yin, 2009, chapter 5, Pressing for a high quality analysis section, para. 5).

Chapter Summary

In this chapter, the qualitative research design for the study was presented. The chapter began with a presentation of the rationale used to support the need for the use of a multi-case study research design. Included in the presentation was information on case study and multi-case study research. The next section of the chapter addressed the research question. Included in the section were the central question and seven subquestions. The participants of the study were described next. The description noted that study participants would be formal and informal leaders employed during the 2016-2017 school year in nine schools purposely selected in the state of Wyoming. Included in the description of participants were the criteria used for the purposeful selection of the schools chosen.

Following the description of participants was a description of the cases to be presented in the study. Next, a description of the data collection procedure was presented. Within the description, the researcher for this study noted that data collection for this study would consist of open semi-structured interviews from leaders of Data Teams, descriptions of documents such as agendas, notes, memos, or data reports from Data Team meetings, and descriptions of picture artifacts and data graphs collected at each school. Information on how sites were contacted followed. Next, a review of how interview questions were developed was presented. Within the section on Development of Interview Questions, reference was made to two separate researcher-constructed tables located in Appendix A. Table A2 was used to align cited evidence from the related literature on data literacy, leadership, and management with the components of data literacy described by Mandinach and Gummer (2016a). Table A3 was used to by the researcher to align the interview questions with (a) the descriptors for the components and subcomponents

of data literacy, (b) the definitions of leadership and management, and (c) the subquestions for the study.

The next section addressed the trustworthiness of the data. Within the section, the anticipated processes, protocols, procedures, and strategies used to ensure that data were accurate and verified were discussed.

In the final section of the chapter, the anticipated data analysis for the study was described. The researcher noted in the description that for this study, a general research process described by Stake (1995) was used. In following the process, direct interpretation of individual instances and aggregation of instances was used. In addition, data were pulled apart and put back together again in new and meaningful ways.

The information presented in this chapter provided an overview of the methodology that was used for the study. The information was intended to describe how the study was conducted. In the next chapter, an analysis of the data collected during the study is presented.

Chapter Four - Findings

This multiple case study sought to examine the data literacy of leaders and how leaders' understanding and use of data influenced the work of instructional Data Teams. This section presents the qualitative data for nine separate case studies. Each case study represents one school site in one of two districts in the state of Wyoming. Each case includes qualitative data collected from inside and outside of each case. For each case, the emergent patterns of leaders' data literacy and the leadership styles that are used to support the Data Teams Process, and the success of the Data Teams at each case site are identified. Also identified and described are the reoccurring themes that are mirrored within all cases.

Analysis of the data for this multicase study was guided by the work of Stake (2006). As Stake (2006) noted, when conducting a case study "the case researcher needs to generate a picture of the case and then produce a portrayal of the case for others to see" (p. 3). To help researchers, Stake (2006) developed a worksheet that can be used to graphically represent the internal and external components of a case (Figure 4). A researcher can use the worksheet as a research tool for visualizing and planning a case. On the worksheet, the case is depicted as a large centrally located circle that has a thick, bold line as a border. Case features that lie inside the boundaries of a case describe the research activities and methodology of the case. Bordering the large central circle are smaller circles with lighter borders. The smaller circles are overlapped by the dark border of the central circle. Features depicted in the outside circles define the context of the case. The two boxes below the central circle provide a space for summarizing the issues and main questions that are foundational to the case.

Figure 4. Stake's Graphic Design of a Case Study

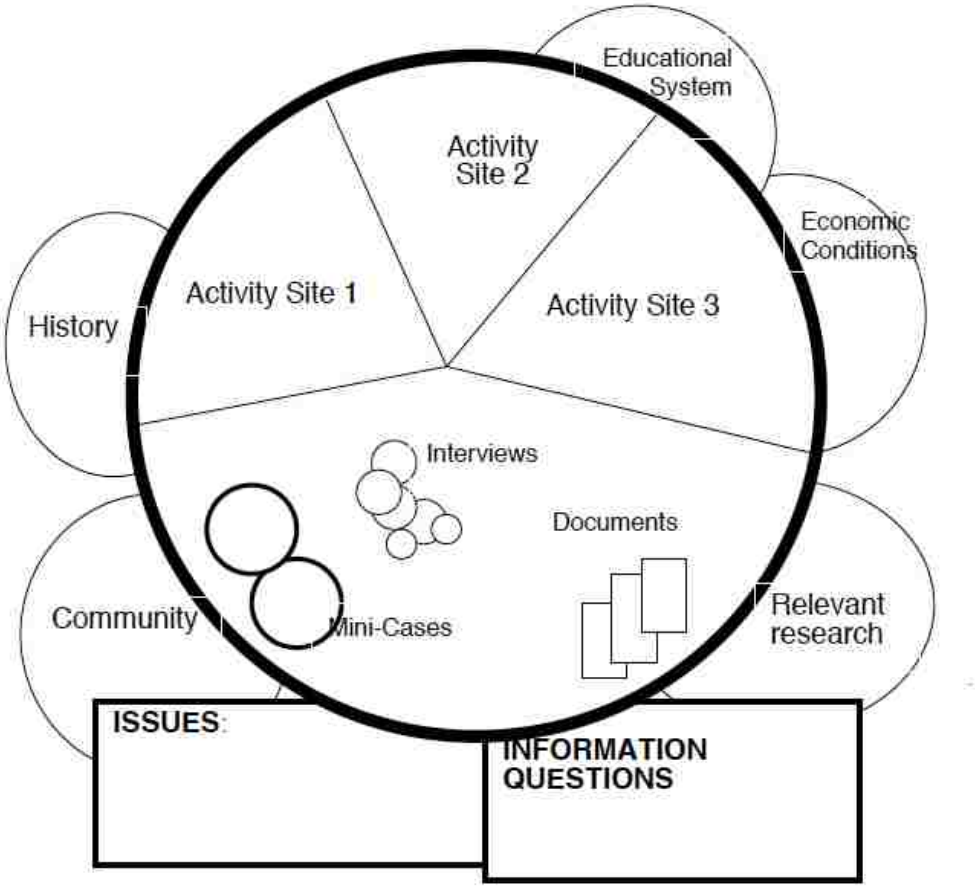

Figure 4: Stake's Graphic Design of a Case Study. From Multiple Case Study Analysis (p.5), by R.E. Stake, 2006, New York: The Guilford Press. Copyright 2006 by The Guilford Press. Reprinted with permission.

To aggregate the themes that were supported by the analysis of each case and identify where a correspondence or consistency of conditions existed within the study, Stake's (2006) worksheet entitled "Estimates of Ordinariness of the Situation of Each Case and Estimates of Manifestation of Multicase Themes in Each Case" was used (Figure 5).

Figure 5. Stake's Worksheet for Aggregating Themes

Estimates of Ordinariness of the Situation of Each Case and Estimates of Manifestation of Multicase Themes in Each Case

W = highly unusual situation, u = somewhat unusual situation, blank = ordinary situation
M = high manifestation, m = some manifestation, blank = almost no manifestation

	Case A	Case B	Case C	Case D	Case E
Ordinariness of this Case's situation:					
Original Multicase Themes					
Theme 1					
Theme 2					
Theme 3					
Theme 4					
Theme 5					
Theme 6					
Added Multicase Themes					
Theme 7					
Theme 8					

Figure 5. Stake's worksheet for 'Estimates of Ordinariness of the Situation of Each Case and Estimates of Manifestation of Multicase Themes in Each Case" retrieved from https://www.guilford.com/add/forms/stake.pdf. from R.E. Stake, Multiple case study analysis, 2006, New York: The Guilford Press. Copyright 2006. Reprinted with permission Guilford Press.

The original worksheet was downloaded from https://www.guilford.com/add/forms/stake.pdf. The worksheet is a table that contains multiple columns. In the first column, original and added case themes are listed. The remaining columns represent each of the cases for the study. A coding system included with the worksheet serves as a reference for evaluating the uniqueness and prominence of each theme for each of the cases. The sheet provides an analysis tool for aggregating the data from the individual cases to identify the prominence of themes and support

the findings for the study. A footnote included in a similar table published in the work of Stake (2006) indicated,

> High manifestation means that the theme is prominent in this particular case study. A highly unusual situation (far from ordinary) is one that is expected to challenge the generality of themes. As indicated, the original themes can be augmented by additional themes. (p. 47).

Stake (2006) further noted that, "The paragraphs on each theme should be attached to the matrix so that the basis for estimates can be readily examined" (p. 47).

Description of Analysis

In this multicase study, Stake's Graphic Design of a Case Study was used to construct a visual representation of the internal and external components relevant to the case for each school site included in the study (Figure 6). Pictured as internal components of each case are demographics collected on each formal and informal leader, interviews, documentation of meetings, and evidence or artifacts. Pictured as external components of each case are training information, school demographics, relevant research, 2016 school accountability results and 2017 school accountability results. Listed in the boxes below the main case circle are the data resources and tools identified at each site and the list of areas of focus used to guide questioning.

Figure 6. Stake's Graphic Design for a Case Study

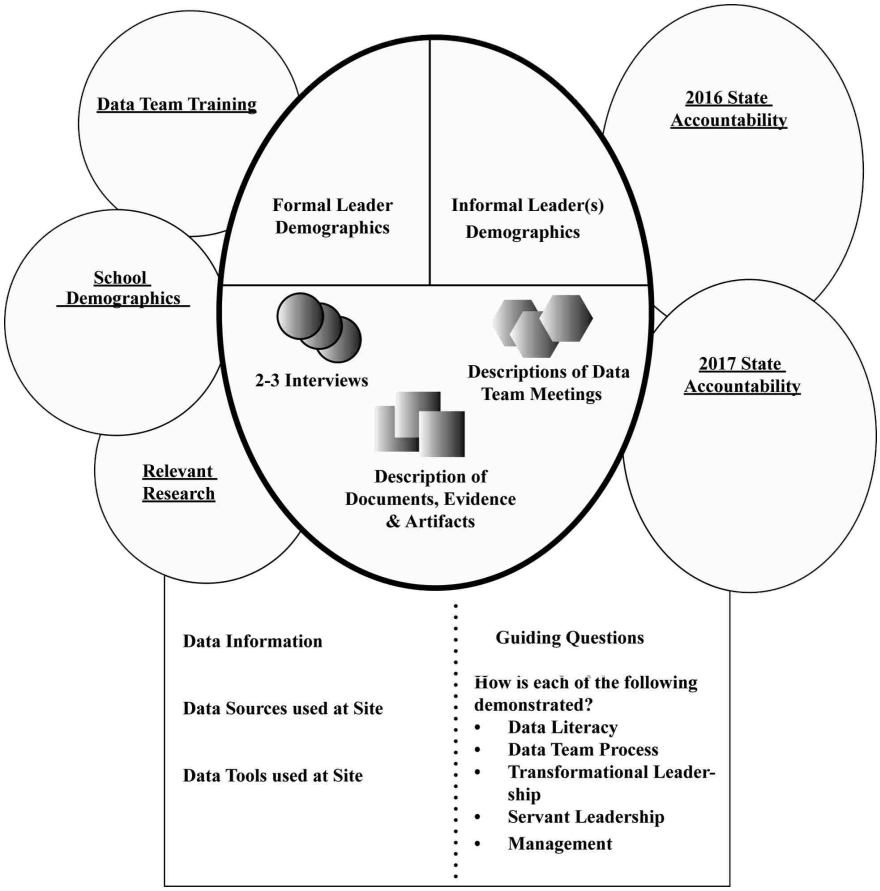

Figure *6.* Data Literacy and Data Teams Case Study. From *Multiple Case Study Analysis* (p. 5), by R.E. Stake, 2006, New York: The Guilford Press. Copyright 2006 by The Guilford Press. Adapted with permission.

The qualitative data for this study were collected through interviews with formal and informal leaders at each site and documents available online through the Wyoming Department of Education, and School District Websites. This study was guided by a central question: How do leaders influence the Data Team? To answer the central question there were seven subquestions:

1. How do leaders initiate discussions about data that create a catalyst for meaningful action?

2. How do leaders determine the data used to support the work of the Data Team?
3. How do leaders utilize analytical skills to support the work of Data Teams?
4. How do leaders build others' capacity to use data effectively?
5. How do leaders supervise the Data Teams Process?
6. How do leaders determine the success of a Data Team?
7. Why do Data Teams need to have the support of leaders?

Identifying categories and themes. To answer each of these questions and understand each case in depth, the methodology presented by Stake (2006) was used. To create a visual representation of each case, information was first compiled using Stake's (2006) case-study worksheet format. The information contained in the worksheet was used as a visual reference for analyzing the descriptions of leadership practices, leaders' data literacy, as well as the Data Teams Process, tools, evidence, and artifacts associated with each case. To begin the research process, participant interviews were transcribed and coded. The computer-based coding program, NVivo, was used to code each interview transcription, and to record annotations and research memos. Documents were first coded to identify categories of information identified a priori. There were six categories and multiple subcategories identified. The first category, School and Leaders, contained two subcategories: (a) School Demographics and Team Meetings, and (b) Leader's Demographics and Training. The category, Components of Data Literacy, included five subcategories that represented the components and subcomponents of data literacy presented by Mandinach and Gummer (2016a). Subcategories included (a) Identify Problems and Frame Questions, (b) Use Data, (c) Transform Data Into Information, (d) Transform Information Into Decision and (e) Evaluate Outcomes. The category, Leadership and Management, described leadership style and included three subcategories: (a) Transformational

Leadership, (b) Servant Leadership, and (c) Management. The Category, Evidence and Artifacts, described the items that were produced and collected by leaders to demonstrate the work and success of the Data Team. The last category, Data Teams Process, included six subcategories: (a) Collect and Chart Data, (b) Analyze Data and Prioritize Needs, (c) Establish SMART Goals, (d) Select Instructional Strategies, (e) Determine Results Indicators, and (f) Monitor and Evaluate Results. The first five categories were used to describe the five sections of findings for each case. The findings for the last category, Data Teams Process, are included in the Multiple Case Analysis for this chapter.

To complete the multiple case analysis for the study, coding queries were completed for all case documents. The results of the queries were used to compile the evidence for each category and its subcategories. The summarized evidence produced the findings for each category in each case. As findings were aggregated, themes for each category emerged. When findings were compared across categories inside and outside the case, cross-category themes emerged for each case. Once all cases were completed, themes from the individual cases were recorded using Stake's worksheet for "Estimates of Ordinariness of the Situation of Each Case and Estimates of Manifestation of Multicase Themes in Each Case" (Guilford Press, n.d.). The worksheet was used to identify the dominant themes in the study as well as supporting quotes from interview transcriptions. The themes identified were used to answer the subquestions of this study, and ultimately the Central Research Question for this study.

Mental Model Case 1

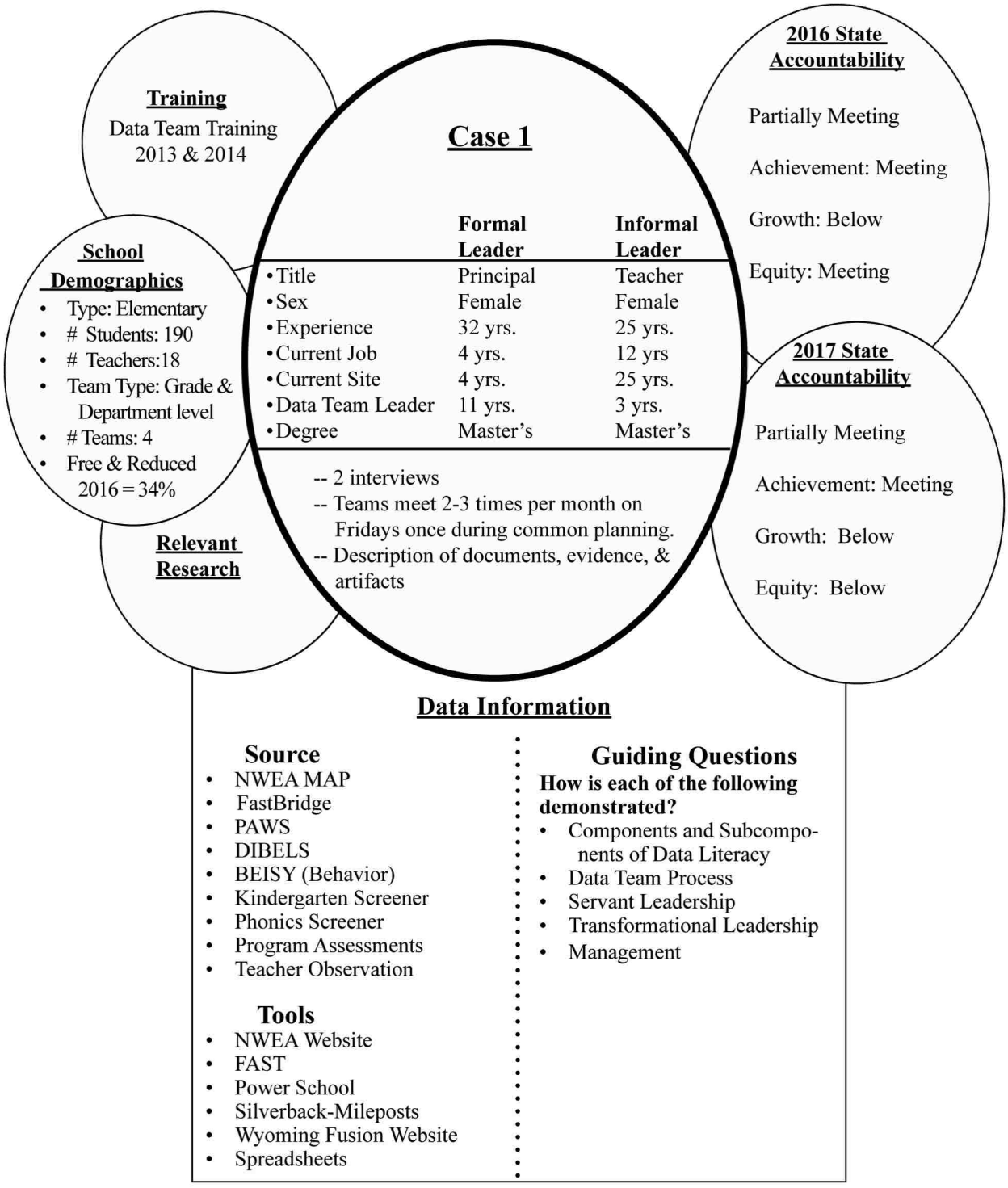

Figure 7. Case diagram for Case 1 for the 2016-2017 school year. School accountability results (Wyoming Department of Education, n.d.) are provided for 2015-2016 and 2016-2017 school year to provide evidence of growth.

School and leaders. Case 1 begins with the description of the findings for the section, School and Leaders. The section contains two subsections. The first subsection describes school demographics and team meetings. The second subsection describes leader demographics and training. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

School demographics and team meetings. Case number one was an elementary school that served approximately 190 students in kindergarten through second grade. Thirty-four percent of the students in the school qualified for free or reduced lunch in 2016. In this school, there were 18 certified teachers serving on four separate grade-level teams. There were three grade-level teams and one team for fine and performing arts. A district schedule provided teams the opportunity to meet together twice a month every other week during a Friday afternoon. An additional Friday was available for team meetings for team members who did not serve on district teams. Most teams also met during a common planning time each week. During the 2015-2016 school year, the school was found to be partially meeting requirements under the Wyoming accountability model. During 2016-2017 the school again was rated as partially meeting state accountability requirements. Descriptions of the Data Teams Process used at the site, contained inside the case, were gathered from interviews of one formal leader and one informal leader.

Leader demographics and training. The formal leader for this case was the school principal who held a bachelor's degree in elementary education with a master's degree in administration with endorsements in special education and K-12 reading. Prior to serving as the school principal, she worked as a special education teacher and instructional facilitator. She noted that she had limited training to support her use of data. She had one statistics class that

was part of her master's program. She also participated in a one-day training presented by representatives from the Wyoming Department of Education on how to read the various indicators associated with PAWS data. Additionally, she participated in several trainings provided by the district over multiple years to support her understanding of PLCs and the Data Teams Process. She received district training on the Data Teams Process during the 2013-2014 and 2014 -2015 school years, as well as multiple district trainings on the PLC process earlier in her career.

The informal leader was an elementary teacher who held a bachelor's degree in elementary education with a master's degree in technology. She was a grade-level team leader at the school. Her formal data training was limited to one research methods class in her bachelor's program. She participated in the district training on the Data Teams Process presented during the 2013-2014 school year.

Themes for school and leaders. The findings for the subsections were analyzed to identify the themes for the category, School and Leaders. There were four themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Components of data literacy. Findings for how leaders use the six components of data literacy are presented next. Findings for each subsection describe the subcomponents of each of the components of the Data Literacy Conceptual Framework. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Identify Problems/Frame Questions. The interview documentation was analyzed to identify information that described the data literacy component, Identify Problems/Frame Questions. Each of the four subcomponents for the component was represented in the interview data of the formal and informal leader. The four subcomponents included (a) Articulate and Communicate the Problem/Question, (b) Involve Other Participants, (c) Understand Contextual Issues, and (d) Understand Student Privacy.

Findings for the case used to support the existence of the component, Identify Problems/Frame Questions, were identified in actions described by leaders. Interview transcriptions revealed that to articulate and communicate the problem or question, leaders and their teams first examined baseline-testing data. The use of percentile results was used to identify student deficits and develop intervention groups. The participants involved by leaders included district instructional facilitators, parents, and students. The contextual issues that were examined and considered in decision making were student behavior, evidence of testing apathy, and deficits associated with incoming preschool skills. There was an understanding that student data were to be kept private and were only to be shared with people directly involved with each child. However, there was no known formal system that held staff accountable for student privacy.

Use Data. The Interview documentation was next analyzed to identify the data literacy component, Use Data. Each of the six subcomponents of the Use Data component was represented in the interview data of the formal and informal leader. The six subcomponents included (a) Identify Possible Sources of Data, (b) Understand How to Generate Data, (c) Understand Data Properties, (d) Understand Data Quality, (e) Understand How to Access Data, and (f) Understand How to Analyze Data

Findings for the case used to support the existence of the component, Use Data, were identified in actions described by the formal and informal leader. Interview transcriptions from the case showed that leaders described multiple sources of data that were used at the site. Data sources identified included, Brief Externalizing and Internalizing Screener for Youth (BEISY) Diagnostic Indicators of Basic Early Literacy Skills (DIBELS), FastBridge Learning (FAST), PAWS, Northwest Education Association Measures of Academic Progress (NWEA MAP), phonics screener, kindergarten screener, teacher observation data, and teacher created assessments. Leader and team use of observation data and teacher created assessments demonstrated the leaders' understanding of the need to generate formative data to guide the decision-making process. The two leaders noted that assessments needed to represent the standards and measure students' identified needs. The leaders' observation demonstrated an understanding of data properties. When describing data quality, the leaders articulated a need for the results of smaller assessments to be predictive of the results on bigger assessments. Included in this description was the need for an alignment between observed performance and assessment results. The leaders tied quality of data to the quality of assessment questions and an appropriate measure of the standard. The leaders understood how to access data results. The data used by teams was retrieved from PowerSchool, NWEA website, FAST website, Silverback-Milepost website, Wyoming Education Fusion website, and spreadsheets. Additionally, the data produced from locally developed assessments was documented and accessible in student portfolios. When the leaders discussed analyzing the data, they first described looking at data from the larger district and state assessments. The leaders noted that when examining the results from these assessments, teams primarily looked at the overall results generated for the school or a particular grade-level. To analyze the data, the leaders and their teams most often used percentage or

percentile scores. While the formal leader described disaggregating results of summative assessments to review scores for the subgroups socio-economic status and gender, she noted her findings were rarely discussed with staff. When results of universal screeners were analyzed, the data were disaggregated to identify specific skill deficits for groups of students. The informal leader noted that teams compared student scores to normed scores to set growth goals. The leaders also noted that teams used data as a starting point for determining the root cause of skill deficits so that appropriate remediation could be implemented.

Transform Data Into Information. Interview documentation was next analyzed to identify evidence of the data literacy component, Transform Data Into Information. Each of the four subcomponents of the component was represented in the interview data of the formal and informal leader. The four subcomponents included (a) Consider Impact and Consequences (Intended and Unintended), (b) Generate Hypotheses, (c) Test Assumptions, and (d) Understand How to Interpret Data.

Findings for the case used to support the existence of the component Transform Data Into Information, were identified in actions described by leaders. Interview transcriptions revealed that teams reviewed research and participated in book studies led by the principal to identify the strategies and programs that would have the greatest impact for addressing student growth. The formal leader considered the impact that staff buy-in and lack of consistency had on results. Failure to reach the moving targets set by the state was a consequence recognized by the leader. Hypotheses regarding the extent of student learning and instructional needs were generated through discussions facilitated during the Data Team meeting. Leaders and their teams considered how student needs differed and used that reasoning to support their thinking about the proposed impact of interventions. Leaders hypothesized that just being aware of a deficit could

change the frequency of a teacher's use of remediation, which in turn would impact learning. To test assumptions about data results or effectiveness of strategies, leaders and their teams used data to identify student skill deficits. An intervention was then implemented and the skill retested to determine the intervention's effectiveness. Leaders recognized that by intervening on one need at a time, the impact that each intervention had on the data could be easily observed to determine if assumptions were correct. Leaders shared assessment and intervention results. The principal interpreted and shared the building level results with staff and the school improvement team. Descriptions were limited to overall percentile scores in relation to the state targets. Informal leaders and other teachers interpreted and shared individual student results with students and their parents. When interpreting and sharing results, leaders utilized charts and graphs.

Transform Information Into Decision. Interview documentation was analyzed next to identify evidence of the data literacy component, Transform Information Into Decision. The two subcomponents of this component were represented in the interview data of the formal and informal leader. The two subcomponents included (a) Determine Next Instructional Steps, and (b) Understand Context for the Decision.

Findings for the case used to support the existence of the component, Transform Information Into Decision, were identified in actions described by leaders. Interview transcriptions for the case revealed that leaders and their teams determined next steps by looking at the data every two weeks to see if interventions were working. Team discussions led to decisions about (a) which skills should be remediated, (b) what interventions were available, (c) what needed to continue or change, and (d) placement of students in skill groups. The need to

understand the expected outcomes was required for the process. The context for decisions was tied to the school improvement goals, team goals, and curriculum standards.

Evaluate Outcomes. Interview documentation was analyzed to identify evidence of the data literacy component, Evaluate Outcomes. Only one subcomponent, Consider Need for Iterative Decision Cycles, was represented in the interview data of the formal and informal leader.

Findings for the case used to support the existence of the component, Evaluate Outcomes, were identified in actions described by the formal and informal leader. The Leaders' descriptions of Data Team meetings revealed the iterative process that was implemented at the site. The Data Teams Process described by leaders included reviewing data every two weeks to identify the problem, identifying a strategy to address the problem, implementing the intervention, reassessing the identified skill deficit, reviewing the data for evidence of growth, determining next steps, and repeating the cycle.

Themes for components of data literacy. The findings for the subsections were analyzed to identify the themes for the category, Components of Data Literacy. There were six themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Leadership and management. In Case 1, the support of formal and informal leaders was identified as being necessary to ensure that teams engaged in the Data Teams Process. Leaders posited that without their support, student academic growth would be minimal. To provide support, leaders engaged in actions associated with the behaviors of management, transformational leadership, or servant leadership. The themes that emerged from the cross

category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Actions of management. The formal and informal leader in Case 1 engaged in management tasks. Leaders supervised the work of teams to ensure that required testing was being completed. Leaders also reviewed agenda notes for each of the team meetings.

Actions of transformational leadership. The formal leader in Case 1 engaged in behaviors that reflected transformational leadership. She understood the school goals and what teams needed to strive for to achieve the goals. To meet goals, she worked with team members to identify changes that were needed in classrooms, grade-levels, and the building. Comments by the informal leader indicated that staff respected and revered the reading literacy expertise of the formal leader. Also, staff valued those things that the formal leader declared as important and mirrored those things in their own beliefs and actions.

Actions of servant leadership. The formal and informal leader demonstrated actions of servant leadership. The formal leader provided support to teams by attending team meetings, providing information about how to look at and interpret the data, and providing instructional tips that were non-evaluative. The informal leader provided leadership by providing encouragement to members, providing research for the team, and seeking assistance for the team and its individual members

Themes for leadership and management. The findings for the section were analyzed to identify the themes for the category, Leadership and Management. There were three themes that emerged from the analysis of information. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Evidence and artifacts. The leaders provided descriptions of the evidence and artifacts that were collected to determine the success of Data Teams. There were several artifacts described. Artifacts included assessment results and graphs from state tests and commercial assessment sites. Also included were color-coded spreadsheets that were maintained by the principal as well as meeting agendas and notes. Additionally, charts created by students of their own growth were described. Leaders noted that students showed growth "on little pieces." They also, noted that interventions for phonemic awareness were no longer needed due to intervention measures implemented by the teams.

Themes for evidence and artifacts. The findings for the section were analyzed to identify the themes for the category, Evidence and Artifacts. There were three themes that emerged from the analysis of information. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Cross-category themes for Case 1. The findings for the case were analyzed to identify the cross-category themes. When information was compared across the categories inside and outside the case, two themes emerged for Case 1. The themes that emerged from the cross-category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Mental Model Case 2

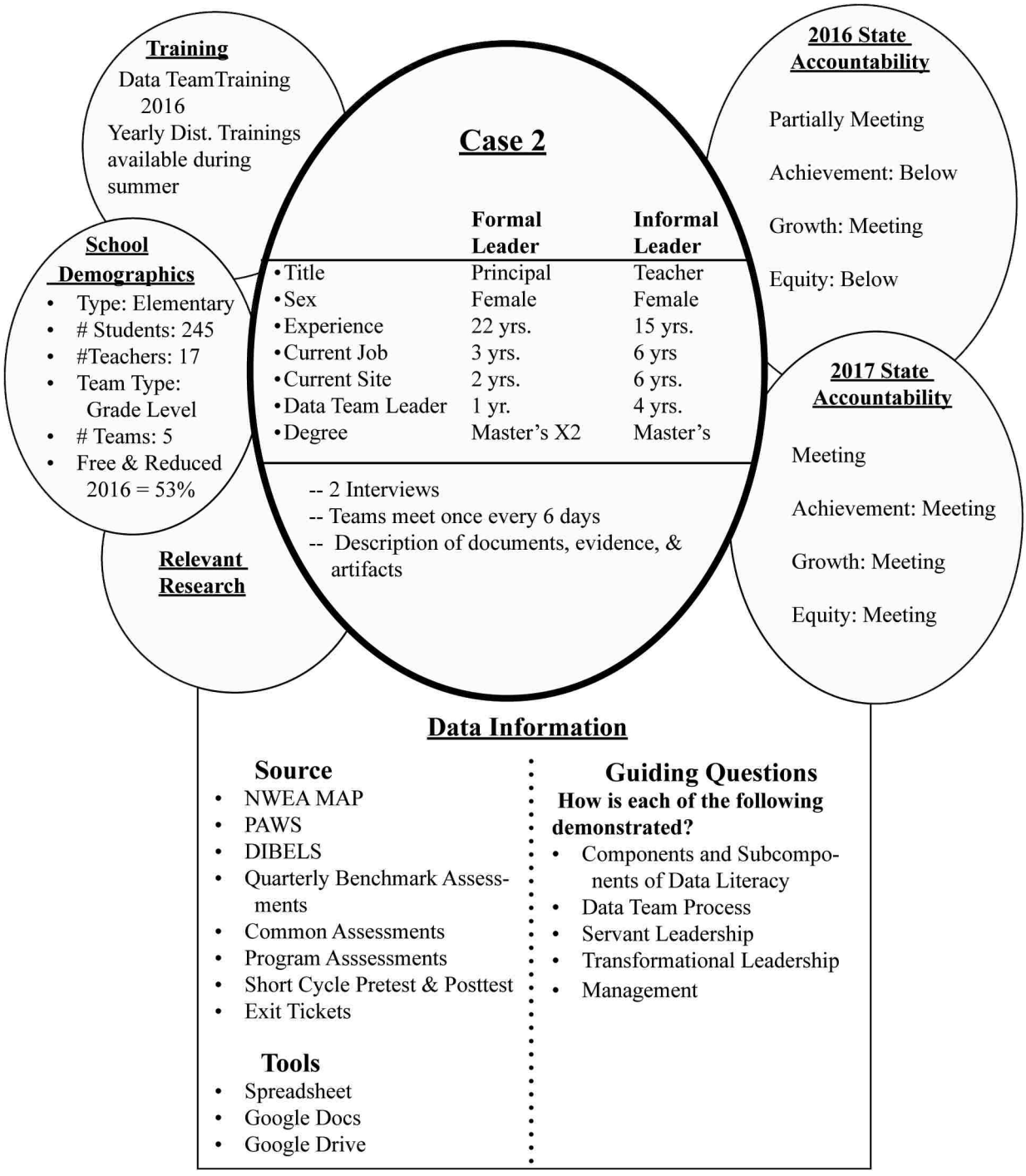

Figure 8. Case diagram for Case 2 for the 2016-2017 school year. School accountability results (Wyoming Department of Education, n.d.) are provided for 2015-2016 and 2016-2017 school year to provide evidence of growth.

School and leaders. Case 2 begins with the description of the findings for the section, School and Leaders. The section contains two subsections. The first subsection describes school demographics and team meetings. The second subsection describes leader demographics and training. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

School demographics and accountability. Case number two was an elementary school that served approximately 245 students in kindergarten through fourth grade. Fifty-three percent of the students in the school qualified for free or reduced lunch in 2016. In this school, there were 17 certified teachers serving on five separate grade-level Data Teams. A district schedule provided the opportunity for teams to meet once every six days. During the 2015-2016 school year, the school was found to be partially meeting expectations under the Wyoming accountability model. During the 2016-2017 school year, the school improved its state accountability score to "meeting expectations." Descriptions of the Data Teams Process used at the site that appear inside the case were gathered from interviews of one formal leader and one informal leader.

Leader demographics and training. The formal leader for this case was the school principal who held a bachelor's degree in communication sciences and disorder. She also held a master's degree in speech therapy, as well as a master's degree in educational leadership and supervision. Her formal data training consisted of one statistics class in college. She noted that her speech therapy background had provided her with considerable experience in interpreting data. She also received district training on how to analyze DIBELS data as well as training on the Data Teams Process in 2016-2017.

The informal leader was an elementary teacher who held a bachelor's degree in elementary education with a master's degree in reading and literacy. She also held an endorsement for teaching middle school. Her formal data training was limited to one statistics class in quantitative and qualitative data. She noted that the school had provided her with training on using data prior to 2016. During the 2016-2017 school year, she participated in two, two-hour district training sessions on the Data Teams Process.

Themes for school and leaders. The findings for the subsections were analyzed to identify the themes for the category, School and Leaders. There were four themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Components of data literacy. Findings for how leaders use the six components of data literacy are presented next. Findings for each subsection describe the subcomponents of each of the components of the Data Literacy Conceptual Framework. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Identify Problems/Frame Questions. Interviews were analyzed to identify information that described the data literacy component, Identify Problems/Frame Questions. Each of the four subcomponents of this component was represented in the interview data of the formal and informal leader. The four subcomponents included (a) Articulate and Communicate the Problem/Question, (b) Involve Other Participants, (c) Understand Contextual Issues, and (d) Understand Student Privacy.

Findings for the case used to support the existence of the component, Identify Problems/Frame Questions, were identified in actions described by the leaders. Interview

transcriptions revealed that to articulate and communicate the problem or question, the data that had been collected would be discussed by leaders and their teams. The data were then measured against the requirements set in the curriculum and the content standards to prioritize needs and identify the problem. The participants involved by the leaders included students, parents, school board, and community. The contextual issues that were examined and considered in decision making were those for which a change could be made or a solution provided. Solutions considered included parent meetings, homework help, and counseling or intervention support. There was an understanding that when discussing or presenting student data, information was to be kept confidential and only shared with those that had a need to know. Data shared through digital documents was protected by practices noted in the district technology policy.

Use Data. The Interview documentation was then analyzed to identify the data literacy component, Use Data. Each of the six subcomponents of the Use Data component was represented in the interview data of the formal and informal leader. The six subcomponents included (a) Identify Possible Sources of Data, (b) Understand How to Generate Data, (c) Understand Data Properties, (d) Understand Data Quality, (e) Understand How to Access Data, and (f) Understand How to Analyze Data.

Findings for the case used to support the existence of the component, Use Data, were identified in actions described by the leaders. Interview transcriptions showed that leaders described multiple sources of data that were used at the site. Data sources included NWEA MAP, PAWS, DIBELS, quarterly benchmark assessments, common assessments, program assessments, teacher-generated short-cycle pretests and posttests, and exit tickets. The formal and informal leaders' understanding of how to generate data also was observed in their descriptions of the use of short-cycle pretests and posttests. The leaders' understanding of how

to generate data was also observed in their descriptions of the use of short-cycle assessments, exit tickets, pretests, posttests, and use of skill specific questions. Assessments were expected to measure the intended target. Assessments were examined against curriculum maps, grades, and yearly pacing to determine relevance and reliability. The quality of data was determined through examination and discussion. Conversations were primarily qualitative and did not dwell on statistics. The formal leader understood how to access data results. She retrieved data from online sites to compile information from all standardized and district-wide assessments using a spreadsheet which she color-coded and shared with teams. The informal leader and her team accessed data from a Google team drive. Each member of the team recorded scores for short-cycle assessments on the Data Teams form provided by the district. The Google doc. was stored and accessible on the Google team drive. The information recorded was color-coded, analyzed, and discussed at team meetings. When data were analyzed, the leaders compared scores between grades and classes. Scores were also disaggregated to examine results for the EL and SPED subgroups. To analyze data the leaders and their teams engaged in discussions throughout the short-cycle process. The informal leader and her teams used discussions to compare data between members' classrooms. Results were measured against standards which were embedded in curriculum maps developed by district teams. Results were also examined for effectiveness of the strategies utilized during the short-cycle. When assessment scores indicated that a particular student was not showing progress and needed additional services, information was forwarded to a second intervention team for review and recommendations. All tracking sheets used by teams were submitted to the formal leader at the end of each month for review of team, class, and student academic growth.

Transform Data Into Information. Interview documentation was analyzed next to identify evidence of the data literacy component, Transform Data Into Information. Each of the four subcomponents of this component was represented in the interview data of the formal and informal leader. The four subcomponents included (a) Consider Impact and Consequences (Intended and Unintended), (b) Generate Hypotheses, (c) Test Assumptions, and (d) Understand How to Interpret Data.

Findings for the case used to support the existence of the component, Transform Data Into Information, were identified in actions described by the leaders. Interview transcriptions for the case revealed that leaders considered the impact of using scores that described student or group proficiency in a specific content standard or skill more relevant than the use of scores that provided a proficiency level for a particular content area. The impact and consequences for using incomplete data sets or mean scores over indicators for student mastery of skills when reviewing short-cycle assessments was also considered. When teams examined data they used percentile scores to identify student groups as being at below basic, basic, or proficient. The leaders and their teams generated a hypothesis about the number of students that could be moved to the next proficiency level by the end of the cycle. Included in the hypothesis was a description of the strategy that would be used to foster the academic growth. The decisions were then recorded as a SMART goal. To test assumptions, strategies were implemented before students were retested. Conversations and a comparison of data results between team members were also used to examine differences in the implementation of a strategy and test assumptions about its effectiveness. To interpret data for others, the leaders used Excel graphs or PowerPoint presentations. Communication regarding data results occurred during parent meetings, in parent involvement activities, and through Facebook.

Transform Information Into Decision. Interview documentation was analyzed next to identify evidence of the data literacy component, Transform Information Into Decision. The two subcomponents of this component were represented in the interview data of the formal and informal leader. The two subcomponents included (a) Determine Next Instructional Steps, and (b) Understand Context for the Decision

Findings for the case used to support the existence of the component, Transform Information Into Decision, were identified in actions described by the leaders. Interview transcriptions for the case revealed that leaders and their teams determined next steps by examining results indicators, establishing instructional groups, and utilizing selected instructional strategies. The leaders worked with various levels of teams in the school to establish groups or identify students needing homework help. Grade-level teams established skill groups to address grade-level content needs. School level teams that included instructional specialists from Title I, Special Education, and English Learners, used data to determine which tier of support each student needed, and then developed strategy groups to support student learning at each level. To ensure that strategies with the highest possible impact were used, the leaders and their teams reflected on the work of Hattie (2009). The effect sizes for the strategies included in Hattie's work supported teams in predicting student growth during a short-cycle. The reflection also allowed leaders and their individual team members to reflect on potential implementation concerns and potential growth for each group of students. The leaders and teams considered district curriculum maps and content standards when planning what students and teachers would be expected to do during instruction. Teams' decisions were also influenced by expectations set in the professional development plans, school level goals, and state accountability requirements.

Evaluate Outcomes. Interview documentation was analyzed to identify evidence of the data literacy component, Evaluate Outcomes. The two subcomponents were represented in the interview data of the formal and informal leader. The subcomponents included (a) Consider Need for Iterative Decision Cycles and (b) Re-examine Original Question or Problem.

Findings for the case used to support the existence of the component, Evaluate Outcomes, were identified in actions described by the leaders. The leaders' descriptions of Data Team meetings revealed the iterative process that was implemented at the site. The Data Teams Process described included meeting every seven days to (1) collect and record data, (2) analyze data, look at curriculum and standards, and identify the problem, (3) set a short-cycle goal, (4) identify strategies, (5) discuss results, or (6) evaluate and set next steps. The process allowed teams to continuously use data results to (a) guide instructional decisions, (b) discuss and evaluate the impact of instruction, (c) re-examine the original question, (d) and make instructional adjustments. The discussions that occurred throughout the process between the leaders and their teams were carried out without any "finger-pointing" to evaluate or judge the quality of others teaching.

Themes for Components of data literacy. The findings for the subsections were analyzed to identify the themes for the category, Components of Data Literacy. There were five themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Leadership and management.

In Case 2, the support of formal and informal leaders was identified as being necessary to ensure that teams engaged effectively in the Data Teams Process. The leaders in Case 2 noted that

teams needed someone who was knowledgeable of the Data Teams Process to guide members and direct the conversation. Without the support of leaders, team members could become complacent in their practice and teams might disband. To provide support, leaders engaged in actions associated with the behaviors of management, transformational leadership, or servant leadership. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Actions of management. The formal and informal leader in Case 2 engaged in management tasks. Tasks of the formal leader included making sure that there was alignment between curriculum and pacing, monitoring team discussions, assessing student data, and tracking student progress. She was described as encouraging and no-nonsense. She did not accept excuses and simply expected the job to be done. Tasks of the informal leader included organizing material by providing reminders, ensuring that meeting data were submitted, and ensuring that assigned tasks were completed. The informal leader also facilitated the meeting to keep it on track.

Actions of transformational leadership. The formal and informal leaders in Case 2 engaged in behaviors that reflected transformational leadership. The formal leader was transformational in her ability to inspire others to engage in the work of Data Teams. She helped to establish goals at the school level that team members were inspired to reach. She guided the vision of the school by engaging staff in trainings that supported the goals. The informal leader demonstrated transformational leadership by making her classroom available to other teams to observe. She described serving as a model to guide others in establishing team practices that supported student growth and the Data Teams Process.

Actions of servant leadership. The formal and informal leader demonstrated actions of servant leadership. The leaders in Case 2 focused on helping others see the importance of their work and to celebrate their success. The formal leader worked side by side with staff and supported them in their work. She sought to secure the things they needed to reach their goals. She secured a school improvement grant that provided additional training and support for the Data Teams Process and wrote a grant that helped her staff build a hydroponic garden. Another grant was written to support the integration of STEAM activities into the curriculum.

Themes for leadership and management. The findings for the section were analyzed to identify the themes for the category, Leadership and Management. Three themes emerged from the analysis of information. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Evidence and artifacts. The leaders provided descriptions of the evidence and artifacts that were collected to determine the success of Data Teams. There were various artifacts described. The formal leader created a color-coded spreadsheet that contained multiple data sources for all students. A record of those students that struggled was kept by the formal leader and passed to the next grade-level the following year. The leaders and their teams kept agendas and notes, as well as their Data Teams form, in the team's Google drive. The Data Teams form was used to track short-cycle results indicators as well as team short-cycle goals. The team goals described the number of students that team members believed could be moved to the next proficiency level by the end of the cycle. The form held longitudinal data that was updated at each meeting. In addition to the form, the leaders and their teams also kept lists that contained the names of students assigned to each group. Lists contained the number of instructional minutes each group received, as well as the standard that was assessed, and the pretest and

posttest scores. The leaders and their team also kept a lesson plan, described as an IPR, that was used to record effective lessons. The plan described how the lesson was taught and what went well in the lesson.

Themes for evidence and artifacts. The findings for the section were analyzed to identify the themes for the category, Evidence and Artifacts. There were five themes that emerged from the analysis of data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Cross category-themes for Case 2. The findings for the case were analyzed to identify the cross category themes. When information was compared across the categories inside and outside the case, two themes emerged for Case 2. The themes that emerged from the cross-category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Mental Model Case 3

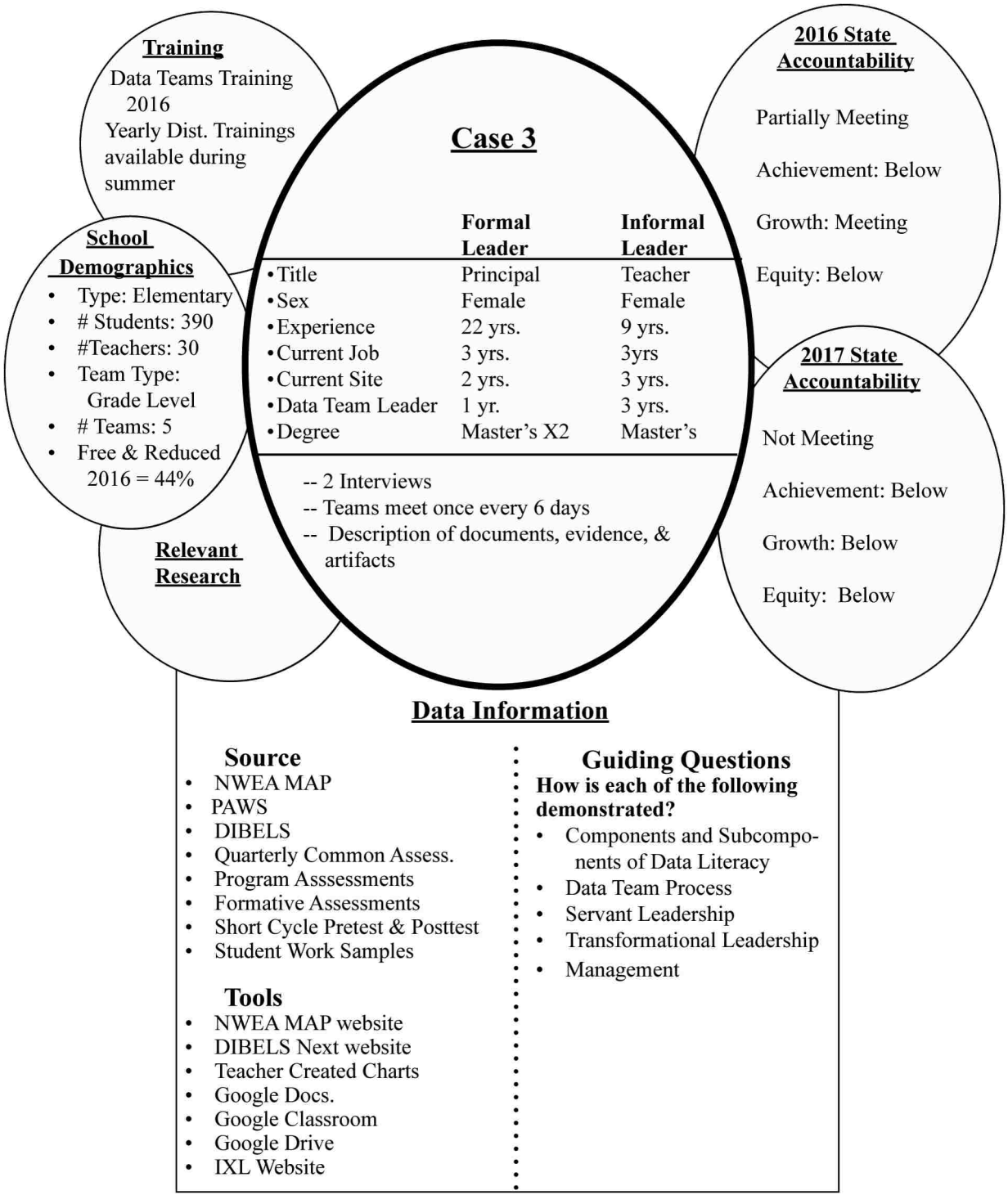

Figure 9. Case diagram for Case 3 for the 2016-2017 school year. School accountability results (Wyoming Department of Education, n.d.) are provided for 2015-2016 and 2016-2017 school year to provide evidence of growth.

School and leaders. Case 3 begins with the description of the findings for the section, School and Leaders. The section contains two subsections. The first subsection describes school demographics and team meetings. The second subsection describes leader demographics and training. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

School demographics and accountability. The third case was an elementary school that served approximately 390 students in kindergarten through fourth grade. Over forty-four percent of the students in the school qualified for free or reduced lunch in 2016. In this school, there were 30 certified teachers serving on five separate grade-level teams. A district schedule provided the opportunity for teams to meet once every six days. During the 2015-2016 school year, the school was found to be partially meeting expectations under the Wyoming accountability model. During the 2016-2017 school year, the school's state accountability rating dropped to not meeting expectations. Descriptions of the Data Teams Process used at the site that appear inside the case were gathered from interviews of one formal leader and one informal leader.

Leader demographics and training. The formal leader for this case was the school principal. She held a master's degree in elementary education, as well as a master's degree in administration and innovation K-12. Her formal data training consisted of one class taken during her master's that covered research and statistics. As an administrator in her district, she received one full day of Data Team training presented during the fall of 2016. She also participated in the Data Team training provided to the school's PLC groups in the spring of 2016.

The informal leader was an elementary teacher who held a bachelor's degree in history and social studies. She also held a master's degree in education. She was endorsed to teach

elementary K-6. She also held an endorsement as a K-12 library media specialist. She did not have any formal data training. She did, however, participate in Data Team training that was provided by the district during the 2015-2016 school year.

Themes for school and leaders. The findings for the subsections were analyzed to identify the themes for the category, School and Leaders. There were four themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Components of data literacy. Findings for how leaders use the six components of data literacy are presented next. Findings for each subsection describe the subcomponents of each of the components of the Data Literacy Conceptual Framework. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Identify problems/frame questions. The interview documentation was analyzed to identify information that described the data literacy component, Identify Problems/Frame Questions. Each of the four subcomponents of this component was represented in the interview data of the formal and informal leader. The four subcomponents included (a) Articulate and Communicate the Problem/Question, (b) Involve Other Participants, (c) Understand Contextual Issues, and (d) Understand Student Privacy.

Findings for the case used to support the existence of the component, Identify Problems/Frame Questions, were identified in actions described by formal and informal leaders. Interview transcriptions revealed that to articulate and communicate the problem or question, the leaders and their teams discussed the data collected. Assessment results were measured against standards and the school improvement plan to determine any instructional adjustments that were

needed. To guide the discussion, the leaders used the four questions of a PLC described by DuFour, DuFour, Eaker, (2008):

1. What is it we want our students to learn…?
2. How will we know if each student is learning…?
3. How will we respond if some of our students do not learn…?
4. How will we enrich and extend the learning for students who are already proficient? (pp. 183-184)

Other participants with whom results and goals were shared included parents, PTO members, students, Title I teachers, school behaviorist, school psychologist, and school counselor. While the leaders acknowledged the contextual issues that were associated with English Learner (EL), Special Education (SPED), poverty, single parent, or transient families, they worked to address only those issues over which they had control. The leaders supported their teams in keeping data confidential. Information was shared between members using team Google drives. Only those that worked directly with the child had access to the information. When names were needed on documents, only first names and possibly a last initial were used. When team members were doing group grading, student papers were labeled with a random letter or number.

Use Data. The Interview documentation was analyzed next to identify the data literacy component, Use Data. Each of the six subcomponents of this component was represented in the interview data of the formal and informal leader. The six subcomponents included (a) Identify Possible Sources of Data, (b) Understand How to Generate Data, (c) Understand Data Properties, (d) Understand Data Quality, (e) Understand How to Access Data, and (f) Understand How to Analyze Data.

Findings for the case used to support the existence of the component, Use Data, were identified in the actions described by the formal and informal leader. Interview transcriptions for the case indicated that leaders described multiple sources of data that were used at the site. Data sources identified included NWEA MAP, PAWS, DIBELS, quarterly common assessments, program assessments, student work samples, formative assessments, and short-cycle pretests and posttests. The leaders' understanding of how to generate pretests for the short-cycle data review process showed an understanding of how to generate data. The leaders' understanding of how to generate data was also observed in their descriptions of the use of formative assessment. Formative assessment data included observations of student work from Kagan cooperative learning activities, projects, writing samples, and student written responses. Assessments were examined against curriculum maps and standards to determine relevance and reliability. The data extracted had to be an exact measure of the skill tested. With larger assessments, the leaders looked for state and national norms as well as score bands to examine student growth and make placement decisions. The quality of data was determined through examination and discussion. When examining results, the leaders wanted to ensure that the standard was measured in depth and across curricular areas and that test questions were presented in a way that allowed poor readers to demonstrate what they knew. Furthermore, the leaders judged the quality of the assessment by how results aligned with the skills or understanding that were to be measured. The leaders understood how to access data results. The data used by teams was retrieved from the NWEA website, DIBELS Next website, teacher created charts, Google Docs, Google classroom, IXL learning website, and the team's Google drive. To analyze data, the leaders and their teams engaged in discussions and made personal observations. Data were color-coded to indicate levels of proficiency. As the gap between student scores was generally large, the leaders

used the statistical mean to get a sense of where the average score should be. Leaders also used state and national norms as a gauge to judge where students should be scoring. Data reports were retrieved from websites and used to identify longitudinal trends. Data results were triangulated. Data from DIBELS was compared to MAP, and then to PAWS to examine the alignment of the results between the assessments. Analyzed results discussed by the team were recorded on the Data Team's form that was kept on the team's Google drive.

Transform Data Into Information. Interview documentation was next analyzed to identify evidence of the data literacy component, Transform Data Into Information. Each of the four subcomponents of the component was represented in the interview data of the formal and informal leader. The four subcomponents included (a) Consider Impact and Consequences (Intended and Unintended), (b) Generate Hypotheses, (c) Test Assumptions, and (d) Understand How to Interpret Data.

Findings for the case used to support the existence of the component, Transform Data Into Information, were identified in actions described by the leaders. Interview transcriptions for the case revealed that leaders considered impact and consequences when examining how assessments might fail to take into account student disabilities or language needs and thereby impact their ability to set appropriate instructional goals. To lessen the impact of these variables the leaders and their teams analyzed test questions to identify those that aligned with student skills and could be clearly understood. There was a need for formative assessments to be predictive of the scores produced for summative assessment scores. There was also a need to have students achieve grade-level goals by the end of the school year. To address time constraints, the leaders worked backwards, first to identify students' learning levels, and then to set incremental goals that would address student learning needs and build student proficiency

towards grade-level standards. When students demonstrated that they didn't understand something that had been taught, the leaders and their team discussed the problem and informally generated a hypothesis about the strategy or program that might address the observed need. To test assumptions about learning, team members implemented agreed upon strategies and interventions over several weeks and then retested students to measure their growth. To interpret the data, the leaders and their teams discussed their observations with one another. During meetings they recorded their observations into their plan. The standardized Data Team form provided a format for reflecting on results over time and making adjustments. Reflections include observations from various data sets. When interpreting assessment results, the leaders looked for areas of proficiency, deficiency, and trends. The leaders did not make excuses for data results. To make interpretation more understandable to other stakeholders, graphs were often used.

Transform Information Into Decision. Interview documentation was next analyzed to identify evidence of the data literacy component, Transform Information Into Decision. The two subcomponents of this component were represented in the interview data of the formal and informal leader. The two subcomponents included (a) Determine Next Instructional Steps and (b) Understand Context for the Decision.

Findings for the case used to support the existence of the component, Transform Information Into Decision, were identified in actions described by the leaders. Interview transcriptions for the case revealed that leaders and their teams determined next steps by first reviewing the data and breaking the data down to identify specific student needs. The results were then examined to determine how instruction would be differentiated. Students were assigned to skill groups or referred to the intervention team and placed on an individual learning

plan. Once groups were developed, the team considered the strategy, resource, or program, that would be used to support instruction. To identify the strategy most likely to have an impact on learning, the leaders and their teams utilized a district resource that outlined John Hattie's (2009) list of research-based instructional strategies. When determining next steps, the leaders utilized curriculum maps and considered the curriculum standards that must be met to provide a context for decisions. They also looked at implementation timelines, the depth at which the standard would be taught, and how the standard would be demonstrated or measured.

Evaluate Outcomes. Interview documentation was analyzed to identify evidence of the data literacy component, Evaluate Outcomes. The two subcomponents of the component were represented in the interview data of the formal and informal leader. The subcomponents included (a) Consider Need for Iterative Decision Cycles, and (b) Re-examine Original Question or Problem.

Findings for the case used to support the existence of the component, Evaluate Outcomes, were identified in actions described by the leaders. The leaders' descriptions of Data Team meetings revealed the iterative process that was implemented at the site. The Data Team met every seven days to discuss their progress. Steps taken during meetings and between meetings included; (1) collecting and charting data, (2) analyzing data, (3) determining the problem, (3) identifying the target or goal, (4) identifying the strategy or skill level groups, (5) determining the final measure, (6) implementing the strategy, (7) reassessing the students, (8) evaluating results, (9) re-examining the problem, or (10) setting next steps. The leaders and their teams worked to keep groups fluid and intervene as needed to support learning. When students had received instruction for approximately two weeks, they were reassessed. The leaders' and teams

evaluated the results and re-examined the original question. The groups were then modified, or a decision to move on to a new standard was made, and the Data Teams Process was repeated.

Themes for Components of Data Literacy. The findings for the subsections were analyzed to identify the themes for the category, Components of Data Literacy. There were six themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Leadership and management. In Case 3, the support of formal and informal leaders was identified as being necessary. The leaders described that they were needed to ensure that the Data Teams Process was effectively maintained at each grade-level. They supported team members who felt overwhelmed and as a result kept teams from stepping away from the process. To provide support, leaders engaged in actions associated with the behaviors of management, transformational leadership, or servant leadership. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Actions of management. The formal and informal leader in Case 3 engaged in management tasks. Tasks of the formal leader included setting and enforcing meeting protocols. To ensure compliance and positive collaboration, the leader was present at meetings. The informal leader demonstrated management by gathering and preparing data for the meetings.

Actions of transformational leadership. The formal leader in case three engaged in behaviors that reflected transformational leadership by identifying areas of instructional practice that did not meet the team or school goals. To support her observation, she provided team

members with a vision of how the instruction should be delivered. In addition, she provided members with the support needed to achieve the vision.

Actions of servant leadership. The formal and informal leader demonstrated actions of servant leadership. The work of the leaders was focused on helping others. The formal leader encouraged team members to take charge and try new things. She wanted team members to know that they would not be held accountable for mistakes that occurred when they tried to implement something new. To support and serve teams, she provided regular written feedback on their Data Team form. The informal leader also served the team by engaging members in daily informal conversations about what was working or not working, and supporting each in identifying solutions to address concerns. The informal leader helped her team by shouldering some of the burden for the data work. During meetings, she served her team by leading them through the color-coding process and the data analyzation. She took steps to keep everyone moving forward every day with a positive attitude.

Themes for leadership and management. The findings for the section were analyzed to identify the themes for the category, Leadership and Management. There were three themes that emerged from the analysis of information. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Evidence and artifacts. The leaders provided descriptions of the evidence and artifacts that were collected to determine the success of Data Teams. Teams kept a Data Team form which was stored in their Google drive. The form described the problem to be addressed, the team goal, team reflections, description of assessments and strategies, and student data. Teams kept meeting agendas and notes. Other artifacts described by leaders were assessment results,

student work samples, individual learning plans, teacher created charts that were color-coded, team agendas with notes, and an instructional planning resource (IPR) which was used to track units taught and rubrics used to evaluate student learning.

Themes for evidence and artifacts. The findings for the section were analyzed to identify the themes for the category, Evidence and Artifacts. There were three themes that emerged from the analysis of data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Cross-category themes for Case 3. The findings for the case were analyzed to identify the cross-category themes. When information was compared across the categories inside and outside the case, two themes emerged for Case 3. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Mental Model Case 4

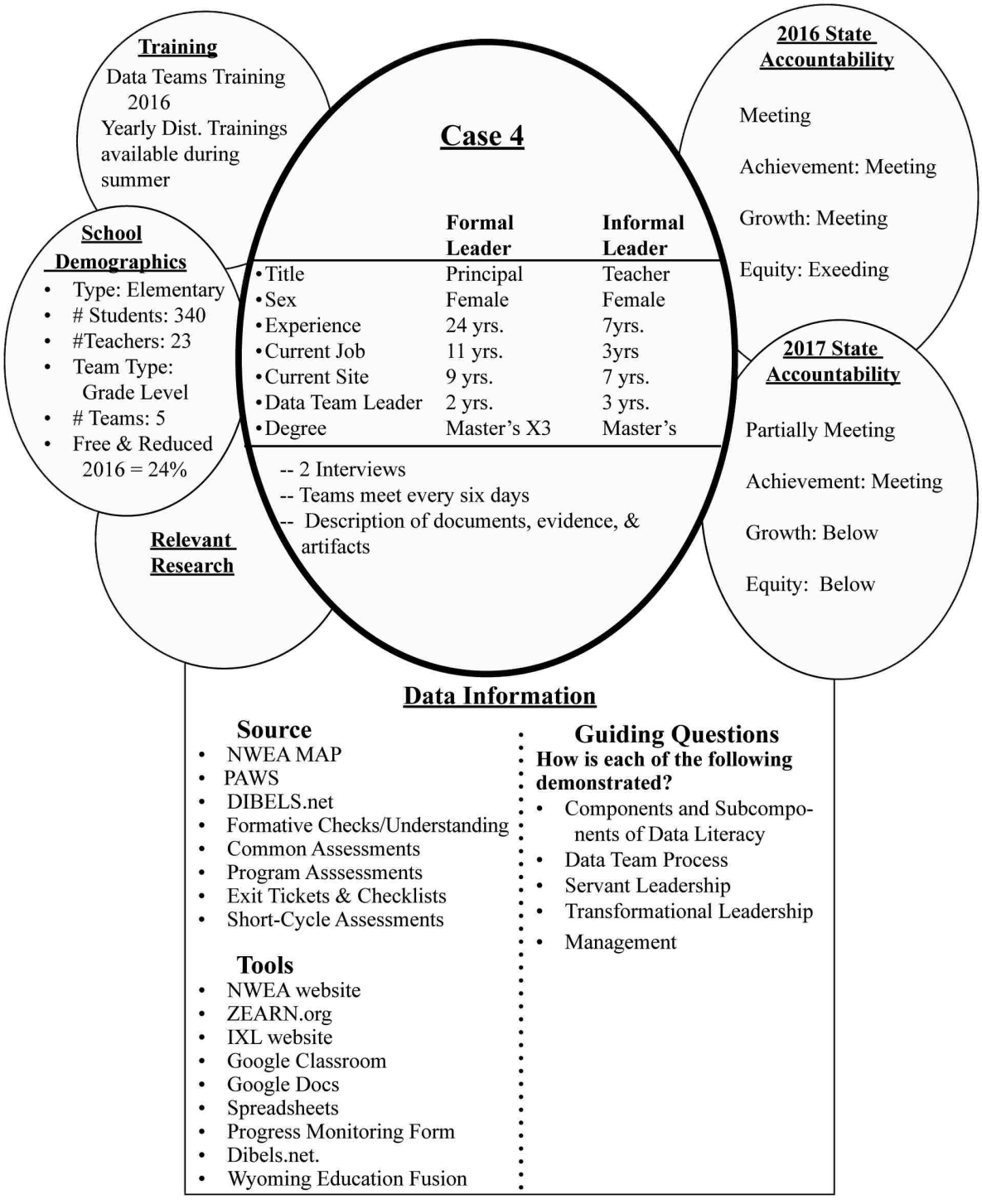

Figure 10. Case diagram for Case 4 for the 2016-2017 school year. School accountability results (Wyoming Department of Education, n.d.) are provided for 2015-2016 and 2016-2017 school year to provide evidence of growth.

School and Leaders. Case 4 begins with the description of the findings for the section, School and Leaders. The section contains two subsections. The first subsection describes school demographics and team meetings. The second subsection describes leader demographics and training. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

School demographics and accountability. Case number four was an elementary school that served approximately 340 students in kindergarten through fourth grade. Over twenty-four percent of the students in the school qualified for free or reduced lunch in 2016. In this school, there were 23 certified teachers serving on five separate grade-level teams. A district schedule provided the opportunity for teams to meet once every six days. During the 2015-2016 school year, the school was found to be meeting expectations under the state's accountability model. During the 2016-2017 school year, the school's score dropped to partially meeting expectations. Descriptions of the Data Teams Process used at the site that appear inside the case were gathered from interviews of one formal leader and one informal leader.

Leader demographics and training. The formal leader for this case was the principal who held three master's degrees, which included a master's degree in administrative leadership K-12, a master's degree in reading, and a master's degree in assessment. She was certified as a trainer of the Mandt system and Schoolwide Information System (SWIS) and had previously held an English second language endorsement. She had received extensive data training in statistics and research methods through her degree programs and had also participated in district training on the Data Teams Process during the summer of 2016.

The informal leader was an elementary teacher who held a master's degree in elementary education. Her formal data training included one class in research that she took during her

degree program. She also participated in training on the Data Teams Process provided by her district.

Themes for school and leaders. The findings for the subsections were analyzed to identify the themes for the category, School and Leaders. There were three themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Components of data literacy. Findings for how leaders use the six components of data literacy are presented next. Findings for each subsection describe the subcomponents of each of the components of the Data Literacy Conceptual Framework. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Identify Problems/Frame Questions. The interview documentation was analyzed to identify information that described the data literacy component, Identify Problems/Frame Questions. Each of the four subcomponents of this component was represented in the interview data of the formal and informal leader. The four subcomponents included (a) Articulate and Communicate the Problem/Question, (b) Involve Other Participants, (c) Understand Contextual Issues, and (d) Understand Student Privacy.

Findings for the case used to support the existence of the component, Identify Problems/Frame Questions, were identified in actions described by formal and informal leaders. Interview transcriptions revealed that to articulate and communicate the problem or question, leaders and their teams followed the steps of the Data Teams Process described in their training manual. Leaders and their teams then quietly reflected on the data and each created a list of intervention ideas based on the standard and SMART goal (Specific, Measurable, Attainable, Relevant and

Timely) lists were then shared and discussed in order to determine and articulate what would be implemented. To guide the discussion leaders used the four questions of a PLC. Other participants with whom results were shared included the district administration team, parents, and intervention team members. The contextual issues identified as having the potential to impact data results were Individual Education Plan (IEP) needs, Individual Learning Plan (ILP) needs, attendance, mobility, and behavior. To support some of these needs, leaders and their teams considered academic accommodations that would give each student access to the general education learning environment. All student data used for the process was kept confidential. Student names were not posted or included on team forms. Documents with student names were only available to those who had been designated as users. Accountability for data privacy was established through district policy and school processes. Implementation was monitored and reinforced by the formal leader. Team members also supported one another in maintaining the expectation.

Use Data. The data literacy component, Use Data, was reviewed next. Each of the six subcomponents was represented in the interview data of the formal and informal leader. The six subcomponents reviewed included (a) Identify Possible Sources of Data, (b) Understand How to Generate Data, (c) Understand Data Properties, (d) Understand Data Quality, (e) Understand How to Access Data, and (f) Understand How to Analyze Data.

Findings for the case used to support the existence of the component, Use Data, were identified in the actions described by the formal and informal leaders. Leaders identified multiple sources of data that were used at the site. Data sources identified included NWEA MAP, PAWS, DIBELS, common assessments, program assessments, short-cycle assessments, exit tickets, checklists, and formative checks for understanding. Leaders' understanding of how

to generate data were evident in descriptions of the team's use of exit tickets, checklists, and formative checks for understanding. Leaders' understanding of data properties was linked to their need to examine assessments against the standards to determine relevance. Being that many of the assessments were either developed commercially or vetted at the district level, leaders' presumed that relevance and reliability had been addressed. To ensure data quality, leaders and their teams checked assessments to determine if questions were understandable and written appropriately for the grade-level. The testing environment and testing conditions were also monitored when assessments were given to ensure the quality of data results. The Leaders understood how to access data results. The data used by teams was retrieved from the NWEA website, DIBELS.net, Google Docs, Google classroom, IXL learning website, Zearn.org, Wyoming Education Fusion and the school's progress monitoring form. To analyze data, the leaders and their teams engaged in discussions and made personal observations. They also collected data and built spreadsheets. When analyzing data from the larger summative assessments such as PAWS, leaders utilized the mean, median, mode, and standard deviation. The longitudinal results were compared to state and district results. When examining other data sets, leaders and their teams sought to identify student proficiency levels. By disaggregating data down to the student level, leaders were able to do a question analysis and identify specific areas of student need. When analyzing data, leaders and their teams also considered outside factors that might impact results such as IEPs, ILPs, EL designations, and attendance. Leaders and their teams used the proficiency levels and skill deficits identified in the data to guide decisions about student placement in flex groups and skill groups.

Transform Data Into Information. The data literacy component, Transform Data Into Information, was reviewed next. Each of the four subcomponents was represented in the

interview data of the formal and informal leader. The four subcomponents reviewed included; (a) Consider Impact and Consequences (Intended and Unintended), (b) Generate Hypotheses, (c) Test Assumptions, and (d) Understand How to Interpret Data.

Findings for the case used to support the existence of the component, Transform Data Into Information, were identified in actions described by leaders. Interview transcriptions for the case revealed that leaders considered impact and consequences when discussing classroom instructional strategies and student placement. During meetings, leaders and their teams considered how push-in support would impact student learning. Testing variables such as testing duration were also discussed and accommodations to address those variables were developed. The intervention support needed to help struggling students was discussed and decided on by the intervention team. Biweekly progress monitors were put in place to measure the impact of each intervention on student growth. At the district level, formal leaders met biweekly with the district curriculum director to discuss upcoming data pieces and coaching. The percentage of students identified at each proficiency level drove the goal-setting process. When leaders and teams met, they examined data to identify the percentage of students at each proficiency level. SMART goals were used to drive the process by allowing teams to generate a hypothesis about how to move students to the next proficiency level. Formal leaders also generated hypotheses about instructional practices during classroom observations. To test assumptions, agreed upon practices were implemented and reassessed. In the classroom, team leaders and team members used exit tickets to test their assumptions about students' understanding of a concept. To interpret the data, the leaders examined student scores and proficiency levels and compared those scores to previous data included on the Data Teams form. Sharing of assessment results and the interpretation of the results primarily occurred between leaders and their teams.

Transform Information Into Decision. The data literacy component, Transform Information Into Decision, was reviewed next. The two subcomponents were represented in the interview data of the formal and informal leader. The two subcomponents reviewed included (a) Determine Next Instructional Steps, and (b) Understand Context for the Decision.

Findings for the case used to support the existence of the component, Transform Information Into Decision, were identified in actions described by leaders. Interview transcriptions for the case revealed that leaders and their teams determined next steps by looking at the number of students at each proficiency level and discussing what could be used to move each to the next group or proficiency level. A district resource that included instructional strategies described in the research of John Hattie (2009) was reviewed. Leaders looked for strategies that had been identified by Hattie as having the highest effect size. Then, the strategy was chosen and implemented. When determining next steps, information embedded in curriculum maps and the content standards provided the context for the decisions made by the leaders and their team. The curriculum was seen as a guide for determining what would be taught and when it would be taught. The resources identified in each curriculum map were used to support the content described in the curriculum map.

Evaluate Outcomes. The data literacy component, Evaluate Outcomes, was reviewed last. The two subcomponents were represented in the interview data of the formal and informal leader. The subcomponents reviewed included (a) Consider Need for Iterative Decision Cycles and (b) Re-examine Original Question or Problem

Findings for the case used to support the existence of the component, Evaluate Outcomes, were identified in actions described by leaders. Leaders' descriptions of Data Team meetings revealed the iterative process that was implemented at the site. The Data Team met every seven

days to discuss their progress. The formal leader utilized the Data Team training manual to guide the process. The team was guided to explicitly follow the steps of the Data Teams Process pictured on the manual cover. To follow the process, data were collected. Teams then analyzed the data and made inferences to identify the problem(s). Next, strategies were selected and implemented. Subsequently, results were evaluated and next steps were decided. Between meetings, student progress was monitored and observations were informally discussed. During formal team meetings, leaders looked back through the previous Data Team form(s) to re-examine the problem against new data results.

Themes for Components of data literacy. The findings for the subsections were analyzed to identify the themes for the category, Components of Data Literacy. There were five themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Leadership and management.

In Case 4, the support of formal and informal leaders was identified as being necessary. Leaders described that they were needed to ensure that members engaged in the Data Teams Process during meeting time and correctly followed the steps of the process. Informal leaders supported their teams and also served on a leadership team for the school. The limited time that leaders and teams had to engage in the process was recognized as a challenge. Having new staff who lacked training in Data Teams as well as other established school programs was also challenging for the formal leader. To address challenges and provide support, leaders engaged in actions associated with the behaviors of management, transformational leadership, or servant leadership.

The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Actions of management. The formal and informal leaders in Case 4 engaged in management tasks. Tasks of the formal leader included setting and enforcing meeting protocols. To ensure compliance and positive collaboration the leaders were present at meetings. The formal leader reviewed lesson plans to ensure alignment with curriculum and team goals. She reminded team members what to bring to meetings. She also reminded each of his or her role.

When she attended meetings, she brought with her the Data Team manual and district resource on strategies. She explained that she did not allow teams to deviate from the written plan. She used the resource to monitor the meeting process and redirect the group when they strayed from the process.

The informal leader demonstrated management by ensuring that the steps of the Data Teams Process were followed during meetings, and that each member carried out his or her assigned role. In addition, the informal leader maintained an electronic and hard copy folder for agenda notes and ensured that the formal leader received an email copy of the notes.

Actions of transformational leadership. The formal leader in Case 4 also engaged in behaviors that reflected transformational leadership by helping the teams understand and engage effectively in the steps of the Data Teams Process. She was enthusiastic and had a vision of how the process should be carried out. She was passionate about her teams receiving constructive feedback to support their work. She regularly provided feedback to members during meetings, through agenda notes and lesson plans to ensure that the process was being implemented with fidelity. Each week she sent weekly notes to her staff, included information about the teams, and thanked all of the members for diving deeper into the process.

Actions of servant leadership. The formal leader also demonstrated actions of servant leadership. She gave her time to support staff needs. She covered classes for members who wanted to visit other classrooms or schools to observe the use of instructional strategies. She provided team members with support for progress monitoring by assigning the PE teacher and a paraprofessional to complete the progress monitors and enter the data in the DIBLES program. She retrieved reports when requested and offered to review research when needed.

Themes for leadership and management. The findings for the section were analyzed to identify the themes for the category, Leadership and Management. There were three themes that emerged from the analysis of information. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Evidence and artifacts. The leaders provided descriptions of the evidence and artifacts that were collected to determine the success of Data Teams. Each team member kept a spreadsheet of data for their class or group. The data from individual spreadsheets was added to the team's spreadsheet. Data from the spreadsheet was sorted into proficiency levels and added to the Data Team template. Included with the proficiency levels on the template was a description of the findings from the analysis, the SMART goal that was set by the team, the strategies that would be implemented, and the success indicator that would be used at the short-cycle. Other artifacts included, student work samples, DIBELS data, PAWS data, the Data Team manual and the district resource that included information on instructional strategies, meeting agendas, and meeting notes. Assessment results, progress monitoring results and the Data Team form provided evidence of the team's success. Leaders described seeing changes in the number of students scoring at each of the proficiency levels listed on the Data Team form. Leaders also

noted that students who were regularly being progress monitored were making visible growth and closing the achievement gap. Leaders also recognized that PAWS data indicated that scores for math increased during the year that the team focused on math, and decreased the following year when the focus for the team was on reading.

Themes for evidence and artifacts. The findings for the section were analyzed to identify the themes for the category, Evidence and Artifacts. There were five themes that emerged from the analysis of data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Cross category themes for Case 4 The findings for the case were analyzed to identify the cross category themes. When information was compared across the categories inside and outside the case, two themes emerged for Case 4. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5, which is included in the Multicase Analysis section of this chapter

Mental Model Case 5

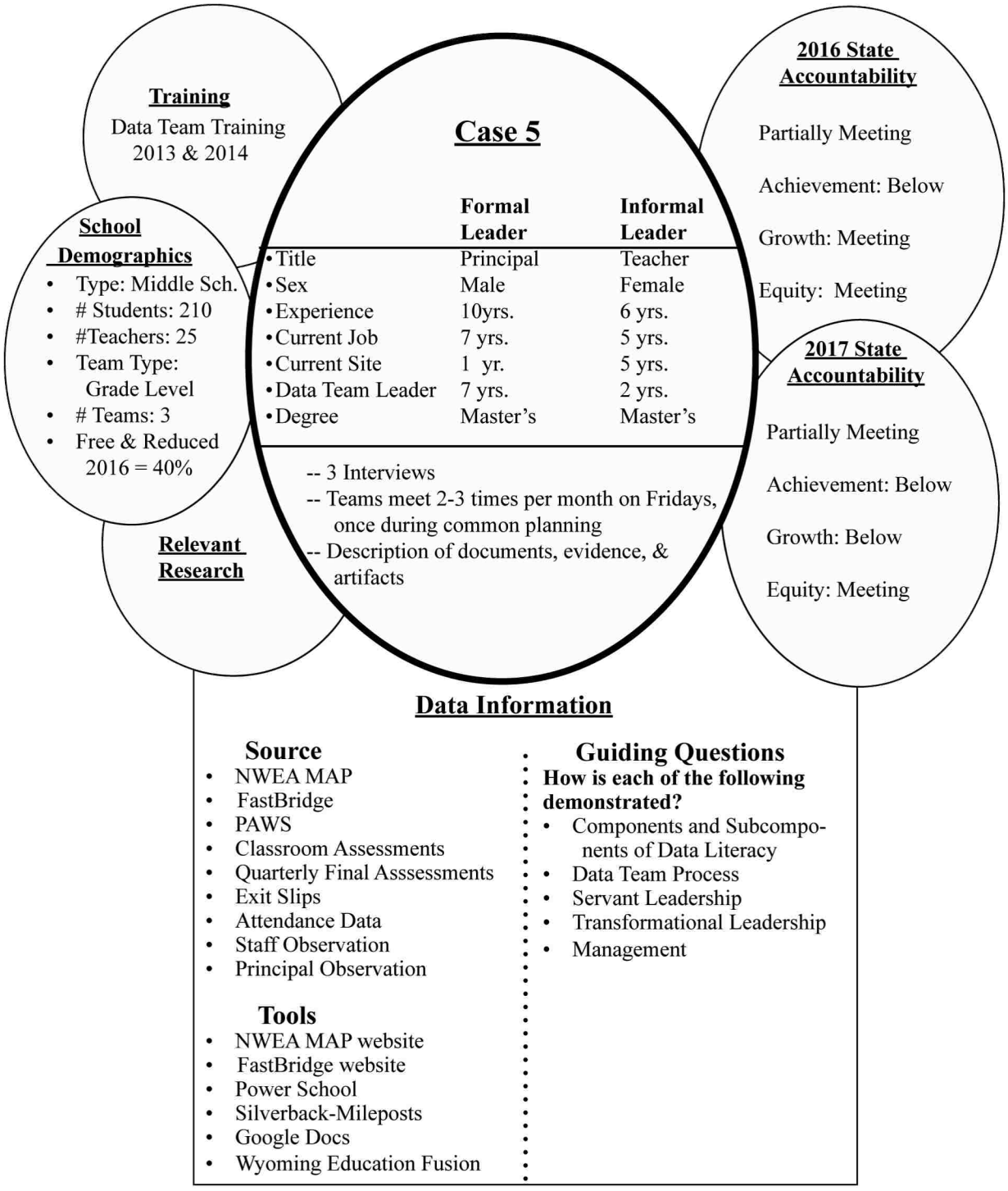

Figure 11. Case diagram for Case 5 for the 2016-2017 school year. School accountability results (Wyoming Department of Education, n.d.) are provided for 2015-2016 and 2016-2017 school year to provide evidence of growth.

School and Leaders. Case 5 begins with the description of the findings for the section, School and Leaders. The section contains two subsections. The first subsection describes school demographics and team meetings. The second subsection describes leader demographics and training. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

School demographics and accountability.

The fifth case was a middle school that served approximately 210 students in grades six through eight. Forty percent of those students qualified for free or reduced lunch in 2016. In this school, there were 25 certified teachers serving on three grade-level teams and one building team. A district schedule provided teams the opportunity to meet together twice a month, every other week, during a Friday afternoon. An additional Friday was available each month to team members who did not serve on district teams. Most teams also met at least once a week during common planning time. During the 2015-2016 school year, the school was found to be partially meeting requirements under the state's accountability model. During the 2016-2017 school year, the school again was rated as partially meeting state accountability requirements. Descriptions of the Data Teams Process used at the site that appear inside the case were gathered from interviews of one formal leader and one informal leader.

Leader demographics and training.

The formal leader for this case was the school principal who held a master's in educational leadership with endorsements in science education and coaching. At the time of the interview, he was enrolled in a doctoral program in Educational Leadership. His formal training included nine hours of statistics taken during his doctoral program. He had also attended training on using

assessment data that was provided to the school district's administrators by the Wyoming Department of Education.

The informal leader was a middle school teacher who held a master's degree in curriculum and instruction with a focus on technology. She also held endorsements in English education. At the time of the interview, she was enrolled in a master's program for educational leadership. Her formal training included a research and statistics class at the undergraduate level and a class in statistics and assessment at the graduate level. She had also participated in district training on the Data Teams Process during the 2013-2014 school year.

Themes for school and leaders. The findings for the subsections were analyzed to identify the themes for the category, School and Leaders. There were two themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Components of data literacy. Findings for how leaders use the six components of data literacy are presented next. Findings for each subsection describe the subcomponents of each of the components of the Data Literacy Conceptual Framework. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Identify Problems/Frame Questions. The data literacy component, Identify Problems/Frame Questions, was reviewed. Each of the four subcomponents was represented in the interview data of the formal and informal leader. The four subcomponents reviewed included (a) Articulate and Communicate the Problem/Question, (b) Involve Other Participants, (c) Understand Contextual Issues, and (d) Understand Student Privacy.

Findings for the case used to support the existence of the component, Identify Problems/Frame Questions, were identified in actions described by formal and informal leaders. Interview transcriptions revealed that to articulate and communicate the problem or question, leaders and their teams engaged in an inquiry process to examine the data and identify the greatest instructional needs. Various data sets were examined, and the leaders presented data trends. Team plans and decisions were generally emailed to the formal leader. Other participants with whom results were shared included the parents and students. Data describing building level results were frequently posted on electronic monitors located around the school. Data were also shared with students and other building stakeholders via impromptu meetings and conversations. When applicable, data results were included in parent newsletters. The identified contextual issues that had the potential to impact data results were attendance, behavior, schedules, and environmental concerns. To identify how to support some of the identified needs, the formal leader used "data wrapping the data." He and building teams utilized data to identify how scheduling was impacting learning. At the grade-level, the informal leader and her team always considered the contextual issues impacting each student when examining the reliability of assessment results. All student data used for the process was kept private. The formal leader relied on the professionalism of his staff and regularly discussed the need for confidentiality. As there were a small number of teachers in each department, data privacy also applied to maintaining confidentiality about the results of student groups that could be tied to the performance of a particular teacher.

Use Data. The data literacy component, Use Data, was reviewed next. Each of the six subcomponents was represented in the interview data of the formal and informal leader. The six subcomponents reviewed included (a) Identify Possible Sources of Data, (b) Understand How to

Generate Data, (c) Understand Data Properties, (d) Understand Data Quality, (e) Understand How to Access Data, and (f) Understand How to Analyze Data.

Findings for the case used to support the existence of the component, Use Data, were identified in the actions described by the formal and informal leader. The leaders identified multiple sources of data that were used at the site. Data sources identified included, NWEA MAP, FAST, PAWS, classroom assessments, quarterly final assessments, exit slips, attendance data, staff observations, and principal observations. The leaders' understanding of how to generate data was evident in descriptions of the team's use of exit slips, and observation information and in the formal leader's use of "data wrapping data." The leaders' understanding of data properties was linked to the need to identify students' level of mastery of grade-level content standards. Being that many of the assessments used to measure standards were developed commercially, the leaders presumed that the results were relevant and reliable. The leaders ensured data quality by checking for the completeness of data and considering any variables that could have impacted results. When looking at student data, the formal leader wanted the data to be descriptive of "the whole child." The leader's understanding of how to access data was evident in descriptions of the programs and sites that were used to house data results. The data used by teams was retrieved from the NWEA website, PowerSchool, Silverback Milepost website, FAST website, Google Docs, and Wyoming Education Fusion. To analyze the data, the leaders and their teams engaged in discussions about the assessments they had given. When analyzing data from the larger summative assessments, leaders utilized the mean, median, and standard deviation. The focus for much of their work was on MAP data. The leaders and teams could access and sort data on the NWEA site and the Silverback Milepost website. The student data could easily be sorted by RIT score or proficiency level when using

these online sites. The informal leader described breaking the data down into the different sections to get to the skill levels for reading and language. The formal leader described starting with aggregated results by school and then working down and extracting the results for grade-levels, cohorts, and the subgroups. He used the data to look at year-to-year trends for the school and cohorts. Team members, however, did not generally drill down very deep into the data. When analyzing assessments at the classroom level, the informal leader relied primarily on mean scores. The tests results from various tests were often compared to support the findings.

Transform Data Into Information. The data literacy component, Transform Data Into Information, was reviewed next. Three of the four subcomponents were represented in the interview data of the formal and informal leader. The subcomponents represented included (a) Consider Impact and Consequences (Intended and Unintended), (b) Test Assumptions, and (c) Understand How to Interpret Data. The subcomponent, Generate Hypotheses, was not represented in leader descriptions.

Findings for the case used to support the existence of the component, Transform Data Into Information, were identified in actions described by leaders. Interview transcriptions for the case revealed that leaders considered impact and consequences when contemplating any change. Team discussions led to identifying issues that required the team to build additional measures to assess student need. The formal leader considered other school level data to identify the impact that the school schedule had on student and team performance. There was no evidence that leaders and teams generated a hypothesis or set short-cycle SMART goals. Instead, the formal leader supported teams in making hypothetical connections between data results and the root cause of an identified problem by using the questioning technique of asking why five times. To begin the process the leader would pose a question that the team would answer and then the

answer was questioned. Questioning the answer continued until there were no more questions that could be asked. The resulting answers, along with team discussions, were used to support teams in testing assumptions about data findings. If teams needed additional information about a problem, they worked with the informal leader to identify and administer additional assessments that would further test assumptions. To interpret the data, the leaders focused on providing only the essential information which was presented using numbers as well as bar graphs.

Transform Information Into Decision. The data literacy component, Transform Information Into Decision, was reviewed next. The two subcomponents were represented in the interview data of the formal and informal leader. The two subcomponents reviewed included (a) Determine Next Instructional Steps and (b) Understand Context for the Decision.

Findings for the case used to support the existence of the component, Transform Information Into Decision, were identified in actions described by leaders. Interview transcriptions for the case revealed that leaders and their teams determined next steps by looking at the overall need of a particular group of students or for the student population as a whole. At the building level, the formal leader was developing a schedule with an intervention period in which students would be assigned additional support and would be progress monitored over several weeks. At the grade-level, the leader and her team analyzed the results of classroom assessments and observations, and then determined the strategy to implement and support the need. While strategies were decided as a group, team members did not always implement the strategies with fidelity, and thus the team struggled to gather consistent and reliable results. When determining next steps, leaders and their teams utilized research-based strategies recommended by the district. The context for their decisions focused on the skill requirements embedded in the content standards which were required for standardized grading.

Evaluate Outcomes. The data literacy component, Evaluate Outcomes, was reviewed last. The two subcomponents were represented in the interview data of the formal and informal leader. The subcomponents reviewed included (a) Consider Need for Iterative Decision Cycles and (b) Re-examine Original Question or Problem.

Findings for the case used to support the existence of the component, Evaluate Outcomes were identified in actions described by leaders. The leaders' descriptions of Data Team meetings revealed that the iterative process that was implemented at the site was missing some of the steps of the Data Teams Process. The Data Team cycle described by leaders included reviewing data every two weeks to identify a problem, discussing how to collect data, collecting the data, discussing the results, identifying and implementing a strategy, and discussing what changed as a result of using the strategy. The leaders noted that there were many inconsistencies in the implementation of strategies between team members that often made it difficult to re-examine the question.

Themes for components of data literacy. The findings for the subsections were analyzed to identify the themes for the category, Components of Data Literacy. There were three themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Leadership and management. In Case 5, the support of formal and informal leaders was identified as being necessary to ensure that teams engaged in discussing and using data during their bi-monthly meetings. The work of leaders was critical for modeling the practice and building its use with skeptical team members who were reluctant to share concerns or seek help. The formal leader posited that the school leaders were needed to advance the process. To

provide support to teams, leaders engaged in actions associated with the behaviors of management, transformational leadership, or servant leadership. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Actions of management. The formal and informal leaders in Case 5 engaged in management tasks by facilitating meetings and downloading assessment results. The formal leader also managed schedules, retrieved and shared demographic data, reviewed grade books, and supervised meetings. The informal leader provided team members with reminders of materials needed for meetings. She also held members accountable for participating in meetings.

Actions of transformational leadership. The leaders in Case 5 engaged in actions involving behaviors associated with transformational leadership by modeling the use of data and encouraging others to take ownership of the implementation process. The formal leader provided the vision for student learning by providing data examples that showed where efforts were effective and ineffective. The informal leader led by example to encourage "collegial accountability" and encourage support for the vision. Through these behaviors leaders were slowly drawing those who had traditionally been resistant into the practice of using data to drive instruction.

Actions of servant leadership. The leaders also demonstrated actions of servant leadership. The formal leader attended all team meetings to support the work of the group. He was available to help find information or answer questions. He encouraged members to try new things and supported them in their efforts. He helped teams disaggregate and interpret data and also sought funding to support projects or programs chosen for implementation. The informal leader worked side by side with her team members as they took on new tasks. She kept the

group moving forward by writing some of the assessments used by the team, taking notes of team meetings, and serving as a liaison between the team and the administration.

Themes for leadership and management. The findings for the section were analyzed to identify the themes for the category, Leadership and Management. There were three themes that emerged from the analysis of information. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Evidence and artifacts. The leaders provided descriptions of the evidence and artifacts that were collected to determine the success of Data Teams. Informal leaders kept the team agendas and notes. The documents described conversations about assessment results and team discussions. Leaders also collected results from MAP, PAWS, classroom assessments report cards, and state accountability reports. The formal leader used Google Docs to maintain the data for discipline referrals.

Themes for evidence and artifacts. The findings for the section were analyzed to identify the themes for the category, Evidence and Artifacts. There were two themes that emerged from the analysis of data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Cross-category themes for Case 5. The findings for the case were analyzed to identify the cross category themes. When information was compared across the categories inside and outside the case, two themes emerged for Case 5. The themes that emerged from the cross-category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Mental Model Case 6

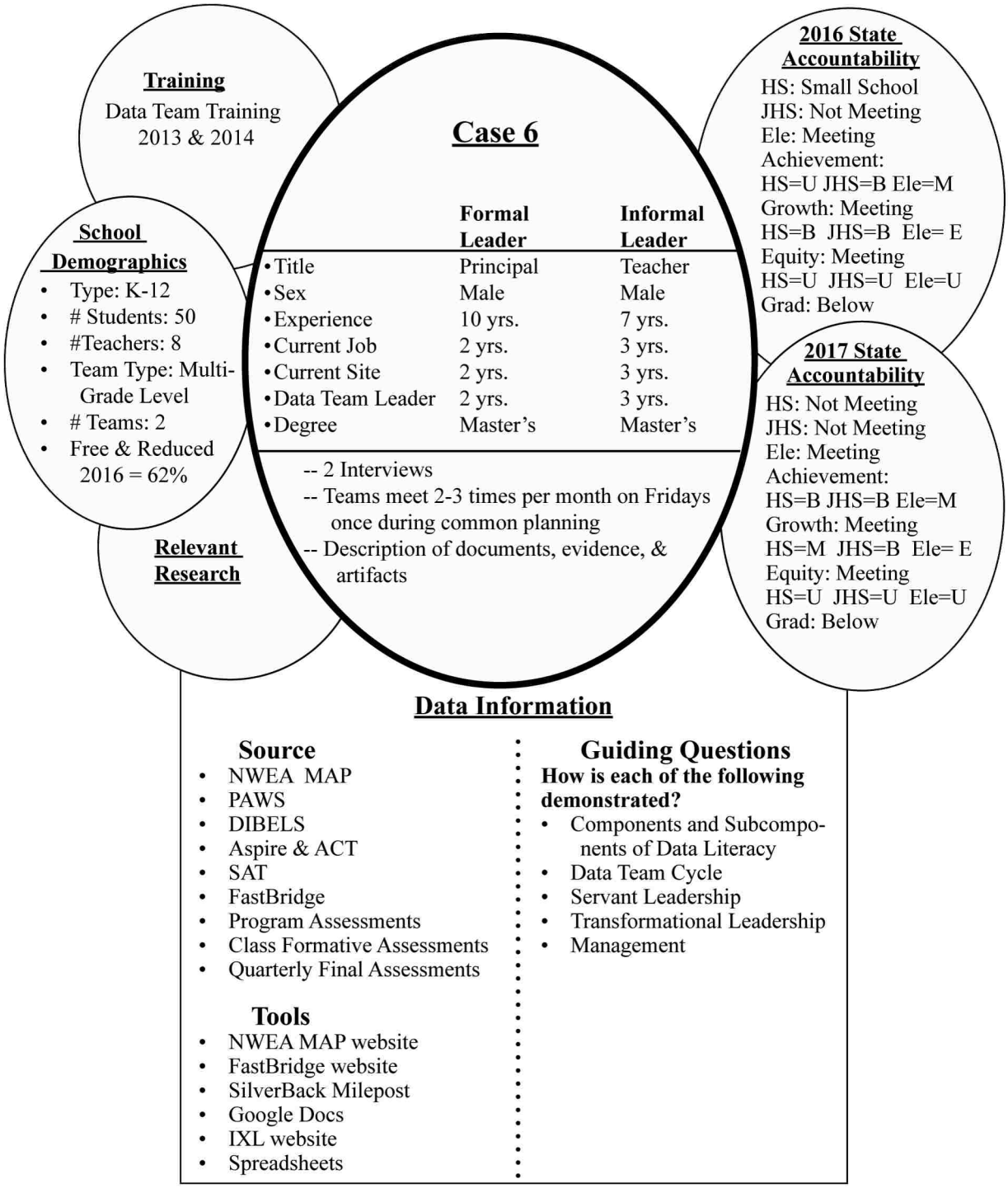

Figure 12. Case diagram for case 6 for the 2016-2017 school year. School accountability results (Wyoming Department of Education, n.d.) are provided for 2015-2016 and 2016-2017 school year to provide evidence of growth. Abbreviations: Not Reported (Small School), Below (B), Meeting (M), Exceeding (E), Undefined (U).

School and Leaders. Case 6 begins with the description of the findings for the section, School and Leaders. The section contains two subsections. The first subsection describes school demographics and team meetings. The second subsection describes leader demographics and training. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

School demographics and accountability. Case number six was a K-12 school that served approximately 50 students. During the 2015-2016 school year, sixty-two percent of the students qualified for free or reduced lunch. In this school, there were eight certified teachers serving on two separate cross-grade-level teams. A district schedule provided teams the opportunity to meet together twice a month every other week during a Friday afternoon. An additional Friday was available if team members did not serve on district teams. During the 2015-2016 school year, the elementary school was found to be meeting expectations and the junior high school was found to not be meeting expectations. At the high school, the graduation rates were found to be below target. Also, the school's overall rating was not disclosed as the rating fell under the small school decision under the state's accountability model. During the 2016-2017 school year, the elementary school was found to be meeting expectations and the junior high school was found to not be meeting expectations. In addition, at the high school the graduation rates were found to be below target and the school was not meeting expectations under the state's accountability model. Descriptions of the Data Teams Process used at the site that appear inside the case were gathered from interviews of one formal leader and one informal leader.

Leader demographics and training. The formal leader for this case was the school principal who held a master's degree in Curriculum and Instruction with a Wyoming Leading to

Reading Literacy endorsement. His formal data training was limited to one research class during his master's program. He also participated in training on using assessment data that was provided by NWEA during the fall of 2016.

The informal leader was a teacher for students in grades 6-12 who held a master's degree in the Art of Teaching with endorsements in secondary education, earth science, chemistry, biology, and Spanish. His formal data training included a class on statistics and an education class on testing and calculus.

Themes for school and leaders. The findings for the subsections were analyzed to identify the themes for the category, School and Leaders. There were two themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Components of data literacy. Findings for how leaders use the six components of data literacy are presented next. Findings for each subsection describe the subcomponents of each of the components of the Data Literacy Conceptual Framework. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Identify Problems/Frame Questions. The data literacy component, Identify Problems/Frame Questions, was reviewed. Each of the four subcomponents was represented in the interview data of the formal and informal leader. The four subcomponents reviewed included (a) Articulate and Communicate the Problem/Question, (b) Involve Other Participants, (c) Understand Contextual Issues, and (d) Understand Student Privacy.

Findings for the case used to support the existence of the component, Identify Problems/Frame Questions, were identified in actions described by formal and informal leaders.

Interview transcriptions revealed that to articulate and communicate the problem or question, leaders and their teams discussed concerns observed in the data. As there was such a small population of students, the problems identified were usually student specific. Other participants with whom results were shared included teachers who were considered specialists in the area of need, previous grade-level teachers, instructional facilitator, students, parents, and the superintendent. The contextual issues identified that had the potential to impact data results were socio-economic status, social-emotional concerns, and other situational concerns of individual students. All student data used for the process was kept private. The formal leader reminded staff at the beginning of each year about who was allowed to know about student data. The team meeting norms reviewed before each meeting also included reference to the confidentiality of data. The formal leader held teams accountable for data privacy and addressed reported infractions with individual team members.

Use Data. The data literacy component, Use Data, was reviewed next. Each of the six subcomponents was represented in the interview data of the formal and informal leader. The six subcomponents reviewed included (a) Identify Possible Sources of Data, (b) Understand How to Generate Data, (c) Understand Data Properties, (d) Understand Data Quality, (e) Understand How to Access Data, and (f) Understand How to Analyze Data.

Findings for the case used to support the existence of the component, Use Data, were identified in the actions described by the formal and informal leader. Leaders identified multiple sources of data that were used at this site. Data sources identified included, NWEA MAP, PAWS, DIBELS, American College Test (ACT), Aspire test, Scholastic Aptitude Test (SAT), FAST, program assessments, class formative assessments, and quarterly final assessments. The leaders' understanding of how to generate data was evident in descriptions of the team's use of

formative assessments to measure student progress and identify student skill deficits. The understanding of how to generate data was also evident in the use of pretests and posttests to measure student learning. The leaders' understanding of data properties was demonstrated in their descriptions of relevance and reliability of data. The leaders expressed that for data to be relevant, assessment results needed to provide information specific to the skill being assessed. When leaders determined reliability, they looked at the standard deviation that was reported on benchmark and summative tests. As many of the assessments used by the teams were developed either commercially or vetted at the district level, leaders presumed that relevance and reliability for most of the measures used had already been addressed. To ensure data quality, leaders and their teams looked for any bias in questioning. They also examined the results for each measure against the results for other measures to determine whether results were valid. The leaders also considered how the population size of the school impacted the validity of reported results.

The leaders and their teams accessed and retrieved data from the NWEA website, FAST website, SilverBack Milepost, Google Docs, IXL learning website, and spreadsheets. To analyze data, the leaders and their teams engaged in discussions about what the data revealed. When student learning deficits were identified, longitudinal data were analyzed to trace the problem back to its origin. When analyzing data, leaders and their teams utilized Google Docs and worked collaboratively to build spreadsheets. To analyze the data, leaders and their teams entered assessment results into the shared spreadsheet and color-coded the results to show the various percentile levels represented in the data. When analyzing data from assessments, such as MAP, PAWS, or ACT, leaders primarily utilized RIT scores, scaled scores, percentage, and percentiles to examine student proficiency and growth. The leaders and their teams analyzed aggregated data to identify proficiency and growth for the elementary and the secondary

students. Data were then disaggregated and analyzed at the student level to identify the instructional needs of each student.

Transform Data Into Information. The data literacy component, Transform Data Into Information was reviewed next. Three of the four subcomponents were represented in the interview data of the formal and informal leader. The subcomponents represented included (a) Consider Impact and Consequences (Intended and Unintended), (b) Test Assumptions, and (c) Understand How to Interpret Data. The subcomponent, (d) Generate Hypotheses was not represented in leader descriptions.

Findings for the case used to support the existence of the component, Transform Data Into Information, were identified in actions described by leaders. Interview transcriptions for the case revealed that the formal leader encouraged his teams to consider impact and consequences when discussing classroom instructional strategies and student placement. He was adamant that conversations be focused on what was best for each student. He wanted teams to focus on only those things that would support student growth. The informal leader noted that teams worked on "solution-based practices." There was no evidence that leaders and teams generated a hypothesis or set short-cycle SMART goals. Instead, the leaders supported teams in making hypothetical connections between data results and the root cause of an identified problem by brainstorming why the problem was occurring, mapping it out on a whiteboard, and identifying the "common threads." The formal leader noted that to test assumptions, various programs or strategies had been implemented at the school level. Those programs and strategies that worked were kept, and those that failed to address concerns were eliminated. The informal leader noted that to test assumptions about individual student learning needs, students were placed in a skill-specific intervention for several weeks and then retested to determine if there had been any growth.

When interpreting the data, the leaders and their teams examined student scores and proficiency levels and compared those to the established norm for the assessment. When discussing the data with students or parents, the leaders presented the student scores along with graphs to show where a student had grown and where they needed additional support. When presenting data to the public, the leaders presented an overall proficiency level or percentage of students showing growth.

Transform Information Into Decision. The data literacy component, Transform Information Into Decision, was reviewed next. The two subcomponents were represented in the interview data of the formal and informal leader. The two subcomponents reviewed included (a) Determine Next Instructional Steps and (b) Understand Context for the Decision.

Findings for the case used to support the existence of the component, Transform Information Into Decision, were identified in actions described by the leaders. Next steps were determined by looking at the number of students at each proficiency level and discussing what could be used to address student skill deficits. Discussions led to students being placed in intervention groups that were scheduled into the school day. Though individual learning plans were required for students that scored below the fiftieth percentile, all students were assigned to a group. Staff certified in core content areas at the secondary level served as a resource to support students at all skill levels for all grades. Instructional strategies for each group were left to the discretion of each supervising team member. The content standards and students' grade-level proficiency on the standards provided the context for leaders' decisions.

Evaluate Outcomes. The data literacy component, Evaluate Outcomes, was reviewed last. The two subcomponents were represented in the interview data of the formal and informal

leader. The subcomponents reviewed included (a) Consider Need for Iterative Decision Cycles and (b) Re-examine Original Question or Problem.

Findings for the case used to support the existence of the component, Evaluate Outcomes, were identified in actions described by the leaders. The leaders' descriptions of Data Team meetings revealed that the iterative process that was implemented at the site was missing some of the steps of the Data Teams Process. The steps of the Data Teams Process described by leaders included meeting every two weeks to (a) present data, (b) identify problems, (c) analyze the information, (d) identify interventions, (e) review posttest data, and (f) determine next steps. The use of biweekly progress monitors allowed teams to evaluate and monitor students' response to the intervention. During team meetings the leaders discussed and determined next steps for each student based on results. The formal leader noted that the limited number of students in the building allowed his teams to review and discuss the progress of all students.

Themes for components of data literacy. The findings for the subsections were analyzed to identify the themes for the category, Components of Data Literacy. There were four themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Leadership and management. In Case 6, the support of formal and informal leaders was identified as being necessary. Leaders kept meetings focused on student data and interventions during bimonthly meetings and kept the process for data review and student intervention moving forward. To provide support to teams, leaders engaged in actions associated with the behaviors of management, transformational leadership, or servant leadership. The

themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Actions of management. The formal and informal leaders in Case 6 engaged in management tasks. The formal leader monitored instructional practice to ensure that the identified problems were being addressed. The informal leader facilitated meetings and delegated responsibilities to be carried out by other team members to ensure that the work of the team was completed.

Actions of transformational leadership. The leaders in Case 6 engaged in actions that reflected behaviors associated with transformational leadership. The formal leader worked with teams to establish school and student goals that he expected teams to reach by the end of the school year. The informal leader modeled the use of data and data-driven decision making to support the school vision for Data Teams. By modeling how to use data, he encouraged others, who followed by engaging in data-driven practices to guide their own instruction.

Actions of servant leadership. The leaders also demonstrated actions of servant leadership. The formal leader attended all team meetings to support the work of the group. He was available to help team members find information or answer questions. He was also supportive of teams implementing new programs, techniques, or strategies as long as what was proposed was supported by research. The informal leader provided individual support to team members to help them analyze student test results that were specific to their students.

Themes for leadership and management. The findings for the section were analyzed to identify the themes for the category, Leadership and Management. There were three themes that emerged from the analysis of information. The themes that emerged from the cross category

analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Evidence and artifacts. The leaders provided descriptions of the evidence and artifacts that were collected to determine the success of Data Teams. Evidence of student academic growth was described as being present in the scores reported from IXL learning website, FAST progress monitoring reports, and pretest and posttest results. The artifacts described by leaders included results from MAP, PAWS, FAST Learning, DIBELS, and classroom assessments. The formal leader also kept Data Team information in Google Docs and various assessment scores in a spreadsheet.

Themes for evidence and artifact. The findings for the section were analyzed to identify the themes for the category, Evidence and Artifacts. There were four themes that emerged from the analysis of data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Cross-category themes for Case 6. The findings for the case were analyzed to identify the cross-category themes. When information was compared across the categories inside and outside the case, two themes emerged for Case 6. The themes that emerged from the cross-category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Mental Model Case 7

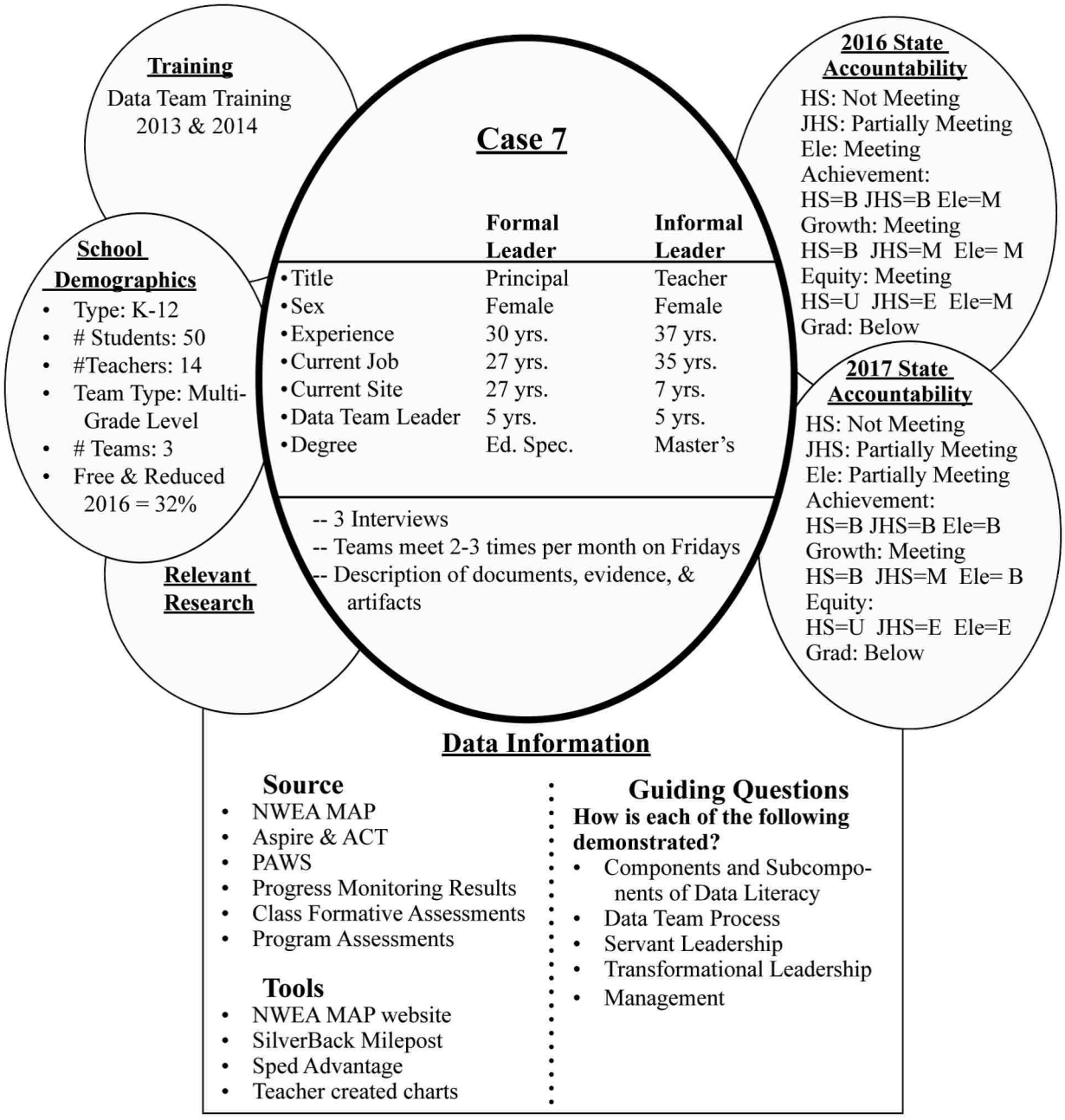

Figure 13. Case diagram for Case 7 for the 2016-2017 school year. School accountability results (Wyoming Department of Education, n.d.) are provided for 2015-2016 and 2016-2017 school year to provide evidence of growth. Abbreviations: Not Reported (Small School), Below (B), Meeting (M), Exceeding (E), Undefined (U).

School and Leaders. Case 7 begins with the description of the findings for the section, School and Leaders. The section contains two subsections. The first subsection describes school demographics and team meetings. The second subsection describes leader demographics and training. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

School demographics and accountability. The seventh case was a K-12 school that served approximately 50 students. During the 2015-2016 school year, thirty-two percent of the students qualified for free or reduced lunch. In this school, there were 14 certified teachers serving on three separate cross-grade-level teams (K-5, 6-12, & K-12). A district schedule provided teams the opportunity to meet together twice a month every other week during a Friday afternoon. An additional Friday was available if team members did not serve on district teams. During the 2015-2016 school year, the elementary school was found to be meeting expectations and the junior high school was found to be partially meeting expectations. Also, at the high school, the graduation rates were found to be below target and the school was not meeting expectations under the state's accountability model. During the 2016-2017 school year, the elementary school's score dropped to partially meeting expectations and the junior high school was found to be partially meeting expectations. In addition, the graduation rates at the high school remained below target and the school was not meeting expectations under the state's accountability model. Descriptions of the Data Teams Process used at the site that appear inside the case were gathered from interviews of one formal leader and one informal leader.

Leader demographics and training. The formal leader for this case was the school principal. She had an educational specialist degree and held endorsements in elementary education, middle school, and administration. Her formal data training consisted of a class in

research and a class in statistics during her master's program. She also participated in the Data Team training that was provided by the school district.

The informal leader was a K-12 teacher who held a bachelor's degree in elementary education with a specialist's degree in special education. She also held a master's degree in counseling psychology, as well as a specialist's degree in administration. She had extensive training in using data. Her formal training with data included classes in statistics and research during her master's program and she had taken classes in psychometrics when working on her specialist's degree in special education. She also attended the Data Teams training that was provided by the school district.

Themes for school and leaders. The findings for the subsections were analyzed to identify the themes for the category, School and Leaders. There were three themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Components of data literacy. Findings for how leaders use the six components of data literacy are presented next. Findings for each subsection describe the subcomponents of each of the components of the Data Literacy Conceptual Framework. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Identify Problems/Frame Questions. The data literacy component, Identify Problems/Frame Questions, was reviewed. Each of the four subcomponents was represented in the interview data of the formal and informal leader. The four subcomponents reviewed included (a) Articulate and Communicate the Problem/Question, (b) Involve Other Participants, (c) Understand Contextual Issues, and (d) Understand Student Privacy.

Findings for the case used to support the existence of the component, Identify Problems/ Frame Questions, were identified in actions described by formal and informal leaders. Interview transcriptions revealed that to articulate and communicate the problem or question, leaders and their teams reviewed information regarding student progress and then listed the concerns that were observed. To articulate the problem, the list was discussed to develop team members' understanding of what was shown in the data as well as to determine what additional data might be needed. Other participants with whom the results were shared included other general education teachers, special education teachers, and, when appropriate, parents. When reviewing data results, the leaders focused their teams on discussing only those issues that were under their control. Contextual issues identified by leaders that had previously been addressed that had the potential to impact data results were technology failures, scheduling concerns, and socio-economic concerns. The formal leader maintained data privacy by reminding staff that data were private and "could not be talked about downtown." To ensure data privacy when releasing results to the public, leaders only shared aggregated results for each school level (K-5, 6-8, & 9-12).

Use Data. The data literacy component, Use Data, was reviewed next. Each of the six subcomponents was represented in the interview data of the formal and informal leader. The six subcomponents reviewed included (a) Identify Possible Sources of Data, (b) Understand How to Generate Data, (c) Understand Data Properties, (d) Understand Data Quality, (e) Understand How to Access Data, and (f) Understand How to Analyze Data.

Findings for the case used to support the existence of the component, Use Data, were identified in the actions described by the formal and informal leader. Leaders identified multiple sources of data that were used at this site. Data sources identified included, NWEA MAP, ACT,

Aspire test, PAWS, progress monitoring results, class formative assessments, and program assessments. The leaders' understanding of how to generate data was evident in descriptions of the team's use of formative assessments to measure student progress. To ensure that scores were relevant and reliable, the informal leader favored the use of rubrics for scoring student work. Her description of relevance and reliability demonstrated her understanding of data properties. To ensure data quality, the informal leader noted that assessment scores needed to reflect information that was specific to the skill being measured. The leaders accessed and retrieved the data results from the NWEA website, SilverBack Milepost, SPED Advantage, and teacher-created charts. When analyzing data, leaders and teams were aware of how to use mean, median, mode and standard deviation. However, the percentile score was used most often. When examining data, leaders and teams identified trends that were occurring in cohort data and at the building level data. The leaders and teams also drilled down to the foundational level of the data to identify student skill deficits for each student. The progress-monitor data that was utilized to measure student skill deficits were regularly collected and analyzed to identify student growth.

Transform Data Into Information. The data literacy component, Transform Data Into Information, was reviewed next. Three of the four subcomponents of this component were represented in the interview data of the formal and informal leader. The subcomponents represented included (a) Consider Impact and Consequences (Intended and Unintended), (b) Test Assumptions, and (c) Understand How to Interpret Data. The subcomponent (d) Generate Hypotheses was not represented in leader descriptions.

Findings for the case used to support the existence of the component, Transform Data Into Information, were identified in actions described by leaders. Interview transcriptions for the case revealed that the leaders and their teams considered the impact and consequences that their

actions had on decision making. To ensure that meetings were focused on data and not the opinion of those who wanted to push their own agenda, meeting norms were followed. To ensure that teams were considering best practices, leaders had team members provide and discuss various examples from the research literature when exploring solutions to a problem. Though leaders and teams discussed problems and worked to implement interventions, there was little follow through to test the effectiveness of the change. The informal leader noted that "they were always anticipating the progress students would make, [but] some of those students needed progress monitoring by another tool and sometimes that was provided them and sometimes not." When leaders were interpreting and presenting the data to others, they used graphs to present an overview of aggregated results for each tested area. When working with each student or parent, the informal leader presented all of the student's data to provide a full picture. She explained the difference between raw scores and the percentile scores and described the performance level for each skill area tested.

Transform Information into Decision. The data literacy component, Transform Information Into Decision, was reviewed next. The two subcomponents were represented in the interview data of the formal and informal leader. The two subcomponents reviewed included, (a) Determine Next Instructional Steps and (b) Understand Context for the Decision.

Findings for the case used to support the existence of the component, Transform Information Into Decision, were identified in actions described by leaders. Next steps were discussed and determined by a school level committee. As the school had only two elementary teachers, one English teacher and one math teacher, the leaders and the team examined the data for students in grade k-12. When examining the data, the leaders and their team looked for foundational skills that required intervention. The leaders and team came up with a list of

strategies and corresponding interventions that they wanted to implement. If a strategy worked, the practice was continued; if the strategy did not work, something new was tried. The content standards and the associated foundational skills provided the context for leaders' decisions.

Evaluate Outcomes. The data literacy component, Evaluate Outcomes, was reviewed last. There were portions of two subcomponents represented in the interview data of the formal and informal leader. The subcomponents reviewed included (a) Consider Need for Iterative Decision Cycles and (b) Re-examine Original Question or Problem.

Findings for the case used to support the existence of the component, Evaluate Outcomes, were identified in actions described by leaders. The leaders' descriptions of Data Team meetings revealed that the iterative process that was implemented at the site was missing some of the steps of the Data Teams Process. The Data Team steps described by leaders included meeting every two weeks to (1) review the data, (2) identify problems, (3) identify strategies or interventions, (4) Implement for a designated period of time, (5) review student progress, and (6) make changes as needed. While the leaders observed that students had shown growth, formal measures to evaluate that growth were not evident in the leaders' descriptions of the process.

Themes for components of data literacy. The findings for the subsection were analyzed to identify the themes for the category, Components of Data Literacy. There were five themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Leadership and management. In Case 7, the support of formal and informal leaders was identified as being necessary. The leaders facilitated the process, ensured that meeting norms were followed, and supported the work of the team. To provide support to teams, leaders

engaged in actions associated with the behaviors of management and servant leadership. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Actions of management. The formal and informal leaders in Case 7 engaged in management tasks. The formal leader required staff to turn in a written report on students that were being monitored. The leaders enforced meeting times, meeting norms, and held members accountable for providing agreed upon programs and strategies.

Actions of servant leadership. The leaders also demonstrated actions of servant leadership. The formal leader supported team members by getting them whatever they needed to implement practices. The informal leader served as a resource to help other members. She provided feedback about strategies and helped others reflect on their work. She assisted teachers who were unfamiliar with data practice and helped them understand and apply the data. She regularly offered information to others about student learning styles, student personality, and student characteristics to support their implementation of interventions or strategies.

Themes for leadership and management. The findings for the section were analyzed to identify the themes for the category, Leadership and Management. There were two themes that emerged from the analysis of information. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Evidence and artifacts. The leaders provided descriptions of the evidence and artifacts that were collected to determine the success of Data Teams. Evidence of student growth was not evident in the leaders' descriptions. The artifacts described by leaders included results from

MAP, PAWS, progress monitoring results, data charts, classroom assessments, student work samples and program assessments. The leaders also kept meeting agendas and notes.

Themes for evidence and artifacts. The findings for the section were analyzed to identify the themes for the category, Evidence and Artifacts. There were two themes that emerged from the analysis of data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Cross-category themes for Case 7. The findings for the case were analyzed to identify the cross-category themes. When information was compared across the categories inside and outside the case, two themes emerged for Case 7. The themes that emerged from the cross-category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Mental Model Case 8

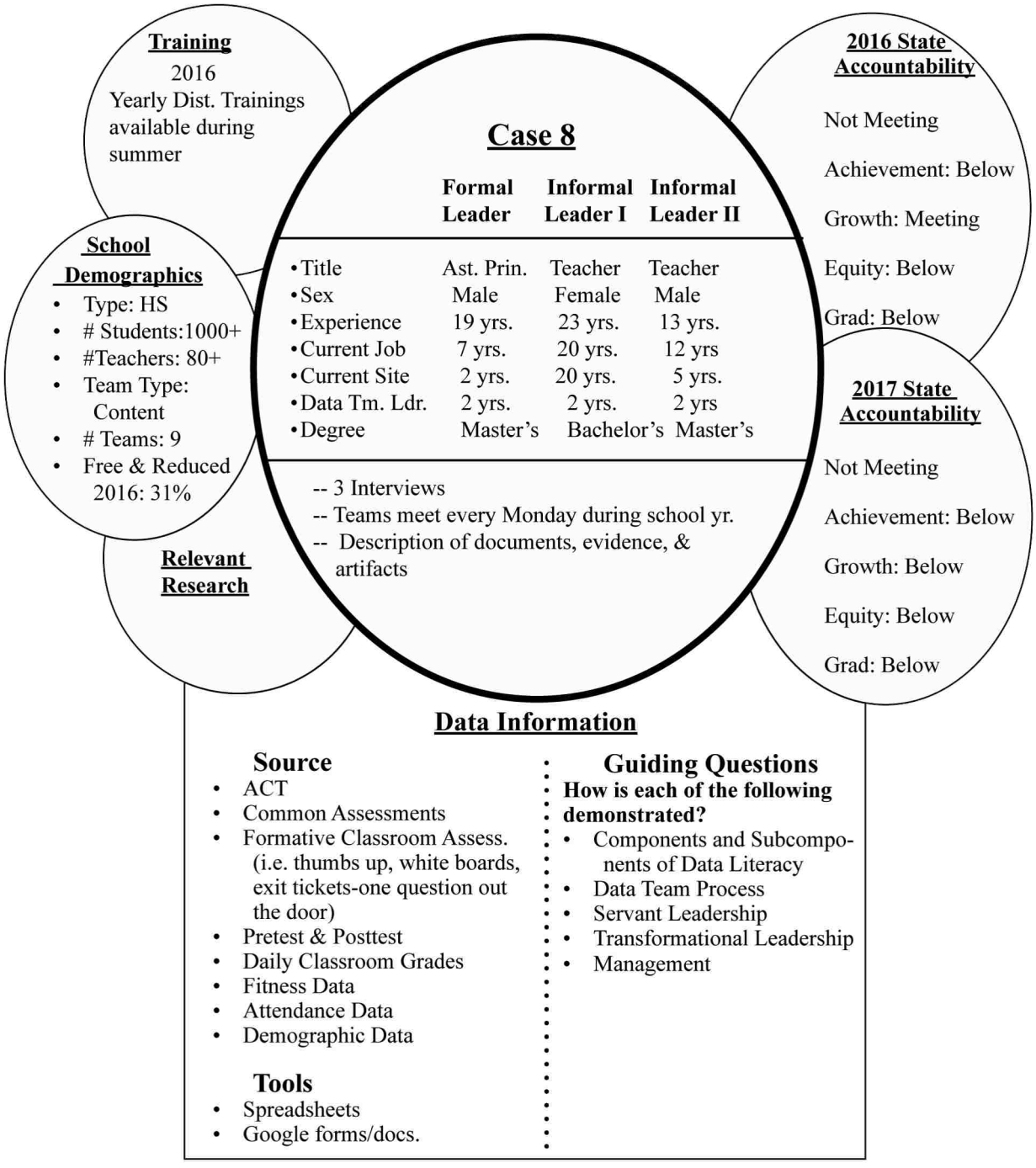

Figure 14. Case diagram for Case 8 for the 2016-2017 school year. School accountability results (Wyoming Department of Education, n.d.) are provided for 2015-2016 and 2016-2017 school year to provide evidence of growth.

School and Leaders. Case 8 begins with the description of the findings for the section, School and Leaders. The section contains two subsections. The first subsection describes school demographics and team meetings. The second subsection describes leader demographics and training. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

School demographics and accountability. Case Number eight was a high school that served over 1000 students. During the 2015-2016 school year, thirty-one percent of the students in the school qualified for free or reduced lunch. In this school, there were over 80 certified teachers serving on nine department teams. A district schedule provided the opportunity for teams to meet for 40 minutes every week. During the 2015-2016 school year, the graduation rates for the school were below targets and the school was found to be not meeting expectations under the state's accountability model. During the 2016-2017 school year, the graduation rates for the school were below targets and again, the school was found to be not meeting expectations. Descriptions of the Data Teams Process used at the site that appear inside the case were gathered from interviews of one formal leader and two informal leaders.

The formal leader for this case was the assistant principal who held a master's degree in educational administration, as well as a master's degree in sports management and sports studies. He was certified as a strength and conditioning specialist with distinction. He had minimal formal data training; however, he participated in Data Team training provided by the district during the winter and summer of 2016.

There were two informal leaders for this case. The first was a physical education teacher who held a bachelor's degree in secondary education with an endorsement in physical education

and coaching. She received no formal data training during her degree program; however, she had attended the district Data Team training during the summer of 2016.

The second informal leader was a fine arts teacher who held a master's degree in music education with an endorsement in K-12 music. His formal training included a research methods class, as well as a class in research statistics that he took when completing his master's program. He also attended Data Team training provided by the district during the 2015-2016 school year.

Themes for school and leaders. The findings for the subsections were analyzed to identify the themes for the category, School and Leaders. There were two themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Components of data literacy. Findings for how leaders use the six components of data literacy are presented next. Findings for each subsection describe the subcomponents of each of the components of the Data Literacy Conceptual Framework. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Identify Problems/Frame Questions. The data literacy component, Identify Problems/Frame Questions, was reviewed. Each of the four subcomponents of this component was represented in the interview data of the formal and informal leader. The four subcomponents reviewed included (a) Articulate and Communicate the Problem/Question, (b) Involve Other Participants, (c) Understand Contextual Issues, and (d) Understand Student Privacy.

Findings for the case used to support the existence of the component, Identify Problems/Frame Questions, were identified in actions described by the formal and informal

leaders. Interview transcriptions revealed that to articulate and communicate the problem or question, leaders and their teams reviewed assessment results and discussed the identified areas or skills where students needed additional support. Other participants with whom the results were shared included students, parents, other teachers or teacher teams, other district teams, and, when applicable, community members. When considering contextual factors, the formal leader noted the need to have a dialog and ask probing questions. The informal leaders were sensitive to student needs. Their descriptions focused on finding the variables that might impact learning such as schedules and changes to schedules. They also considered the impact on learning for students at risk, those identified as learning disabled, or those receiving free or reduced lunch. When sharing data, names of students were not mentioned, and all applicable laws involving confidentiality of student records were followed. To alleviate concern on the student's part, leaders, when sharing each student's data results with the student, were forthcoming with information about who had access to the student's data, why they had that access, and how the data would be used.

Use Data. The data literacy component, Use Data, was reviewed next. Each of the six subcomponents was represented in the interview data of the formal and informal leaders. The six subcomponents reviewed included (a) Identify Possible Sources of Data, (b) Understand How to Generate Data, (c) Understand Data Properties, (d) Understand Data Quality, (e) Understand How to Access Data, and (f) Understand How to Analyze Data.

Findings for the case used to support the existence of the component, Use Data, were identified in the actions described by the formal and informal leaders. The leaders identified multiple sources of data that were used at the site. Data sources identified included, ACT, common assessments, formative classroom assessments (i.e., thumbs up, whiteboards, and exit

ticket-one question out the door), pretests and posttests, daily classroom grades, fitness data, attendance data, and demographic data. The leaders' understanding of how to generate data was evident in descriptions of the team's use of formative classroom assessments to measure student progress. The understanding was also evident in the use of pretests and posttests to measure the short-cycle growth of students. The leaders' understanding of data properties was linked to their need to examine assessments against the standards to determine relevance. The leaders did not describe how they determined the reliability of a particular measure. Instead, they described their practice of comparing assessment results against classroom assessments and daily grades. To ensure data quality, the leaders and their teams checked assessments to determine if questions were understandable. To access some of the data results, the leaders relied on a staff member who had previously been a district instructional facilitator to retrieve the data for them from online sites. The leaders and their teams also accessed short-cycle data, which was kept on Google Docs and spreadsheets.

To analyze data, the leaders and their teams engaged in discussions about team members' interpretation of the data. Results were analyzed to identify areas of weakness and specific skill deficits of students. Spreadsheets were constructed to capture the data results. Though the formal leader expressed concern that teams were limited in their use of measures of central tendency, the informal leaders described using mean, median and mode to compare the results between various groups. The leaders also described analyzing data to identify the percentage of students who scored at each proficiency level on a particular assessment.

Transform Data Into Information. The data literacy component, Transform Data Into Information, was reviewed next. Each of the four subcomponents of this component was represented in the interview data of the formal and informal leader. The four subcomponents

reviewed included (a) Consider Impact and Consequences (Intended and Unintended), (b) Generate Hypotheses, (c) Test Assumptions, and (d) Understand How to Interpret Data.

Findings for the case used to support the existence of the component, Transform Data Into Information, were identified in actions described by the leaders. Interview transcriptions for the case revealed that the leaders considered impact and consequences when analyzing the effectiveness of instructional strategies. The leaders also discussed the impact that schedules and other contextual factors had on student assessment results. To generate hypotheses about what may or may not be causing changes in the data, leaders asked probing questions which were used to set team goals. Goals addressed the results that leaders and their teams wanted to see within a set amount of time. Goals also addressed what members would do to support student growth within the cycle. To test assumptions, the leaders and their teams engaged in action research by implementing various instructional strategies and using pretests and posttests to determine how the change had impacted results. The leaders and their teams also examined demographic data, schedules, and other data sources to validate or refute the assumptions made. When the leaders and their teams interpreted data results, they would discuss what they saw. When presenting the data to other stakeholders, the leaders provided a description of the skills that were addressed and the growth that the student or group of students had made.

Transform Information Into Decision. The data literacy component, Transform Information Into Decision, was reviewed next. The two subcomponents of this component were represented in the interview data of the formal and informal leader. The two subcomponents reviewed included (a) Determine Next Instructional Steps and (b) Understand Context for the Decision.

Findings for the case used to support the existence of the component, Transform Information Into Decision, were identified in actions described by leaders. Interview transcriptions for the case revealed that leaders and their teams determined next steps by engaging in a conversation about the strategy that would best fit the identified need. To determine the strategy to be used, the team utilized a resource provided by the district that included a description of instructional strategies identified in the research of John Hattie (2009). The leaders supported their teams in choosing a strategy that had been found by Hattie (2009) to have a high effect size. When determining next steps, teams reviewed ACT scores and standardized test scores for those students who had not taken the ACT to identify student deficiencies in meeting literacy standards. The context for Data Team decisions made by all leaders and teams at the school was focused on identifying gaps and supporting student growth on the reading literacy standards. For departments that traditionally had not been charged with teaching reading literacy, the content standards provided a roadmap to build and monitor instruction.

Evaluate Outcomes. The data literacy component, Evaluate Outcomes, was reviewed last. The two subcomponents of this component were represented in the interview data of the formal and informal leader. The subcomponents reviewed included (a) Consider Need for Iterative Decision Cycles and (b) Re-examine Original Question or Problem.

Findings for the case used to support the existence of the component, Evaluate Outcomes, were identified in actions described by leaders. The leaders' descriptions of Data Team meetings revealed the iterative process that was implemented at the site. The Data Team met every seven days for 40 minutes to discuss their progress. One informal leader utilized the Data Team training guide provided by the district to lead the process. The leaders described the need to get

through all steps of the Data Team cycle. The steps that were described by leaders included (a) pretest to identify need, (b) analyze the data, (c) identify instructional techniques, (d) set goals, (e) implement the technique over a specified time, (f) posttest and examine results, (g) go back through the cycle. When posttest results were examined, leaders compared the results for each of their groups to identify whether the original problem had been addressed. When there was a marked difference between the results collected by each member, the leader and their team evaluated their results and inquired of other members about their use of the selected strategy. Through those conversations, the leader and the team examined needed changes and discussed decisions about whether to continue with the problem or identify a new one.

Themes for components of data literacy. The findings for the subsection were analyzed to identify the themes for the category, Components of Data Literacy. There were five themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Leadership and management. In Case 8 the support of formal and informal leaders was identified as being necessary. The leaders described that they were needed to model the process and ensure that teams engaged in the process in a meaningful way. The limited time that leaders and teams had for engaging in the Data Teams Process was recognized as a challenge. To address challenges and provide support to teams, leaders engaged in actions associated with the behaviors of management, transformational leadership, or servant leadership. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Actions of management. The formal and informal leaders in Case 8 engaged in management tasks. Tasks of the formal leader included attending the meetings to monitor the work of the teams and the process. The informal leaders ran meetings, helped to organize data and trained other members of their team on the process.

Actions of transformational leadership. The informal leaders in Case 8 engaged in actions that reflected the behaviors associated with transformational leadership. They provided a vision of how a reading literacy goal could be implemented successfully into a co-curricular area without sacrificing course content. They modeled the process and encouraged members to explore new approaches and take on new challenges. They were confident in their belief, and conveyed that to others to build an understanding of the process among team members. Their work with the Data Teams Process inspired others and transformed not only their teaching practices but also those of others on their team who sought advice and support from the leaders.

Actions of servant leadership. The informal leaders also demonstrated actions of servant leadership. The descriptions of their work with Data Teams demonstrated that they were team members first as they perceived their role in the team as being equal to others. They took their turn at performing the various team roles. They helped others interpret the data results of their students and worked with them to brainstorm solutions to address instructional concerns. They continually worked to foster relationships and ensure the success of all.

Themes for leadership and management. The findings for the section were analyzed to identify the themes for the category, Leadership and Management. There were three themes that emerged from the analysis of information. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Evidence and artifacts. The leaders provided descriptions of the evidence and artifacts that were collected to determine the success of Data Teams. Student growth was evident in leaders' descriptions of results identified during the short-cycle process. To collect data on results, each team member kept a spreadsheet of data for their class or group. The data from individual spreadsheets was added to the team's shared Google Docs. Artifacts for the team included the shared Google doc, the district data training book, the district resource that included instructional strategies taken from Hattie's (2009) research, ACT results, and state accountability results.

Themes for evidence and artifacts. The findings for the section were analyzed to identify the themes for the category, Evidence and Artifacts. There were five themes that emerged from the analysis of data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Cross-category themes for Case 8. The findings for the case were analyzed to identify the cross-category themes. When information was compared across the categories inside and outside the case, two themes emerged for Case 8. The themes that emerged from the cross-category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Mental Model Case 9

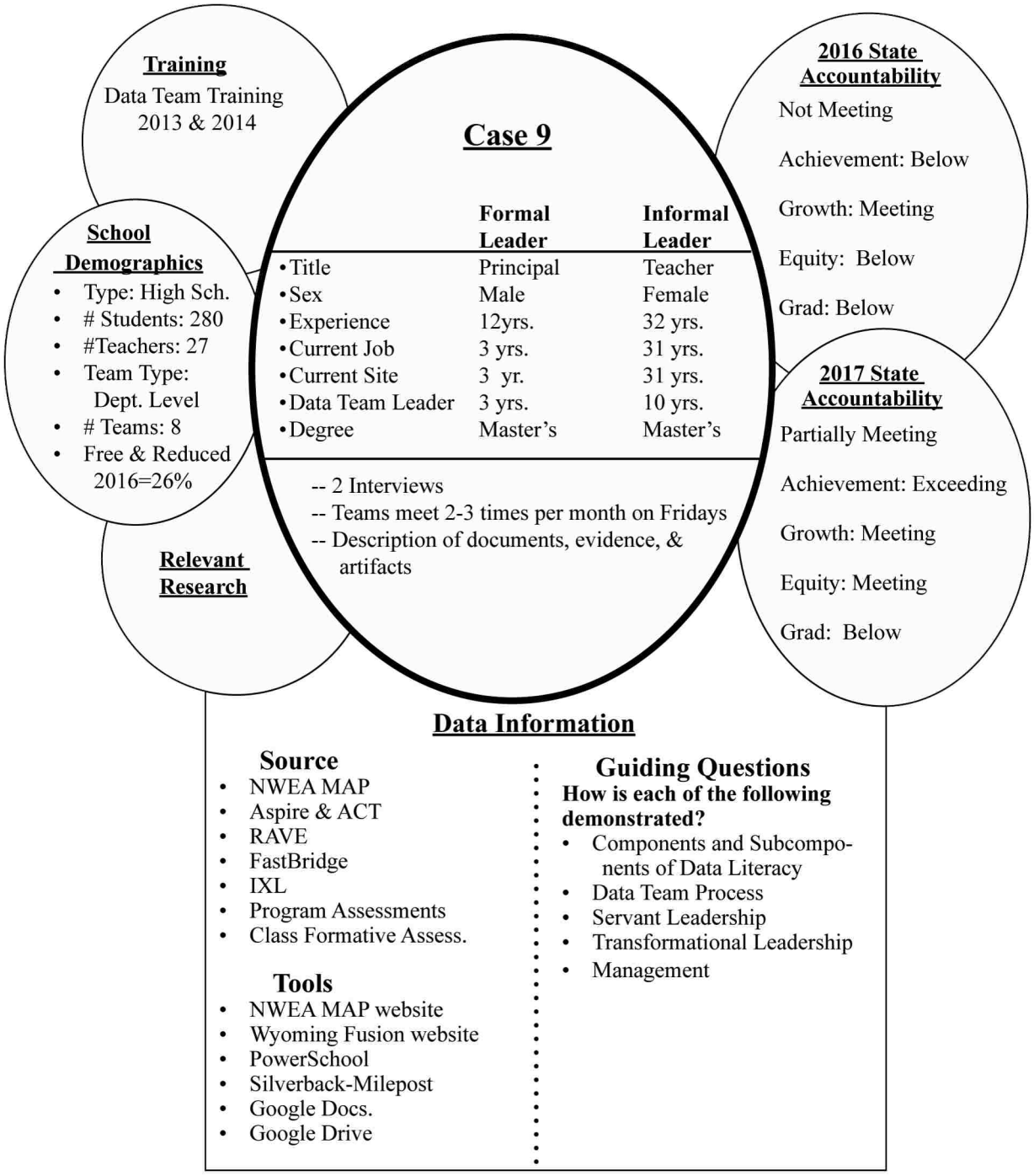

Figure 15. Case diagram for Case 9 for the 2016-2017 school year. School accountability results (Wyoming Department of Education, n.d.) are provided for 2015-2016 and 2016-2017 school year to provide evidence of growth.

School and Leaders. Case 9 begins with the description of the findings for the section, School and Leaders. The section contains two subsections. The first subsection describes school demographics and team meetings. The second subsection describes leader demographics and training. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

School demographics and accountability. Case number nine was a high school that served approximately 280 students. Over twenty-six percent of the students in the school qualified for free or reduced lunch in 2016. In this school, there were 27 certified teachers serving on three cross-curricular building level teams and eight department teams. A district schedule provided teams the opportunity to meet together every other week during a Friday afternoon. An additional Friday was available if team members did not serve on district teams. During the 2015-2016 school year, the school scored below the graduation target and was found to be not meeting requirements under the state's accountability model. During the 2016-2017 school year, the graduation rate was below target, and the school's overall accountability score increased to partially meeting. The increase during the 2017 school year, was attributed to an increase of three points on the overall student ACT score for the school.

Leader demographics and training. The formal leader for this case was the assistant principal who held a master's degree in curriculum and instruction with an endorsement in educational leadership for principal k-12. He also held teaching endorsements in biology and physical science, as well as coaching endorsements for head coach basketball, and head coach football. His formal training consisted of the classes in statistics and research that were included in each of his two degree areas. He also described attending other data training before being employed in his current position. While he did not participate in district training on Data Teams,

he was provided "bits and pieces" by the district in training sessions before the start of school each year.

The informal leader was a high school teacher who held a master's degree in educational technology and bachelor's in English Education. Her formal data training consisted of a statistics class that was included in her master's program. She also participated in PLC training presented by the DuFours, an assessment training provided by the state, a training held in Portland, and the Data Team training provided by the district during the 2013-2014 school year. In addition, she tried to build her understanding of the process through reading.

Themes for school and leaders. The findings for the subsections were analyzed to identify the themes for the section, School and Leaders. There were three themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Components of data literacy. Findings for how leaders use the six components of data literacy are presented next. Findings for each subsection describe the subcomponents of each of the components of the Data Literacy Conceptual Framework. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Identify Problems/Frame Questions. The data literacy component, Identify Problems/Frame Questions, was reviewed. Each of the four subcomponents of this component was represented in the interview data of the formal and informal leader. The four subcomponents reviewed included (a) Articulate and Communicate the Problem/Question, (b) Involve Other Participants, (c) Understand Contextual Issues, and (d) Understand Student Privacy.

Findings for the case used to support the existence of the component, Identify Problems/Frame Questions, were identified in actions described by the formal and informal leaders. Interview transcriptions revealed that to articulate and communicate the problem or question, leaders and their teams started the process by reviewing scores from MAP, Aspire test, and ACT to identify where skills deficits were occurring for each cohort of students. That process was used to support a building goal in either math or language arts that was to be supported by teams. Teams examined the data for individual students in each of their courses to identify specific areas of need. Participants with whom the results were shared included, students, parents, CTE teachers, and the school board. When considering contextual factors, the formal leader sought to identify and address student needs for meals, housing, health, and counseling. Student eligibility to participate in extra-curricular activities was also considered. The informal leader considered variables that occurred during testing, such as the absence of a teacher or student apathy. All understood the need for data privacy. Student level data results were available and discussed only with those who were allowed access. The district controlled electronic access to some of the student data. Staff were reminded that all paper copies that contained identifiable information about students were to be shredded.

Use Data. The data literacy component, Use Data, was reviewed next. Each of the six subcomponents was represented in the interview data of the formal and informal leader. The six subcomponents reviewed included (a) Identify Possible Sources of Data, (b) Understand How to Generate Data, (c) Understand Data Properties, (d) Understand Data Quality, (e) Understand How to Access Data, and (f) Understand How to Analyze Data.

Findings for the case used to support the existence of the component, Use Data, were identified in the actions described by the formal and informal leader. The leaders identified

multiple sources of data that were used at the site. Data sources identified included NWEA MAP, ACT, Aspire test, RAVE, FAST, IXL learning website, program assessments, and class formative assessments. The leaders' understanding of how to generate data was evident in descriptions of formative classroom assessments that were developed by the team and individual team members to provide evidence of a particular student need or growth. The leaders' understanding of data properties was linked to their need to measure the content and standards embedded in the curriculum maps to determine relevance. The informal leader and her team compared assessment results between fall NWEA MAP and eighth grade PAWS to determine if results were consistent and reliable. She and her team also reviewed the quality of course assessments by reviewing the tests to determine if each measured what was intended to be measured. The leaders shared and accessed data using online programs and sites.

The leaders accessed data from the (a) NWEA website, (b) Wyoming Fusion website, (c) PowerSchool, and (d) Silverback-Milepost. Data and information were shared using Google Docs and Google Drive. To analyze data, the leaders and their teams engaged in discussions. The building level and cohort level results for district and state summative assessments were analyzed first. Data were disaggregated to identify results for boys and girls. The leaders and their teams then examined the results at the strand level to identify the areas where additional focused instruction was needed. Individual student results were analyzed next to identify those students needing extra support. Throughout the year, content area teams analyzed program assessment data and formative assessment data to identify group and individual student needs. The leaders and their teams used Lexile scores to guide and support student reading goals. The informal leader used the mean scores and median scores when reviewing student progress on

program assessments and formative assessments. Results were used to guide decisions regarding next instructional steps.

Transform Data Into Information. The data literacy component, Transform Data Into Information, was reviewed next. Two of the four subcomponents of this component were represented in the interview data of the formal and informal leader. The subcomponents represented included (a) Generate Hypotheses, (b) Test Assumptions, and (c) Understand How to Interpret Data. The subcomponent, (d) Consider Impact and Consequences (Intended and Unintended), was not represented in leader descriptions.

Findings for the case used to support the existence of the component, Transform Data Into Information, were identified in actions described by the formal leaders. Interview transcriptions for the case revealed that generating a hypothesis and goal setting occurred only in the work of the building team. The formal leader supported the team in making the hypothetical connections about student scores on the ACT. To make the hypothetical connections, the team reviewed assessment results from other measures and discussed why the problem might be occurring. To get to the root cause of the problem, the leader and his team used the questioning strategy of the five whys. The information was used to develop a building goal that addressed raising the composite score on the ACT to 22 by the following year. To support the goal, time was scheduled for students to complete the online John Bayler test preparation course. In addition, the content teams were charged with supporting student reading. To test assumptions, the leaders and their teams compared results of summative assessments against their curriculum maps to identify missing or incomplete information in the curriculum. The leaders also talked with students about their perceptions of curriculum and instructional needs to gain evidence to support assumptions. The informal leader and her team tested assumptions by implementing

new classroom practices and using teacher observation and formative assessment results to examine the impact of the practice on student growth. To interpret data, leaders discussed assessment results with their teams and described individual student results for parents and students.

Transform Information Into Decision. The data literacy component, Transform Information Into Decision, was reviewed next. The two subcomponents of this component were loosely represented in the interview data of the formal and informal leader. The two subcomponents reviewed included, (a) Determine Next Instructional Steps and (b) Understand Context for the Decision.

Findings for the case used to support the existence of the component, Transform Information Into Decision, were identified in actions described by leaders. Interview transcriptions for the case revealed that the informal leader and her team determined next steps by making observations about class and individual student performance and discussing the steps needed to remediate deficits or enrich learning. At the building level, the formal leader and his team provided members with instructional strategies from the book, *The Core Six: Essential Strategies for Achieving Excellence with the Common Core,* by Silver and Dewing (2012). The strategies were to be used by all content teams to support team discussions and decisions about student instruction. To provide a context for decisions the leaders and their teams continually reflected on the standards and content embedded in their curriculum maps.

Evaluate Outcomes. The data literacy component, Evaluate Outcomes, was reviewed last. One of the two subcomponents was loosely represented in the interview data of the formal and informal leader. The subcomponent, Consider Need for Iterative Decision Cycles was

reviewed. There was no evidence found in leader descriptions for the subcomponent, Re-examine Original Question or Problem.

Findings for the case used to support the existence of the component, Evaluate Outcomes, were identified in actions described by leaders. The leaders' descriptions of Data Team meetings revealed the iterative process that was implemented at the site. The informal leader's description of Data Team meetings revealed that the iterative process used included (a) review assessment results, (b) identify strategy or practice, (c) implement the strategy or practice, and (d) share and review observations and results of formative assessments. She described utilizing practices learned during the district Data Team training to support the work being done by the team.

Themes for components of data literacy. The findings for the subsection were analyzed to identify the themes for the category, Components of Data Literacy. There were five themes that emerged from the analysis of this data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Leadership and management. In Case 9, the support of the formal and informal leaders was identified as being necessary. The leaders described that they were needed to keep teams moving forward with practices that produced student academic growth. To address challenges and provide support to teams, leaders engaged in actions associated with the behaviors of management, transformational leadership, or servant leadership. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Actions of management. The formal and informal leader in Case 9 engaged in management tasks. Tasks of the formal leader included attending the meetings to monitor the

work of the teams and the process. He organized and led the building level meetings. He also set and enforced expectations for meeting practices. The informal leader organized and ran the content team meeting. She held members accountable for following meeting norms. She ensured that meetings stayed on topic, and agreed upon deadlines were met.

Actions of transformational leadership. The formal leader in Case 9 engaged in actions related to behaviors associated with transformational leadership. He shared his vision of having the school raise the ACT composite score. The vision became part of the school goal and he guided and encouraged staff to identify practices that would support the goal. Staff embraced the vision which resulted in an increase in student score results for the ACT.

Actions of servant leadership. The leaders also demonstrated actions of servant leadership. The formal leader described himself as an instructional leader who worked side by side with team members to help them understand data and make instructional adjustments. He described providing members with professional development to support their personal growth goals. He also described sitting down with each to discuss instructional strategies or to provide support on how to analyze individual student data. The informal leader shared work examples and ideas with other team members and wrote assessments that were shared with the team. She also encouraged and supported the work of each team member.

Themes for leadership and management. The findings for the section were analyzed to identify the themes for the category, Leadership and Management. There were three themes that emerged from the analysis of information. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Evidence and artifacts. The leaders provided descriptions of the evidence and artifacts that were collected to determine the success of Data Teams. Student growth was evident in leaders' descriptions of ACT composite scores. Artifacts for the team included the PLC agenda and notes; a list of strategies from the book *The Core Six: Essential Strategies for Achieving Excellence with the Common Core*, by Silver and Dewing (2012); assessment results from ACT, NWEA MAP, and Rave; student work samples; honor roll lists; and state accountability results.

Themes for evidence and artifacts. The findings for the section were analyzed to identify the themes for the category, Evidence and Artifacts. There were four themes that emerged from the analysis of data. The themes that emerged from the cross category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Cross-category themes for Case 9. The findings for the case were analyzed to identify the cross-category themes. When information was compared across the categories inside and outside the case, two themes emerged for Case 9. The themes that emerged from the cross-category analysis of the data for this case are listed in Table 5 in the Multiple Case Analysis section of this chapter.

Multiple Case Analysis

There were nine cases that were analyzed for this multicase study and there were multiple themes that emerged from each case. In total, twenty-two original themes emerged from the multicase study (Table 2).

Table 2. The emerging themes by case.

Case Themes	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9
School and Leaders									
The leaders had little formal training in how to analyze quantitative data.	X	X	X						X
The leaders each held at least one master's degree.	X	X	X	X	X	X	X		X

Case Themes	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9
The leaders were employed in the district when Data Teams training was provided.	X	X	X	X			X	X	
The school district provided training and meeting time to support the Data Teams Process.	X	X	X	X	X	X	X	X	X
Components of Data Literacy									
The leaders and their teams discussed quantitative and qualitative results from various forms of assessments (formative and summative) to identify student needs and measure student growth.	X	X	X	X	X	X	X	X	X
The leaders and their teams continuously engaged in non-evaluative discussions to review data and instructional practices.	X	X	X	X				X	X
The leaders and their teams engaged in action research to test the impact of strategies, practices or programs on student learning.	X	X	X	X		X	X	X	X
The leaders and their teams utilized student proficiency levels and percentage or percentile scores to analyze and interpret the data and identify the problem to be addressed.	X	X	X	X	X	X	X	X	X
The leaders and their teams used assessment websites to access and mine data results.	X	X	X	X	X	X	X		X
The leaders and their teams utilized assessments that aligned with curriculum maps or measured content standards.	X	X	X	X			X	X	
Leadership & Management									
Actions that demonstrated the use of management practices were used by leaders to support the work of Data Teams.	X	X	X	X	X	X	X	X	X
Actions associated with behaviors of transformational leadership were used by the leaders to support the work of Data Teams.	X	X	X	X	X	X		X	X
Actions associated with behaviors of servant leadership were used by the leaders to support the work of Data Teams.	X	X	X	X	X	X	X	X	X
Evidence & Artifacts									

Case Themes	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9
Evidence of the work done by the teams was found in Data Team agendas, notes, or Data Team forms.	X	X	X	X	X		X	X	X
The described artifacts included the results gathered from multiple formative and summative assessments.	X	X	X	X	X	X	X	X	X
The described artifacts included school or district-provided resources that were used by leaders and their teams for decision making.		X		X		X		X	X
The use of a data-driven process contributed to student academic growth, as evidenced in leaders' descriptions.	X	X	X	X		X		X	X
The described artifacts include spreadsheets used by leaders and teams to collect or chart data results.		X		X		X		X	
Data Teams Process									
The leaders and their teams used the Data Teams Process to determine student placement in differentiated instructional groups or individual interventions.	X	X	X	X		X	X		
The school or district provided resources that were used by leaders and their teams to guide decisions and support the Data Teams Process		X	X	X	X	X		X	X
Cross Category Themes									
Evidence of short-cycle growth reported by leaders was not evident in state accountability reports for the site	X		X	X	X	X	X	X	
The leaders and their teams accessed multiple sources of data which were used to discuss the progress being made by individual students, classroom populations, grade-level populations, and building populations.	X	X	X	X	X	X	X	X	X

Note: Themes that emerged from each case are displayed. X = emerged from the case.

When information from each of the cases was aggregated, two additional themes emerged. The twenty-four themes were charted using Stake's (2006) worksheet entitled, Estimates of

Ordinariness of the Situation of Each Case and Estimates of Manifestation of Multicase Themes in Each Case (Stake, n.d.). The worksheet appears in Table 5 at the end of the section.

Using the multicase worksheet. Within the worksheet, each theme was coded first to describe the ordinariness of each theme for each case as it related to the other cases in the study. Second, each theme was coded to describe the level of manifestation for each theme for each case in the study. The analysis was used to describe the importance of each theme in the study. Of the twenty-four themes, there were two that represented the Data Teams Process. As the manifestation of the process was an integral part of the research, the Multi-case analysis for the study begins with the multicase analysis of the Data Teams Process. The description of findings from the multicase analysis of the multicase themes for nine cases in the study follows.

Analyzing the Data Teams Process. As the Data Teams Process was used as a framework within which the components and subcomponents of the inquiry cycle for data literacy were examined, the use of that process and the themes associated with that process were analyzed first. To begin, the two inquiry cycles were overlaid to identify where there was alignment between the two. When the inquiry cycle for the Data teams Process was laid on top of the inquiry cycle for the Data Literacy Conceptual Framework, the resulting image revealed that that the various steps of the Data Teams Process were described or replicated in the various subcomponents of the Data Literacy Conceptual Framework. Step one of the process, **Collect and Chart Data**, included five of the six subcomponents of the Data Literacy component, Use Data. The five subcomponents of the component, Use Data, included in step one were (a) Identify Possible Sources of Data, (b) Understand How to Generate Data, (c) Understand Data Properties, (d) Understand Data Quality, and (e) Understand How to Access Data. The sixth subcomponent, of the component Use Data, which was, Understand How to Analyze Data, was

described in step two of the process, **Analyze Data and Prioritize Needs**. Included in step two were the four subcomponents of the component Identify Problems/Frame Questions, which included (a) Articulate and Communicate the Problem/Question, (b) Involve Other Participants, (c) Understand Student Privacy, and (d) Understand Contextual Issues. Step two also included the subcomponent, Understand How to Interpret Data, which belonged to the component, Transform Data Into Information. The remaining subcomponents of the component Transform Data Into Information, were reflected in step three of the process, **Establish SMART Goals**. The three subcomponents of the component, Transform Data Into Information that were described by step three included (a) Consider Impact and Consequences (Intended and Unintended), (b) Generate Hypothesis, and (c) Test Assumptions. Step four and step five of the process, **Select Instructional Strategies** and **Determine Results Indicators**, were reflected in the subcomponents for the Data Literacy Component, Transform Information Into Decision, which included the subcomponents, (a) Determine Next Instructional Steps, and (b) Understand Context for the Decision. Finally, Step six of the process, **Monitor and Evaluate Results** was reflected in the Data Literacy component, Evaluate Outcomes, which was included the subcomponents, (a) Consider the Need for Iterative Decision Cycles, and (b) Re-examine Original Question or Problem. The six steps of the Data Teams Process with associated components and subcomponents of the Data Literacy Conceptual Framework are shown in Table 3.

Table 3. Data Teams Process aligned with the Data Literacy Conceptual Framework

Steps of Data Teams Process	**Step 1 Collect and Chart Data**	Step 2 **Analyze Data and Prioritize Needs**	Step 3 **Establish SMART Goals**	Step 4 **Select Instructional Strategies** Step 5 **Determine Results Indicators**	Step 6 **Monitor and Evaluate Results**
Components and Subcomponents Of Data Literacy	**Use Data**: *Identify Possible Sources of Data*	Use Data: *Understand How to Analyze Data*	Transform Data into Information: *Consider Impact and Consequences (Intended and Unintended)*	Transform Information Into Decision: *Determine Next Instructional Steps*:	Evaluate Outcomes: *Consider Need for Iterative Decision Cycle*

	Use Data: *Understand How To Generate Data*	Identify Problems/Frame Questions: *Articulate and Communicate the Problem/Question*	Transform Data into Information: *Generate Hypotheses*	Transform Information Into Decision: *Understand Context for the Decision*	Evaluate Outcomes: *Re-examine Original Question or Problem*
	Use Data: *Understand Data Properties*	Identify Problems/Frame Questions: *Involve Other Participants*	Transform Data into Information: *Test Assumptions*		
	Use Data: *Understand Data Quality*	Identify Problems/Frame Questions: *Understand Student Privacy*			
	Use Data: *Understand How to Access Data*	Identify Problems/Frame Questions: *Understand Contextual Issues*			
		Transform Data into Information: *Understand How to Interpret Data*			

Note: Listed under each step of the Data Teams Process (Besser, 2010) are the components and subcomponents of the Data Literacy Conceptual Framework (Mandinach & Gummer, 2016) that aligned with each step of the process.

Implementation of the Data Teams Process. Evidence of the leaders' implementation of the six steps of the Data Teams Process in each case emerged from interview transcriptions. Findings revealed that the level of implementation of the process varied between cases. The findings also revealed that the fidelity of the implementation for each step for each case varied between sites. The components that were used at each at each site are shown in Table 4.

Table 4. Data Teams Process steps implemented at each case site.

Steps of the Data Teams Process	C1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9
Six Step Data Teams Process									
1. Collect and Chart Data	X	X	X	X	X	X	X	X	X
2. Analyze Data and Prioritize Needs	X	X	X	X	X	X	X	X	X
3. Establish SMART Goals		X	X	X				X	X
4. Select Instructional Strategies	X	X	X	X	X	X	X	X	X
5. Determine Results Indicators	X	X	X	X	x	x		X	x
6. Monitor and Evaluate Results	X	X	X	X	X	x	x	X	x

Note: Each case was reviewed to identify which steps of the Data Teams Process were being implemented at each site. X= full implementation. x=loosely implemented or inconsistently implemented.

Multicase analysis of themes for the Data Teams Process. When the transcriptions from each case in the study were analyzed, two themes for the category, Data Teams Process emerged. The two themes were analyzed as part of the analysis of multicase themes and are included in Table 5, Multicase Analysis Worksheet. The two multicase themes that emerged for this category were,

1. The leaders and their teams used the Data Teams Process to determine student placement in differentiated instructional groups and individual interventions.
2. The school or district provided resources that were used by leaders and their teams to guide decisions and support the Data Teams Process.

During team meetings, leaders and their teams engaged in discussions to determine the interventions that would be used to support student learning. These actions were described in theme one, **The leaders and their teams used the Data Teams Process to determine student placement in differentiated instructional groups and individual interventions.** The theme appeared in six of the nine cases. There was a high manifestation of the theme in the four elementary schools where RTI practices and tiered support for individual students appeared as an ordinary practice. As one leader described, "We know we're only using that data to understand how to do flex groups and skilled groups to move those students from one section to the next, from one proficiency to the next." While the theme was implemented in the K-12 schools, the implementation was unusual, and the manifestation of the theme was higher at one site than the other. Scheduling at the middle school and the two high schools also appeared to present challenges for creating groups, and made implementation of the theme unusual. One informal leader explained,

> You know at the high school it's very hard to incorporate intervention times. Um, you know when you have a seven-period schedule and you're just going, it's hard to just pull students out. So, a lot of that intervention is just expected in the classroom with the teacher.

The middle school principal described a plan that he was in the process of completing that would address the need for intervention groups during the 2017-2018 school year. Also, one formal leader at one of the high schools described using Lexile scores to place students in reading groups that had been scheduled into the school day. The leaders at all sites were aware of the need to address student learning deficits and were actively working to ensure that there were practices in place to support student learning.

To guide the work with interventions and differentiation, leaders helped access resources to support the decision-making process of the team. Many of the resources that were utilized to support the work of teams during meetings were provided by the school or district. Theme two described how **the school or district provided resources that were used by leaders and their teams to guide decisions and support the Data Teams Process.** In Case 1 and Case 7, there was no evidence of district or school resources that were provided to support the work of the teams. In Cases 2 through 6, 8, and 9, district or school resources were described. The manifestation of the theme was high for cases 2 through 4, and 6, 8, and 9. The resources described also provided support for the theme. Work done by the teams was found in Data Team agendas, notes, or Data Teams form. In the district where case 2, 3, 4, and 9 were located, teams utilized a district-developed Data Team form. The form provided space for documenting data results and meeting notes. The form also included links to video resources on the meeting process. The teams in cases 2, 3, 4, and 9 also used a district training manual as well as the

book, *Visible Learning for Teachers* (Hattie, 2009), along with a document that contained the descriptions of the instructional strategies identified in the research of Hattie (2009). As explained by one formal leader when asked for evidence of the work done by teams,

> The data collection form and student work samples. It really all comes to this! It aligns everything, and we know it doesn't touch everything. But, it's a great starting point. And our data shows from PAWS last year that we fell in math. So we need to use this!

She held up the district Data Team form. "We need to use this, to implement." She held up the Hattie (2009) book and the district developed document, which described the strategies and effect sizes identified by Hattie (2009). "And for me, it all comes down to good teaching!" In the district where cases 1,5,6,7, and 9 were located, sources varied between schools. One formal leader provided six strategies for his teams from the book *Strategies That Work* (Harvey & Goudvis, 2007). Another formal leader provided his teams with strategies from the book *The Core Six; Essential Strategies for Achieving Excellence With the Common Core* (Silver & Dewing, 2012). In this district, there was also a common PLC agenda form that was used by all teams. One informal leader using the PLC agenda form noted,

> And I don't love that agenda form! But when you know that we are meeting this day and we are not going to get back together again until, and we need to get it done by....So we at least have when we are going to have it done by, there to remind us….So, we hold ourselves accountable.

The leaders' descriptions that supported this theme were very telling of how important it was for the teams to have accesses to reliable sources to guide their work. The descriptions were telling, also, of how important it was for leaders to have access to resources to monitor and support the

work of the team. The themes that emerged as a result of the work of the data team are described next in the Multicase analysis of themes.

Analysis of multicase themes. There were seven separate themes analyzed in this study. These themes are (a) School and Leader, (b) Components of Data literacy, (c) Leadership and Management, (d) Evidence and Artifacts, (e) Data Literacy Process, (f) Data Teams Process (described in the previous section), (g) Cross category Themes, and (h), and Added Multicase Themes. Each of the twenty-four themes was analyzed to identify ordinariness of the situation described by the theme. The themes were also analyzed to identify the degree at which the manifestation was observed.

Analysis of themes for school and leaders. There were four themes that emerged from the multicase analysis of the information included in the subcategories, School Demographics and Accountability, and Leader Demographics and Training. These four themes are;

1. The leaders had little formal training to analyze data.
2. The leaders each held at least one master's degree.
3. The leaders were employed in the district when Data Team training was provided.
4. The school district provided training and meeting time to support the Data Teams Process.

Interview transcriptions from each site were used to provide the details and descriptions that were used to support each theme.

The first theme, **The leaders had little formal training in how to analyze quantitative data** was found in four of the nine cases. Those cases revealed that the formal and informal leader had little formal data training. However, when the data training of all participants was aggregated and analyzed fourteen of the nineteen leaders were found to have little formal data

training. There were six leaders who had formal training. The first was the formal leader in Case 4 who held three masters' degrees. One of those degrees was in assessment. The second was the formal leader from Case 5 who had taken nine credit hours of statistics as part of a doctoral degree. The third was the informal leader in Case 6 who as part of his master's degree completed classes in research, calculus, and testing. The fourth was the formal leader in Case 7 who held two masters' degrees. One of those degrees was in counseling and psychology. The fifth was the informal leader in Case 8 who completed a class in research and another in research statistics at the doctoral level.

Theme two, **The leaders each held at least one master's degree,** examined the leaders' academic degree level. The theme emerged from eight of the nine cases,. A review of the degrees held by formal leaders revealed that all had at least one master's degree. This was supported by Wyoming state licensure requirements, which dictate that school principals hold a teacher's certification and have completed an educational leadership program from an accredited college or university (PTSB, n.d.). A review of each of the informal leader's years of experience and their years of experience at the site did not explain why so many held master's degrees. Years of experience for the informal leaders who held master's degrees ranged from seven to thirty-seven years. Their years employed at the site ranged from three to thirty-five years. The informal leader in Case 8 was the only informal leader to hold only a bachelor's degree. She had been working in the education profession for thirty-two years and had been employed at the site for thirty-one years. The only evidence that emerged that described why so many informal leaders had a master's degree was found in a comment from the informal leader in case 9 who said, "We started the training process a year before last with some PD [professional development] sessions in some workshops, and then they rolled it out to the staff as a whole."

He chuckled and continued sarcastically, "Why I lost, I have a master's degree in music education!"

Training opportunities similar to those described by the informal leader in Case 9 appeared in the leader's descriptions for all sites. Information regarding the number of years each leader served at the site provided support for the third theme, **The leaders were employed in the district when Data Team training was provided.** Analysis results showed (a) at six of the nine sites, the formal and informal leaders had participated in the districts Data Team training, (b) at two of the sites only the informal leaders had participated in district Data Team training, and (c) at one site neither the formal or informal leader had participated in the district Data Team training. Thus, four of the nineteen leaders interviewed for the study had not received Data Team training. As a result, the fourth theme, **The school district provided training and meeting time to support the Data Teams Process,** appeared in varying degrees in each of the nine of the cases.

The training for staff in the district where cases 1, 5, 6, 7, and 9 were located was provided during the 2013-2014 and 2014-2015 school years. In recalling that training, an informal leader said,

> I think it really became a conversation for everyone after [formal leader] came. I think we had pockets where people were a little more data-driven especially, folks who had early PLC training. But, for people who hadn't had PLC training, I think it was after [formal leader]. And, partly because we were held accountable to do some kind of formative assessment, get together, and check out the results.

The training in the district where cases 2, 3, 4, and 8 were located was provided during the 2016-17 school year with ongoing training available. Leaders in that district were excited

about the training and the support the training provided staff. One informal leader said, "We have actually been super lucky because we had a Data Team expert come in." A formal leader who recognized the need to support teams, said, "Having [the trainer] from Colorado come and speak on their behalf and explain the process has given them more of a structure."

To support the structure required for Data Teams, each district developed a meeting schedule. In the district where cases 2, 3, 4, and 8 were located, teams met every six days for approximately 40 minutes. The meeting schedule was later changed to every seven days. The use of the days varied between sites. At one site a leader noted,

> We have a seven-day rotation…..So, for example, every day-one during planning we meet for math and we bring our short data cycle assessment that we agreed to do the meeting before and have that ready to talk about. Um, and the same is true for reading, just happens on a different day, or language, or writing, whatever we are looking at.

At another site in the same district the formal leader noted,

> We're on a seven-day rotation. In those seven days they get two days for their PLC Data Teams, just with their grade-level. And, then once a week we are fortunate to be a Title school and we are using some of our Title funds once a week for our grade-level teachers to also be meeting with EL, SPED, and Title to go over and plan together for the upcoming week.

At yet another site a leader noted, "Our grade-level teams meet once in a seven-day rotation, but we don't always do Data Teams cuz we also have to do the other work that our PLC would do. So, we try to do Data Teams meetings probably about once a month." In cases 2, 3, 4, and 8 teams met every two weeks for approximately ninety minutes. Teams whose members did not serve on the district curriculum, assessment, or instruction team were able to meet one

additional time during the month. The teams appeared to follow the set district meeting schedule. One informal leader noted,

> We do quite a bit of, you know, progress monitoring which is every two weeks. And then, we sit down at our PLC meetings and examine the data, and you know, prioritize from there. We look at it, and then say, you know this is what we really need to focus on before we can move on to this.

Another leader working in the same district, when describing the interventions process said,

> We need to be in a spot where we can say, yes, our students are performing where we want them….that really comes back to our building level meeting times on our Friday early out day and just making sure we have time as a content area to meet, and to work through some of those things.

Analysis of themes for components of data literacy. There were six themes that emerged from the multicase analysis of the information included in the category, Components of Data Literacy. Themes included:

1. The leaders and their teams discussed quantitative and qualitative results from various forms of assessments (formative and summative) to identify student needs and measure student growth.
2. The leaders and their teams continuously engaged in non-evaluative discussions to review data and instructional practices.
3. The leaders and their teams engaged in action research to test the impact of strategies, practices or programs on student learning.

4. The leaders and their teams utilized student proficiency levels and percentage or percentile scores to analyze and interpret the data and identify the problem to be addressed.
5. The leaders and their teams used assessment websites to access and mine data results.
6. The leaders and their teams utilized assessments that aligned with curriculum maps or measured content standards.

Evidence for the first theme, **The leaders and their teams discussed quantitative and qualitative results from various forms of assessments (formative and summative) to identify student needs and measure student growth,** appeared in all nine cases. In Cases 1, 2, 3, 4, 6, and 8 there was a high manifestation of the theme. In Case 5 and 7 there was some manifestation of the theme. The level of manifestation was determined by examining the types of data that teams reviewed as well as the depth of the discussions on data that were described. Also, considered were the steps taken as a result of those discussions. The leader's descriptions of the process provided evidence of the theme. An informal leader working in a primary school noted, "Well, we would usually look at the results of the testing results or whatever we were using. Everyone would be given a copy, we would look through them, discuss anything that stood out to us, and then try to bundle those up. You know, if we noticed that kids weren't doing well in a certain area, we tried to identify the areas and then from there we would come up with interventions." A second informal leader at another site said,

> So, we first start off with a pre-assessment of whatever skill we need. Initially, like we talked about and discussed, what is it that we want kids to know and to be able to do. Question number two is, what means do we have to collect the data to figure out, do they know it, do they not know it. Then we can go from there.

Leaders at the secondary level shared similar experiences. An informal leader said,

> So, we are required to take the (PAWS) or MAPs twice a year. So, we deliver that, and then after each of those tests we meet as a group to look at improvement, to monitor any data that we can find, and then discuss that data. If it's progress monitoring, we try to do progress monitoring for students that need it once a month.

In every case the descriptions clearly conveyed the message that leaders and their teams were continuously discussing various types of data.

When discussing data results, leaders and their teams worked to create a culture in which members felt safe to discuss and share individual successes and failures. The second theme, **The leaders and their teams continuously engaged in non-evaluative discussions to review data and instructional practices,** emerged from the findings in Case 1, 2, 3, 4, 5, 8, and 9. At those sites, leaders recognized the importance of focusing on student data. As one leader noted, "So I think that one of the things we really focus on is making sure that the data is what we're looking at. And, we are not judging like individual teachers or whatever!" As another explained, it's "creating that atmosphere where it's ok to try new things. It's ok to give it a whirl. And if it succeeds or it doesn't succeed, all of those are successes 'cause you gave it a whirl!" While the second theme appeared in seven of the cases, the theme was not evident at the two K-12 sites. As those schools had very few students in each grade-level, there was little opportunity to use student data in an evaluative or punitive manner. The formal leader described the phenomenon when he was asked how he used scores of central tendency. He said,

> The mean, the median, and the mode when you have four kids in fifth grade, those don't matter. I mean you can't do very much with them. I mean, I have one sixth grader. Her mean median and mode, pretty easy! [He laughed,] she's it!

To identify practices that were effective and ineffective, **The leaders and their teams engaged in action research to test the impact of strategies, practices or programs on student learning,** emerged from all cases. This was an ordinary practice that was replicated at all sites. However, the practice manifested at different levels at each site. When talking about the practice, one informal leader compared it to the diagnostic practices in the medical field. In doing so, he recognized the importance of using a systematic approach and trying one thing at a time to identify what worked and what did not. As another leader described, "We grab data, we try to implement some things….,we go back and we try again." The informal leader described the process used. He said,

> Usually, within our Data Team we'll have a very specific target that we want. And, we go back through and we say is this a strategy that will hit it….After we get our assessments back, we'll look at it to see how our students did to see if we chose the right tool or strategy. And if we didn't, [and] we see gaps, then we go back and we try again.

The use of action research provided leaders and their teams the opportunity to identify those practices and interventions that were effective and ineffective and to make timely instructional changes based on their findings.

The goal of all remediation was to help students perform at a proficient level. The fourth theme, **The leaders and their teams utilized student proficiency levels and percentage or percentile scores to analyze and interpret the data and identify the problem to be addressed**, spoke to this practice. The descriptions of the use of proficiency, percent, and percentile scores, described by theme five, were found to be an ordinary practice at all sites. The practice also manifested at a high level for all sites. Though the theme described leaders' use of

proficiency levels, at five of the nine sites findings revealed that leaders also examined RIT scores to determine student proficiency levels. As one leader described,

> I also checked to see if they grew fall to spring just to see growth. And then I looked at their percentage inside the MAP. But, I also looked at their RIT score. Cause, as you know, their RIT score might grow but their percentage might not!

At the high school level, leaders also examined ACT composite scores and Lexile scores to determine student proficiency. While five of the nineteen leaders acknowledged understanding how to interpret and use other assessment scores, these practices were not used to support the work of the teams.

Some of the assessment scores that were used by leaders and their teams were retrieved from online sites. The fifth theme, **The leaders and their teams used assessment websites to access and mine data results**, emerged from leader's descriptions in eight of the nine cases within the study. There were various sites that the leaders described using. Sites included; NWEA, DIBELS.net, Wyoming Fusion, FAST, Silverback Milepost, Zearn.org, IXL learning website, PowerSchool, and SPED Advantage. As noted by the formal leader at one site,

> When we use MAPs, which we won't be using this year, we go to the NWEA website…., and then we'll go onto the DIBELS Next website. And once again we pull that same report. And I also like to pull the report that shows us the graph like over time. We'll look at our PAWS data the same way! And then, if we are truly utilizing it how we should be within our classroom and we're marking our kids, we'll see a data trend.

The use of websites to store and retrieve data was found to be ordinary at six of the sites. Case 2 was unusual in that the formal leader retrieved the data to build a spreadsheet that was shared with team members. Case 4 was unusual because a paraprofessional and the PE teacher were

assigned the task of data input and retrieval. Case 8 was unusual because leaders described reviewing ACT and standardized test scores at the building level but did not mention how those results were obtained. In cases 1, 3, 5, 6, 7, and 9, there was a high manifestation of the theme found. In Cases 2 and 4 there was some manifestation of the theme that emerged. In Case 8 there was no manifestation of the theme.

The assessment results accessed online provided only a portion of the assessment data used by teams. The leaders within the study also described using formative classroom assessments, program assessments, common assessments, quarterly final assessments, and fitness data. As leaders suggested in case descriptions, assessments were used to measure students' proficiency of the content standards. As content standards were embedded in curriculum maps, leaders often described how assessments were aligned to the curriculum. As described by one of the formal leaders,

> Well, I think we take a look at a break-down of those content areas and those different assessments. And, take a look at those descriptors with those skill sets that they should be performing at different levels, and going back to address those in our curriculum maps. So that's where some of that comes back. Also, matching that up with the state standards. And, making sure that we are addressing those in our curriculum!

The sixth theme, **The leaders and their teams utilized assessments that aligned with curriculum maps or measured content standards**, when analyzed using the multicase worksheet, was found to be an ordinary situation in all nine of the cases. The theme had a high manifestation in Case 1 through 4 and 8, as well as some manifestation in Cases 5 through 7 and 9.

Analysis of themes for leadership and management. There were three themes that emerged from the multicase analysis of the information provided by leaders that described behaviors that reflected actions of leadership and management. Themes included:

1. Actions that demonstrated the use of management practices were used by leaders to support the work of Data Teams.
2. Actions associated with behaviors of transformational leadership were used by the leaders to support the work of Data Teams.
3. Actions associated with behaviors of servant leadership were used by the leaders to support the work of Data Teams.

The first theme, Actions that demonstrated the use of management practices were used by leaders to support the work of Data Teams, was found in all nine cases. In eight of the nine cases, the actions of management were ordinary and there was some manifestation. Collectively, in the majority of the cases, the formal leaders demonstrated management by attending meetings, organizing and facilitating building level meetings, ensuring compliance and collaboration, monitoring instruction, and reviewing agendas and lesson plans. The informal leaders demonstrated management by organizing and facilitating meetings, maintaining and sharing agendas, organizing and submitting data, reminding members of deadlines, holding members responsible for meeting norms, ensuring that members were on topic and engaged in the meeting, and ensuring that the steps of the Data Teams Process were followed. As one informal leader explained, "My role was to ensure that they were using it, that they were gathering the data, and that they were having regular meetings to discuss it!" Another informal leader noted,

> So I gather all of our data. I try to make it as simple as possible. And, like I said, to use as many things online as we can. So literally, I will call a group and I will say hey this is

> the data that we agreed upon that we were going to collect. We discussed what the rubric is supposed to be, or what the grading of it is supposed to be. Here is where I want you to input it.

While the descriptions of management in most cases were typical, one case was found to be somewhat unusual and the manifestation of the theme was high. In Case 4, the formal leader cleared her schedule to participate in all team meetings. She carried the Data Team manual with her to every meeting to ensure that the process was implemented correctly. Her reflections on the process were evident in the various notes that were scribbled on the cover of her Data Team manual. When she was unable to attend a meeting, she required that she receive a copy of the Data Team form. She explained, "I review them. Their team leaders are responsible for maintaining an electronic and a hardcopy folder of those." Not only did she monitor the meetings but she also monitored lesson plans and instruction. She explained,

> And then in the lesson plans, everyone in my building is required to use planbook.com. And so I check those lesson plans weekly for integrity. So if I walk in and you're not doing what you say you're doing, you know, just talk to me. Why, because I also know that kids take us in different directions. But, without those questions and that feedback they'll just give you lip service sometimes because they're overwhelmed! They have a lot going on.

While she empathized with her staff, she did not allow them to deviate from the plan. Her understanding of the need to ensure that the process was occurring and was followed was echoed in descriptions provided by many of the other formal and informal leaders.

In addition to engaging in actions of management, leaders also engaged in actions of leadership. **Actions associated with behaviors of transformational leadership were used by**

the leaders to support the work of Data Teams. In the study, seven of the nine formal leaders and five of ten informal leaders demonstrated behaviors that reflected transformational leadership. Formal leaders showed transformational leadership by (a) providing a vision for the implementation of the Data Teams Process, (b) providing a vision for instructional practice, (c) providing a vision for student learning, and (d) providing data and feedback to identify changes that were needed to demonstrate growth toward goals. Informal leaders showed behaviors that reflected transformational leadership by modeling how to use data and instructional strategies to achieve school goals and make a positive impact on student growth. In six of the cases in the study, the theme emerged as a usual situation. In Case 4 and Case 8 the theme emerged as a somewhat unusual situation. In Cases 1 through 4, and 5, 6, 8, and 9 there was some manifestation of the theme. In Cases 4 and 9 there was a high manifestation of the theme. Case 4 was somewhat unusual and had a high manifestation of the theme due to the actions of the formal leader. She had a powerful vision of what she wanted her teams to achieve through the use of the process and worked to "empower" and inspire teachers to do the work and achieve the vision. Case 8 was somewhat unusual and had a high manifestation of the theme because of the vision set by the informal leaders. The informal leaders in Case 8 were teaching in a co-curricular area and yet experienced great success in implementing and assessing English Language Arts standards. They relished the challenge and inspired others to meet the challenge. As one of the leaders explained, "As team leaders and administrators we model the process, go through the process, and that helps them have great support and an understanding that we believe in it!" The other informal leader said,

> I think that's been part of the fun! I think just personally when you get into the rut as a teacher, when you're teaching the same pieces, when you're teaching the same material

> over and over again, you know, it's pretty easy to get burnt out. So, it's important to have a fresh approach and a fresh challenge to add some new pieces…. And it's unpleasant when it falls to pieces on you. But man, when it works, it's like that's really cool!

The leaders in Case 8 were enthusiastic about the work they were doing. The leaders in the case appeared to promote a vision that was embraced and shared by their teams.

Many of the leaders in the study also described engaging in behaviors associated with servant leadership. Actions associated with behaviors of servant leadership were used by the leaders to support the work of Data Teams. Findings of the study revealed that six of the nine formal leaders and all ten of informal leaders demonstrated servant leadership. Collectively the formal leaders demonstrated servant leadership by (a) participating in meetings, (b) securing requested materials, (c) securing funding for team projects, (d) providing non-evaluative feedback to support team decisions, (e) providing time, (f) covering classes for members, and retrieving requested reports, (g) helping members analyze the data, (h) reviewing research requested by teams, and (i) providing additional staff to complete data input. Collectively, the informal leaders demonstrated servant leadership by (a) taking on extra work to help the team, (a) taking meeting notes, (b) providing research to team members, (c) helping members analyze and color code data, (d) serving as the team liaison, and (e) supporting team members who wanted to learn new strategies and engage in team practices. In eight of the nine cases the theme emerged as a usual situation. In Case 2, the theme emerged as an unusual situation due to actions of the formal leader. She aggressively sought funding through grants to support projects that her teams deemed as important. She worked side by side with each team to help with projects. She attended all curriculum trainings that were required of her staff to ensure that she

could support them in their work. She compiled longitudinal data for the teams and the school to support their discussions. She said, "I feel like it's my job to support everyone in everything they do!"

Manifestation of the theme that described servant leadership emerged in all cases. In Cases 1, 4, 5, 6, 7, 8 and 9 there was some manifestation of the theme. In Cases 2, and 3, there was a high manifestation of the theme. In Cases 1 and 2, the commitment of the formal leaders to follow and support the leadership of others was very apparent. In describing the actions of the formal leader in Case 2, the informal leader said, "She has encouraged within our building things that we love doing, too. So, she's like, 'you guys bring to the table things that you don't even think about! So what are things you enjoy that you like doing?'" In Case 3 the formal leader described the encouragement that she provided her team members with to try new strategies and practices. She explained that she allowed them to decide what they personally would like to try, and then she offered her support to help them achieve that goal. She noted that she encouraged members to ask for her help and when they did she told them, "I'll come in when I am out and about. I'll look at you. I'll coach you, and it's not going to be held against you."

Analysis of themes for evidence and artifacts. There were five themes that emerged from the multicase analysis of the information provided by leaders that described the types of evidence and artifacts that were collected by leaders at each site. Themes included:

1. Evidence of the work done by the teams was found in Data Team agendas, notes, or Data Team forms.
2. The described artifacts included the results gathered from multiple formative and summative assessments.

3. The described artifacts included district or school-provided resources that were used by the leaders and their teams to guide the decision-making process.
4. The described artifacts included spreadsheets used by the leaders and teams to collect or chart data results.
5. The use of a data-driven process contributed to student academic growth, as evidenced in leader descriptions.

The information presented described leaders' observations of the student growth that was made as a result of the work done by teams. The information also included lists of artifacts already described in the various findings and themes for this study.

In the study, theme one indicated, **The evidence of the work done by the teams was found in Data Team agendas, notes, or Data Team forms**. The theme emerged in eight of the nine cases and presented as an ordinary situation in four cases. In those cases, the manifestation of the theme was low. The theme presented as an unusual situation in four of the cases where district practice required the use of Data Team forms for recording and tracking data. At those sites the manifestation of the theme was high.

The next theme that emerged was, **The described artifacts included the results gathered from multiple formative and summative assessments**. The theme emerged from all nine cases where it presented as an ordinary situation with a high manifestation. In all leader descriptions assessment data provided the foundation for analyzing student growth.

The theme that followed was, **The described artifacts included district or school provided resources that were used by the leaders and their teams to guide the decision making process**. The theme emerged from six of the nine cases. In Cases 6 and 9, the theme presented as an ordinary situation with some manifestation. In Cases 2, 3, 4, and 8, the theme

presented as an unusual situation with a high manifestation. In these four cases there was a district-provided resource that included descriptions of the strategies described by Hattie (2009). The leaders referenced the resource and the research multiple times during interviews. Resources mentioned at the other sites included a book provided by the formal leader.

The described artifacts included spreadsheets used by the leaders and teams to collect or chart data results was the next theme that emerged. In the study, the leaders described using spreadsheets to compile and analyze data. The theme emerged in five of the eight cases as an ordinary situation. In each of the five cases there was some manifestation. In four of the cases, leaders also described color-coding the spreadsheet data to make it easier to identify the various proficiency levels represented.

In seven of the nine cases in the study, leaders observed that a data-driven process contributed to student academic growth at the site. The situation for this theme was ordinary for all cases. There was some manifestation of the theme in six of the cases. In Case 2, there was a high manifestation of the theme as the work done by teams resulted in a positive change in the state accountability report. As the informal leader in Case 2 expressed, "This is our first year since I have been at [school x] that our school has actually made adequate progress from the state!" Growth at the state level was also observed in Case 9. The formal leader there explained, "I think the successes are, you know, the ACT data that we got back preliminarily this year with the 22. You know that's big for us! Um, it just provides that reassurance that what we're doing is working." While two sites saw changes in their state scores, other observed incremental changes in the scores on short-cycle assessments. As one of the leaders observed,

> The informal successes that we've had have been small. You know it's a lot of incremental successes, which can sometimes be hard to get excited about! You know, we

look and we see this kid got this, this group got better, you know we raised our average on this from a 2.5 to a 3 when we're looking at our results. Just little stuff here and there!

When leaders spoke about their work and student growth they were hopeful that their work would have an impact on the end-of-year summative results.

Analysis of cross-category themes. There were two cross category themes that emerged in this study. Cross-category themes emerged when the various categories inside and outside each case were examined together. The themes included;

1. Evidence of short-cycle growth reported by leaders was not evident in state accountability reports for the site.
2. The leaders and their teams accessed multiple sources of data which were used to discuss the progress being made by building populations, grade-level populations and individual students.

The first cross category theme, **Evidence of short-cycle growth reported by leaders was not evident in state accountability reports for the site** was identified in five of the nine cases in the study. Cases 2 and 9 were not included as each showed an increase on the 2017 accountability report. Cases 5 and 7 were not included, as the case leaders did not report evidence of growth. When state accountability reports for the 2016-2017 school year were analyzed for the cases where leaders reported growth, there were (a) four cases where the theme presented as a normal situation, and (b) one case that presented as an unusual situation. The situation was found to be ordinary for cases in which there was no change in the overall state accountability rating between 2016 and 2017. Cases 1, 4, 6, and 8, presented as an ordinary situation. The situation was found to be unusual in case 3, where the state accountability rating decreased between 2016 and 2017. There was some manifestation of the theme in cases 1 and 6,

as there was no decrease demonstrated in the rating of one or more of the three indicators used to determine the overall rating. There was a high manifestation for cases in which at least one of the three indicators used to determine the overall rating was lower in 2017. Cases, 3, 4, and 8 demonstrated a lower rating on one of the three indicators used to determine the overall accountability rating.

The second cross category-theme**, The leaders and their teams accessed multiple sources of data which were used to discuss the progress being made by building populations, grade-level populations and individual students**, emerged from seven of the nine cases. Leaders in the study observed that building level data from state summative assessments were reviewed by teams to set building goals and identify areas of need. A formal leader explained, "We use the data to set our school goals for AdvancEd [accreditation] and our accountability goals. You know, some….will use it for individual classroom goals." Another leader described using PAWS scores when looking at how to make changes in the building or when moving students. A third leader noted, "I think ideally our end target is the ACT. You know that's been part of our school's focus. Our school's effort just building wide is making sure we have our kids ready for that!" While growth at the building level was the ultimate goal of teams, discussion primarily focused on addressing grade-level needs. An informal leader said,

> You know, when we're in the Data Teams we might talk about specific children. But, for the most part, we talk about what our grade-level data looked like. Where are we meeting expectations and where are we not meeting expectations.

Another informal leader said,

> When we have our weekly meetings and we're looking at the data that we bring, we have the evidence at the end of the benchmark, when the kids are taking that assessment,…. that the kids have mastered that specific benchmark.

The leaders also discussed the need to use data to identify and remediate the needs of individual students. As noted by a formal leader who said,

> I think we have to focus on the growth of each kid. And making sure that those kids are growing towards [proficiency]. And, it doesn't necessarily have to be the state's number. But, they are showing growth, so that they can get to grade-level individually.

In the Data Teams Process, teams reviewed classroom and grade-level data but recorded and tracked where each student was scoring. In describing that process one formal leader said,

> Really, [it is in] this chart! When we collect and chart data, and we bring work samples, that's how we drill down! We bring it down to the student level [identifying] exactly what question did this student miss, and how many [questions were missed].

Review of the leaders' descriptions showed the theme presenting as ordinary in all Cases 1, 2, 3, 4, 5, 8, and 9. In Cases 6 and 7, the situation was somewhat unusual as the small number of students enrolled in each class in the K-12 setting created little need to utilize the data to evaluate or support grade-level or classroom goals. There was some manifestation of the theme in Cases 5, 6, 7, and 9. The manifestation of the theme was high in cases 1, 2, 3, 4, and 8.

Analysis of added multicase themes. There were five original sections of themes analyzed in the study. A sixth section that included two themes emerged when evidence from all cases were considered together. The added themes included:

1. Data privacy was linked to professionalism and often included knowing how to handle student data and with whom the data could be shared.

2. Teams utilized Google Docs or Google Drive to share data or meeting documents.

The first theme, **Data privacy was linked to professionalism and often included knowing how to handle student data and with whom the data could be shared,** was found in the transcriptions for all nineteen leaders. In their descriptions of data privacy, the leaders were adamant that student data must be kept private and shared only with those who had a legal right to see it. As one leader noted, "Data is confidential. We share it with those that have a need to know!" Another noted,

> It stays within the school; we don't talk about it outside of our meetings. You don't talk about it in the hallway. You don't talk about it in the lunchroom or the workroom. Data is private; it stays within your team, or [with] the principal and behind closed doors!

There was little evidence that data privacy was discussed or needed enforcement. Keeping data private was just an expected part of the professionalism demonstrated by all team members. While some leaders described the expectation being shared with members at the beginning of each year, others just assumed the expectation was covered in district policy. As one informal leader explained,

> I assume that has to go along with our privacy policy within our tech department and making sure that the people who are allowed to be a part of our Data Teams Process are the ones that have access to that information. And that's it!

Across the study, the situation was found to be ordinary, and there was some manifestation of the theme for all cases.

When describing data privacy, some leaders made note of how Google was used to help keep data private. An informal leader explained, "We do use our Google platforms which are private groups, which are only allowed via our PLC groups." In seven of the nine cases in the

study **teams utilized Google Docs or Google Drive to share data or meeting documents**. In those cases, leaders described the use of Google Docs or Google Drive to share and store data or information. The situation for cases 2, 3, 4, 5, 6, 8, and 9 was therefore found to be ordinary. There was somewhat of a manifestation of the theme in cases, 5, 6, and 8. In cases 2, 3, 4, and 9 there was a high manifestation of the theme.

Table 5. Multicase Analysis Worksheet

Multicase Themes	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9
School and Leaders									
The leaders had little formal training in how to analyze quantitative data.	M	M	M	W m	u M	m	W m	u m	m
The leaders each held at least one master's degree.	M	M	M	W M	u M	M	W M	u M	m
The leaders were employed in the district when Data Team training was provided.	M	M	M	M	u m	W	M	M	u m
The school district provided training and meeting time to support the Data Teams Process.	m	u M	u M	u M	m	u m	m		W M
Components of Data Literacy									
The leaders and their teams discussed quantitative and qualitative results from various forms of assessments (formative and summative) to identify student needs and measure student growth.	M	M	M	M	m	M	m	u M	u M
The leaders and their teams continuously engaged in non-evaluative discussions to review data and instructional practices.	m	M	M	M	M			M	m

Multicase Themes	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9
The leaders and their teams engaged in action research to test the impact of strategies, practices or programs on student learning.	M	M	M	M		m	M	m	M
The leaders and their teams utilized student proficiency levels and percentage or percentile scores to analyze and interpret the data and identify the problem to be addressed.	M	M	M	M	M	M	M	M	M
The leaders and their teams used assessment websites to access and mine data results.	M	u m	M	u m	M	M	M	W	M
The leaders and their teams utilized assessments that aligned with curriculum maps or measured content standards.	M	M	M	M	m	m	m	M	m
Leadership and Management									
Actions that demonstrated the use of management practices were used by leaders to support the work of Data Teams.	m	m	m	u M	m	m	m	m	m
Actions associated with behaviors of transformational leadership were used by the leaders to support the work of Data Teams.	m	m	m	u M	m	m		u M	m
Actions associated with behaviors of servant leadership were used by the leaders to support the work of Data Teams	m	u M	M	m	m	m	m	m	m
Evidence and Artifacts									
Evidence of the work done by the teams was found in Data Team agendas, notes, or Data Team forms.	m	u M	u M	u M	m		m	u M	m

Multicase Themes	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9
The described artifacts included the results gathered from multiple formative and summative assessments.	M	M	M	M	M	M	M	M	M
The described artifacts included school or district provided resources that were used by leaders and their teams for decision making.		u M	u M	u M		m		u M	m
The use of a data-driven process contributed to student academic growth, as evidenced in leaders' descriptions.	m	M	m	m		m		m	m
The described artifacts included spreadsheets used by leaders and teams to collect or chart data results.	m	m		m		m		m	
Data Teams Process									
The leaders and their teams used the Data Teams Process to determine student placement in differentiated instructional groups or individual interventions.	M	M	M	M		u M	u m	u	u
The school or district provided resources that were used by leaders and their teams to guide decisions and support the Data Teams Process	u	M	M	M	m	M	u	M	M
Cross Category									
Evidence of short-cycle growth reported by leaders was not evident in state accountability reports for the site	m		u M	M		m		M	
The leaders and their teams accessed multiple sources of data which were used to discuss the						u	u		

Multicase Themes	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9
progress being made by individual students, classroom populations, grade-level populations, and building populations.	M	M	M	M	m	m	m	M	m
Added Multicase Themes									
Data privacy was linked to professionalism and often included knowing how to handle student data and with whom the data could be shared.	m	m	m	m	m	m	m	m	m
Teams utilized Google Docs or Google Drive to share data or meeting documents.		M	M	M	m	m		m	M

Note. Includes case coding for type of situation and degree of manifestation of case study themes. W = highly unusual situation, u = somewhat unusual situation, blank = ordinary situation, M = high manifestation, m = some manifestation, blank = almost no manifestation Data Literacy and Data Teams Multicase Study. Adapted from Stake's worksheet for 'Estimates of Ordinariness of the Situation of Each Case and Estimates of Manifestation of Multicase Themes in Each Case" (Stake, n.d.) by R.E. Stake, 2006, New York: The Guilford Press. Copyright 2006 by The Guilford Press. Reprinted with permission.

Chapter Summary

This chapter presented the findings and themes that emerged from leaders' descriptions of data literacy, Data Teams, leadership, and management in nine separate case studies. Each case study represented one school site in one of two districts in the state of Wyoming. The qualitative data for each case was analyzed using Stake's (2006) Graphic Design of a Case Study. The worksheet provided a visual representation of the qualitative data collected from inside and outside of each case. To provide a rich description of each case, findings that represented the information presented inside and outside each case were described. There were multiple themes that emerged from the analysis of each case as well as from the combined cases.

In the study, twenty-four themes were identified. Themes represented the emergent patterns of leaders' data literacy and the leadership style used by leaders to support the Data Teams Process, and the success of the Data Teams at each case site. The themes were charted and analyzed using Stake's (2006) worksheet for "Estimates of Ordinariness of the Situation of Each Case and Estimates of Manifestation of Multicase Themes in Each Case." The worksheet provided an analysis tool for aggregating the data from the individual cases to identify the correspondence or consistency of conditions as well as the prominence of themes in the study. Once each theme had been charted and analyzed, the results were described. To paint a vivid picture when describing each theme, rich thick description that included quotes from leaders were used. In the next chapter the findings of the study that answer the subquestions and central research question for this study are presented.

Chapter Five: Conclusions

Each year, in the state of Wyoming, accountability results that describe each school's level of success in meeting state accountability requirements are published. To determine the performance level of each school, the Wyoming Department of Education utilizes student assessment scores and other school data. As school data is used to determine school success, it is critical that school leaders understand how to use data to monitor and support the student learning that contributes to that success. As Earl and Katz (2006) recognized, "There is no escaping data. Not only are school leaders surrounded by policies that require them to account using data, but they also are expected to become 'data driven' themselves in their school based planning" (p. 3).

The knowledge and skills needed to effectively engage in data-driven decision making have been recognized as data literacy (Earl & Katz, 2002, 2006; Gummer & Mandinach, 2015; Jacobs et al., 2009; Knapp et al., 2006; Love, 2004; Love et al., 2008; Mandinach, Friedman et al., 2015; Mandinach & Gummer, 2016a; 2016b; Wu, 2009). According to Mandinach and Gummer (2016a), to demonstrate data literacy, educational leaders must use a cycle of inquiry to (a) identify problems and frame questions, (b) use data, (c) transform data into information, (d) transform information into decision, and (e) evaluate outcomes. To engage school teams in a data inquiry cycle, the Data Teams Process can be used (McNulty & Besser, 2011). Using this process, school leaders and their teams (a) collect and chart data, (b) analyze data and prioritize needs, (c) establish SMART goals, (d) select instructional strategies, (e) determine results indicators, and (f) monitor and evaluate results. The data knowledge and skills of the leaders play a critical role in the ability of the team to utilize data and to develop plans that are used by team members to guide teaching and learning (Campsen, 2010; Love, 2009; Love et al., 2008;

McNulty & Besser, 2011; Peery, 2010).

While apparent that leaders need to have a certain level of data literacy to engage effectively in the Data Teams Process, previous research indicated that many leaders lack the background, skills, and dispositions needed for data literacy (David, 2008; Earl & Katz, 2006; Earl & Louis, 2013; Mandinach & Gummer, 2016a; Mandinach & Jimerson, 2016; Schildkamp & Ehren, 2013; Schildkamp, & Lai 2013; Schildkamp & Poortman, 2015; Wayman et al., 2013). This study examined the data literacy of formal and informal leaders who led Data Teams in select Wyoming schools. This study also sought to examine the actions of leadership and management used by these leaders to support the work of the Data Team.

The study consisted of nine cases. Within those nine cases, there were nine formal leaders and ten informal leaders. The cases represented nine schools belonging to two separate school districts in the state of Wyoming that had received Data Team Training from Houghton Mifflin Harcourt. The superintendent for each of the districts identified the formal leaders that were invited to participate in the study. Subsequently, the formal leaders identified the informal leaders that were invited to participate in the study. All leaders worked in schools where there were at least two members assigned to a team that engaged in a short-cycle Data Teams Process to continuously review student data. While the delimitation for group configuration appeared to be met at all nine sites, there was an unanticipated group dynamic that emerged from the cases at the two K-12 schools. In these cases, schools used cross-grade-level teams to review data and address content needs.

The study was guided by one central research question, “How do leaders influence the Data Team?” To answer the central research question, seven subquestions were developed to

examine the leaders' understanding and use of data, as well the actions of leadership and management used by leaders when working with Data Teams. Subquestions included:

1. How do leaders initiate discussions about data that create a catalyst for meaningful action?
2. How do leaders determine the data used to support the work of the Data Team?
3. How do leaders utilize analytical skills to support the work of Data Teams?
4. How do leaders build others' capacity to use data effectively?
5. How do leaders supervise the Data Teams Process?
6. How do leaders determine the success of a Data Team?
7. Why do Data Teams need to have the support of leaders?

To answer each of the subquestions and ultimately the central research question, interview documents and information collected from inside and outside of the nine separate case sites were analyzed using Stake's (2006) worksheet. The themes that emerged from the analysis of each case and from all cases together were then aggregated and analyzed using Stake's (2006) worksheet 4: "Estimates of Ordinariness of the Situation of Each Case and Estimates of Manifestation of Multicase Themes in Each Case" to identify where a correspondence or consistency of conditions existed within the study. The following sections present the research findings to answer each of the seven subquestions. These findings are then related to the existing literature that was reviewed in Chapter Two.

Findings

Answer to the Central Research Question. Qualitative findings from this research were used to answer the Central Research Question, How do leaders influence the Data Team? Findings from the study indicated that the actions of Data Team leaders when engaging in the

Data Teams Process, demonstrated an understanding of the components and subcomponents of the inquiry cycle for the Data Literacy Conceptual Framework identified by Mandinach and Gummer (2016a). The researcher found that to create a catalyst for meaningful action, leaders supported their teams in identifying problems and framing questions. While leaders and their teams utilized multiple sources of data, much of that data was produced through district developed, or district adopted measures. When additional measures were needed, leaders and their teams identified formative measures that could be used to assess a specific skill or the success of a particular strategy.

To analyze data, leaders discussed the results with their teams. While leaders in this study had a basic understanding of how to read and interpret statistical scores, in their analysis work with teams, they primarily interpreted results using a mean, percentile rank, or proficiency indicator. Leaders supported teams to better understand data results by color- coding data or providing charts and graphs to create a visual representation for teams to discuss.

In this study, evidence was provided that leaders worked to build the capacity of teams by creating an environment where team members felt safe to share data and ask advice of others. Leaders attended meetings, worked side by side with teams, provided non-evaluative feedback about data, and provided strategies regarding the Data Teams Process. The leaders encouraged members to try new teaching strategies and techniques to support the learning needs of students. Leaders also provided resources or supported teams in using district-created resources to guide and monitor their work. Leaders described the incremental growth that was observed in student scores as a success. They also noted the collegiality of the team as a part of their success. At two of the sites, success was realized in the results of the state accountability report. When leading the Data Teams Process, the leadership and management practices of the leaders were

intertwined. Evidence supported that leaders utilized a mix of transformational leadership, servant leadership, and management behaviors. In addition, leaders were needed to keep teams focused on the use of data and the Data Teams Process. The answer for the Central Research Question was supported by the findings for the seven subquestions for the study.

Subquestion One. The first subquestion was, How do leaders initiate discussions about data and create a catalyst for meaningful action? The answer to the first subquestion was; Leaders used the Data Teams Process to initiate discussions by using data to focus teams on students' most urgent learning needs. When engaging in those discussions or sharing information from those discussions, leaders involved various stakeholders. When involving others, leaders were cognizant of the need to ensure data privacy. This was important as teams examined many contextual issues surrounding the data results for each student or each group of students. As a result, the discussions of the team created a framework for sharing information and for building shared knowledge.

The answer for Subquestion One was supported by the findings that emerged in this study. The findings used to support the question described how leaders identified the problems and framed the questions to be addressed by Data Teams. The need to identify problems and frame questions was supported by the work of Gummer and Mandinach (2015) and Mandinach and Gummer (2016a), who recognized the practice as a component of the inquiry cycle for the Data Literacy Conceptual Framework.

To provide an opportunity to review and discuss data in order to identify problems or frame questions, the leaders in the study supported their teams in carrying out the actions for step two of the Data Teams Process. The findings are supported by the work of others (Besser, 2010; McNulty & Besser, 2011; Peery, 2011). When engaging in step two, leaders kept teams focused

on the most urgent needs of learners by helping members to identify the academic strengths and needs of students and to develop data-based inferences. The findings are consistent with those of others (Besser, 2010; Hooft et al., 2010; Jacobs et al., 2009; McNulty & Besser, 2011; Peery, 2001; Vahey et al., 2006).

In the study, to help team members identify the most urgent needs of learners, the leaders initiated discussions that were focused on student data results. By engaging others in the discussions, the leaders were able to support their teams by articulating or communicating the problem. To articulate the problem or question to be studied, leaders guided team members in reviewing the data that had been collected and helped to identify areas of academic need for the building population, individual grade-levels or individual students. The findings are consistent with the literature of Gummer and Mandinach (2015), Knapp, Swinnerton, et al. (2006), and Mandinach and Gummer (2016a), who recognized a need to articulate or communicate the problem or question.

When working with teams, leaders involved other stakeholders, either as process participants or as informational consumers. To support teams, leaders engaged team members in conversations about student data results to identify areas of student need and growth. The participants that were involved in data discussions included team members; intervention specialists such as Title I, SPED; and instructional facilitators. Student data results were shared with parents, community members, the superintendent, and the school board. The findings are consistent with the literature of Gummer and Mandinach (2015), Knapp, Swinnerton, et al. (2006), and Mandinach and Gummer (2016a), who recognized a need to involve other participants or stakeholders when working with data.

When initiating discussions, the leaders understood the importance of student privacy, and the practices that were needed to keep student data protected and private. All of the leaders in the study described an understanding of who should have access to student data and what steps were necessary to maintain the confidentiality of that data. The need to understand student privacy, was supported by the work of Mandinach and Gummer (2016a), who recognized the understanding as a subcomponent of the inquiry cycle for the Data Literacy Conceptual Framework.

When working to determine the problem, leaders in this study identified the contextual issues that might impact results. The need to Understand Contextual Issues was identified as a subcomponent of the inquiry cycle for the Data Literacy Conceptual Framework by Mandinach and Gummer (2016a). Transcriptions for this study revealed that team discussions created an opportunity for leaders to extract and share useful meaning from organizational experience. This procedure helped to identify contextual issues that might be impacting data results. The findings are supported by Fullan's (2001) description of "Knowledge Building," which alluded to the positive change that occurs when information is shared within a social context. For those working in schools, knowledge building included learning from one another.

In this study, leaders were found to initiate discussions by using data to focus teams on students' most urgent learning needs. By focusing on the most urgent needs that were presented in the data, leaders and their teams were able to articulate the problem. When engaging in those discussions or sharing information from those discussions, leaders involved various stakeholders. When involving others, leaders were cognizant of the need to ensure data privacy. Ensuring data privacy was important as teams examined many contextual issues surrounding the data results for each student or each group of students. As a result, the discussions of the team created a

framework for sharing information and for building shared knowledge. These findings, supported by the information from the research literature, were used to answer the first subquestion; How do leaders initiate discussions about data and create a catalyst for meaningful action?

Subquestion Two. The second subquestion was, How do leaders determine the data used to support the work of the Data Team? The answer for the second subquestion was; leaders identified, accessed, and used multiple sources and various types of data to support the work of Data Teams. The district chose many of the assessments that were used by leaders in this study. However, the leader and their team members generated some formative assessments. When considering the data to be used, leaders considered the purpose for the data. The quality of the data and the reliability of the results were recognized as being important. Leaders looked for measures that were grade level appropriate, produced results that accurately described the skill or problem being measured, and were predictive of the scores students' would receive on PAWs.

The answer for Subquestion Two was supported by the findings that emerged in this study. The findings used to support the answer to the question described the leaders' understanding of data and data use. Qualitative findings from the study revealed that prior to engaging in discussions, leaders and their teams identified and accessed multiple sources of data that could be used to discuss the progress being made by individual students, classroom populations, grade-level populations, or building populations. The need to identify possible data sources was supported by the work of Mandinach and Gummer (2016a), who recognized the practice as a subcomponent of the inquiry cycle for the Data Literacy Conceptual Framework. In the current study, the data sources discussed by leaders in all nine cases included quantitative and

qualitative results from various forms of formative and summative assessments. The need for multiple sources of data or various types of data to engage in a data driven process was described in the literature on data literacy (Data Quality Campaign, 2014; Earl & Katz, 2006; Jacobs et al., 2009; Love et al., 2008).

By collecting multiple sources of data, leaders supported teams with implementing the first part of step one in the Data Teams Process, Collect and Chart Data, which was supported by five of the six subcomponents of the inquiry cycle for the Data Literacy Conceptual Framework. As described by Besser (2010), when engaging in step one of the process, "Data teams gather and display data from formative data results" (p. 3). In this study, the data sources that were gathered and displayed by leaders and their teams were found to also included data from benchmark and summative measures. While the practice was not explicitly reflected in the criteria described by Mandinach and Gummer (2015), the practice was reflected in the broader process for data-driven decision making. Ikemoto and Marsh (2007) noted that in a DDDM process, multiple forms of data were systematically collected and analyzed to guide a range of decisions directed at improving the success of students and schools. The need for multiple sources or various types of data to engage in a data-driven process was also associated with data literacy (Data Quality Campaign, 2014; Earl & Katz, 2006; Jacobs et al., 2009; Love et al., 2008).

Findings for this study revealed that to support data use, leaders helped teams with collecting assessments that were used to support an identified purpose. The findings are consistent with the work of Earl and Katz (2006), who noted that a data literate leader "thinks about the purpose" of data use (p.19). Some of the assessments described, such as NWEA MAP and PAWS were used as a broad measure of students' understanding of grade-level content

standards. Assessments such as DIBELS or FAST were used to measure foundational skills and provided teams with frequent progress-monitoring data that described a student's attainment of specific skills. The leaders and their teams also collected and reviewed data from program assessments which measured students' understanding of the content contained in a particular unit of a district adopted curriculum resource. The district adopted and provided many of the assessments used. Team members, with the support of the leader, generated formative measures that were used for daily checks of student understanding. The need for leaders to understand how to generate data was supported by the work of Mandinach and Gummer (2016a), who identified the understanding as a subcomponent of the inquiry cycle for the Data Literacy Conceptual Framework.

In this study, leaders had a basic understanding of data properties and data quality. The findings are consistent with those who noted that data literacy required an understanding of data properties and data quality (Gummer & Mandinach, 2015; Love et al., 2008; Mandinach & Gummer, 2016a). When considering data quality, the leaders in this study supported their teams by identifying measures that would produce results predictive of the results that students would receive on a PAWS assessment. The leaders also looked for assessments that were grade-level appropriate. In addition, they sought measures that produced results that accurately described the skill or problem being measured. These findings are supported by the work of Earl and Katz (2006), who recognized that data literacy required the ability to "recognize sound and unsound data" (Earl & Katz, 2006, p. 19).

Findings for the study indicated that leaders understood how to access data. Some of the data that was used by teams was retrieved from program or assessment websites. Data also was accessed and stored on a Google drive. The use of online sites not only provided leaders with

access to data but also provided access to data tools for manipulating and disaggregating the data. The findings are consistent with the findings of those (Data Quality Campaign, 2014; Schield, 2004), who recognized that data literacy includes the ability to access data. The findings are supported by several researchers (Gummer & Mandinach, 2015; Knapp et al., 2006; Lachat et al., 2006; Mandinach & Gummer, 2016a), who noted, that to support the use of data, practitioners needed to understand how to use technology, or technology-based systems.

In the study, leaders identified, accessed, and used multiple sources and various types of data to support the work of Data Teams. The data were used to support various purposes. The district chose some of the data used, such as common assessments or program assessments, and leaders supported their teams by generating some of the formative assessments that were used. To determine the type of assessment data that would be generated, the leaders and their team discussed the purpose of the data. Conversations included how the data would be collected and how the information or results would be used. When examining the data, the leaders considered variables that might affect data quality or the reliability of results. These findings, supported by the information from the research literature, were used to answer the second subquestion; How do leaders determine the data used to support the work of the Data Team?

Subquestion Three. The third subquestion was, How do leaders utilize analytical skills to support the work of Data Teams? The answer for the third subquestion was; leaders' descriptions of their use of data showed they possessed basic analytical skills. However, fourteen of the nineteen leaders were found to have received little data training. To access, chart, or manipulate data the leaders in this study used spreadsheets, Data Teams forms, and online sites. The leaders described being familiar with the programs and reports that were produced through online sites. When reviewing data, leaders used aggregated and disaggregated results.

To analyze data, leaders and their teams compared the data from various assessments, classrooms, and groups. When discussing the data, the leaders posed questions about the results to help teams identify the academic needs of individual students or groups.

The answer for Subquestion Three was supported by the findings that emerged in this study. The findings used to support the answer to the question described the basic statistical principles, indicators, and measurement concepts that leaders used to analyze data. The qualitative findings from the study that described the subcomponent, Understand How to Analyze Data, were supported in the research literature that described Data Teams and Data Literacy.

In the related literature, various researchers identified a need for those that use data to have statistical skills (Earl & Katz, 2006; Gal, 2002; Gummer & Mandinach, 2015; Love et al., 2008; Mandinach & Gummer, 2016a). Yet, in this study, fourteen of the nineteen leaders had little formal data training. The formal training for most of the leaders consisted of one research or statistics class taken during a degree program. These findings are consistent with the research, which noted that too many educators, including leaders, lacked the training necessary to create, understand, analyze, and interpret data (Creighton, 2001; Earl & Katz, 2002, 2006; Hess & Kelly, 2007; Jimerson & Wayman, 2015; Mandinach, Honey, et al., 2006; Mandinach, Rivas, et al., 2006; Mandinach & Gummer, 2016a; Mandinach & Jimerson, 2016; Goertz, Oláh, & Riggan, 2010: Lai & Schildkamp, 2013; Means, Padilla, Debarger & Bakia, 2009; Piro & Hutchinson, 2014; Popham, 2009; Stiggins, 2008).

Although many of the leaders at the various sites had little formal training, there was evidence that each possessed basic analytical skills. Leaders participating in this study used spreadsheets, Data Team forms, and online sites to access, chart, or manipulate data. These

findings are supported by the work of Hooft et al. (2010), Schield (2004), and Vahey et al. (2006), who posited that data literacy required knowing how to utilize the appropriate data tools to access and manipulate data. When using data tools, leaders participating in this study utilized aggregated and disaggregated data. When leaders disaggregated data, various levels of data were used. These findings are consistent with the work of Love et al. (2008), who noted that data literacy included an understanding regarding the use of aggregated, disaggregated, strand, item, and student work data to drill down into results as well as the work of Mandinach and Gummer (2016a), who noted that through the disaggregation of data, teams were "able to plan for the acceleration of learning for all students" (p. 19). To plan for learning, leaders discussed and compared data from different assessments, classrooms, and groups. Findings from this study indicated that leaders and other team members posed questions about data results to identify the academic needs of various groups of students. These findings support the work of Lachat et al. (2006), who recognized to develop data literacy and teachers' use of data, that essential questions were needed to guide the analysis of data.

Findings from this study indicated that leaders understood how to analyze data. To support the work of their teams, leaders used simple data tools and online programs to access and manipulate data. Leaders were able to disaggregate data and support teams in drilling down into the data to examine (a) student scores by grade or class, (b) scores for individual students, (c) strand scores for individual students, or (d) individual student scores for specific questions. While leaders described having a basic understanding of how to analyze data, the analysis work that was done during team meetings was more qualitative than quantitative. These findings, supported by the information from the research literature, were used to answer the third subquestion, How do leaders utilize analytical skills to support the work of Data Teams?

Subquestion Four. The fourth subquestion was, How do leaders build others capacity to use data effectively? As noted by Fullan (2008) Capacity Building concerns competencies, resources and motivation. Marsh and Farrell (2015) described capacity building as a learning process in which individuals make sense of information and construct new knowledge through activity and social interactions, mediated by prior knowledge, beliefs, and experiences" (274). In this study, to support teams, and build new knowledge leaders used charts graphs and PowerPoint presentations to present data results. When supporting teams, leaders considered the intended and unintended consequences of data use. The leaders used the data to make hypothetical connections, develop hypotheses, and SMART Goals. The leaders also encouraged team members to test assumptions through action research. The leaders helped teams discuss and analyze problems to determine the strategies or next instructional steps to be used. The leaders linked results to curriculum maps and standards to support the decision making process. Additionally, the leaders guided their teams to re-examine the original problem and to consider whether additional work was needed to meet the goal.

The answer for Subquestion Four was supported by the findings that emerged in this study. The findings used to support the answer to the question described how the components (a) Transform Data Into Information, (b) Transform Information Into Decision, and (c) Evaluate Outcomes were demonstrated by the leaders in the study. Findings revealed that leaders described actions that reflected the subcomponents of each of the components when engaging in steps three through six of the Data Teams Process. The three steps included (a) Establish SMART Goals, (b) Select Instructional Strategies, and (c) Determine Results Indicators (Besser, 2010; McNulty & Besser, 2011; Peery, 2011). The qualitative findings from the study were supported in the research literature that described Data Teams and data literacy.

In this study, leaders demonstrated an understanding of how to transform data into information. The data literacy component, Transform Data into Information, was identified in the work of Mandinach and Gummer (2016a). To transform data into information, transcriptions revealed that leaders guided teams to consider the impact and consequences associated with using data. These findings are supported by the work of Mandinach and Gummer (2016a), who noted that data literacy included the practice of considering impact and consequences. Findings from the data were also consistent with the research of Earl and Katz (2006), who recognized that data literacy included the ability to consider impact and consequence and "systematically consider an issue from a range of perspectives" (p. 45). To consider impact and consequences, the leaders and their teams engaged in discussions about variables that might impact students' results and ultimately the school's state accountability report. Considering variables allowed leaders to make inferences about data results. The findings are consistent with the research of Earl and Katz (2006) and Knapp et al. (2006) that described the need to think about what results mean and what data can tell about students. Findings are also consistent with research on data literacy that described a need to understand how to make data-based inferences (Love et al., 2008; Vahey et al., 2006).

To transform data into information, leaders guided teams in making hypothetical connections between data results and the possible cause of a problem. The leaders in the study supported teams by brainstorming or mapping out data results to identify problems. Some of the leaders used the questioning strategy of five whys to identify the root cause of a problem. At five of the nine sites, the leaders supported teams in setting SMART goals. The use of SMART goals was supported by step three of the Data Teams Process, Establish SMART Goals, described in the literature (Besser, 2010; McNulty & Besser, 2011; Peery, 2011). At four of the

nine sites in the study, leaders guided teams in developing hypotheses about how the various strategies or programs might impact student learning. These findings are supported by the work of Mandinach and Gummer (2016a), who noted that data literacy included the practice of generating hypotheses.

To transform data into information, findings from the study revealed that leaders and their teams tested assumptions about data by implementing practices and reviewing results. These findings are supported by the work of Mandinach and Gummer (2016a), who explained that data literacy included the practice of testing assumptions. Analysis of the data revealed that leaders and their teams engaged in action research to test the impact of strategies, practices, or programs, on student learning. The findings are supported by the work of Perry (2011), who posited that the continual use of action research allowed Data Teams to get to the heart of student learning. The findings are also supported by observations made by McNulty and Besser (2011), who recognized that the use of "cause and effect data" (p. 40) by Data Teams provided a way for group members to continuously examine the impact that the various components of the educational system had on student growth and to make corrections to actions as needed. To identify how implemented strategies and practices were impacting student growth at each of the sites this research revealed that leaders guided their teams in examining student academic proficiencies, deficiencies, and data trends. The leaders also encouraged their teams to consider previous data results and compare results when examining student growth.

To transform data into information, leaders in this study also understood how to interpret data. The findings are supported by the work of several noted researchers (Mandinach & Gummer, 2016a; 2016b; Vahey et al., 2006), who posited that data literacy included an understanding of how to interpret data. The findings revealed that when interpreting data,

leaders used meeting agendas, notes, or district Data Team forms to record meeting information and data results discussed by teams. When presenting data, leaders described using charts, graphs, and PowerPoint presentations. These findings are consistent with information presented by Love et al. (2008), who recognized that data literacy included an understanding of how to effectively use graphs and charts to display data. Leaders in this study agreed that when interpreting and presenting data to others, the data had to be presented in a way that was easy to understand. These findings are consistent with the work of Earl and Katz (2006), who noted that an individual who is data literate "makes interpretation paramount" (p. 20) and "pays attention to reporting and to audiences" (p. 20).

Findings from this study also revealed that leaders used data results to identify instructional solutions. These findings are consistent with the work of Gummer & Mandinach (2015), Mandinach & Gummer (2016a) and Mandinach and Gummer (2016b), who wrote that data literacy included the understanding of how to transform the information gained from data results into a decision. Results were also supported by the research of Jacobs et al. (2009), who recognized that data use required analyzing practice "to see if areas of the curriculum need to be retaught or if a new type of instructional strategy may be needed" (p. 46).

When transforming information into a decision, leaders in this study determined next instructional steps by helping teams choose the strategies used to deliver instruction in each team member's classroom or skill group during the short-cycle period. The instructional strategies used by teams were chosen from resources provided by the district or school. The selection of instructional strategies was part of step four of the Data Teams Process described in the literature (Besser, 2010; McNulty & Besser, 2011; Peery, 2011). By using the information gained from the data results to choose instructional strategies, the leaders helped teams and team members

tailor the instruction for various and diverse groups of students. The findings are consistent with information provided by Data Quality Campaign (2014). When choosing strategies and determining next steps, leaders in the study considered how the work would support students' understanding of the grade-level content standards that were embedded in the team's curriculum maps. The need for leaders to determine next instructional steps and understand the context for decisions was supported by the work of Gummer and Mandinach (2015), Mandinach and Gummer (2016a) and Mandinach and Gummer (2016b). The findings are also supported in the work of several scholars (Hooft et al., 2010; Lachat et al., 2006; Lai & Schildkamp, 2013; Mandinach & Gummer, 2016a; Vahey et al., 2006), who understood that to create meaningful connections between data results and instruction, data must be interpreted within the context of the issue to be addressed.

In this study, leaders used the Data Teams Process to create opportunities for teams to select instructional strategies, determine next instructional steps and understand the context for the decision. In six of the nine cases in the study, the leaders and their teams were found to use the Data Teams Process to determine student placement in differentiated instructional groups or individual interventions. The practice of using data to determine student placement in skill groups or individual interventions was found to be an ordinary practice in the elementary schools. The practice of using data to determine student need for intervention was support by descriptions found in the literature for RtI (Center on Response to Intervention, 2010; Gerzel-Short & Wilkins, 2009; Shinn, 2007).

Following the implementation of an intervention, leaders evaluated outcomes. This practice was supported by the work of Mandinach and Gummer (2016a), who included Evaluate Outcomes as a component of the inquiry cycle for the Data Literacy Conceptual Framework.

The practice of evaluating outcomes was also espoused by Mandinach and Gummer (2015), who acknowledged that evaluating outcomes included testing hypotheses, reviewing results, scrutinizing results, and considering feedback loops. In this study, the actions of leaders and teams when evaluating outcomes were described in step five of the Data Teams Process, Determine Results Indicators (Besser, 2010; McNulty & Besser, 2011; Peery, 2011). To evaluate outcomes, leaders at eight of the nine sites guided teams in reviewing and discussing data results that were collected and presented at the end of each short-cycle. At four of the nine sites, leaders used results to re-examine the original problem and determine next steps. Mandinach and Gummer (2016a) identified the practice of re-examining the question or problem as a subcomponent of the inquiry cycle for the Data Literacy Conceptual Framework. When evaluating outcomes, leaders considered the need for an iterative process that would allow the team to continue to act on a particular problem that had not yet been resolved. This practice was articulated in the work of Gummer and Mandinach (2015), Mandinach and Gummer (2016a) and Vanhoof et al., (2013), who also called for a recursive way to act on data and find solutions for a problem. The six steps of the Data Teams Process provided the iterative process that was used by leaders in the study. The six steps of the process were described in the work of various researchers (Besser, 2010; McNulty & Besser, 2011; Peery, 2011). In this study, the Data Teams Process provided a lens to view leaders' use of the components and subcomponents of the inquiry cycle for the Data Literacy Conceptual Framework within an existing school environment.

In this study, findings revealed that leaders at the various sites understood how to transform data into information, transform information into decisions, and evaluate outcomes. When transforming data into information, leaders considered the intended and unintended

consequence of data use. Leaders supported teams by making hypothetical connections and developing hypotheses. To test assumptions, leaders guided teams in using action research. To interpret and present results for others, leaders utilized charts and graphs or PowerPoint presentations. When transforming data into a decision, leaders supported teams in determining next instructional steps. To determine next steps, leaders guided teams by choosing strategies that would best support instruction. Also, leaders ensured that curriculum maps and the content standards that were supported in the maps provided the context for decisions that were made by teams. When evaluating outcomes, leaders guided teams to re-examine the original question or problem and consider the need for an iterative decision cycle to address the problem. These findings, supported by the information from the research literature, were used to answer the fourth subquestion, How do leaders build others' capacity to use data effectively?

Subquestion Five. The fifth subquestion was, How do leaders supervise the Data Teams Process? The answer to the fifth subquestion was, leaders utilize a mix of transformational leadership, servant leadership, and management behaviors to supervise Data Teams. In this study, there was evidence in leaders descriptions of the existence of an authoritative relationship between the leader and team members. This was evident when leaders described how they kept teams focused on following the steps of the Data Teams Process, how they required data to be organized and ready for meetings, and their expectations that agreed upon strategies would be implemented. There was also evidence in leaders' descriptions of the use of transformational leadership to supervise teams. Leaders in this study modeled the use of data and the Data Teams Process. Their actions inspired others to seek their assistance to replicate their use of data and instructional strategies. They built trusting relationships, provided non-evaluative feedback and kept teams focused on the school vision. Leaders' descriptions also provided evidence of their

use of servant leadership to supervise teams. The leaders in this study supervised teams by ensuring that the needs of the members were met. They described providing encouragement, materials, time, and advice to members. They worked to be present to answer questions. They took on extra tasks to lighten the load for others.

The answer for subquestion five was supported by the findings that emerged in this study. The findings used to support the answer to the question described the leadership and management actions that were used by formal and informal leaders to support the work of the data team. For the purposes of this study, leadership was described as the actions used by leaders that influence followers to engage in real changes that reflect the mutual purpose of the leader and follower (Rost, 1993). Management was described as the authoritative actions used by managers with subordinates to coordinate activities that are used to produce a particular product or provide a particular service (Rost, 1993). The qualitative findings from the study that were used to answer the question were supported in the research literature that described management, transformational leadership, and servant leadership.

Qualitative findings that were relevant to leaders' use of management practices were evident in the practices of all the formal leaders and informal leaders participating in this study. Some of the practices described by leaders were found to align with the four essentials elements of management described by Rost (1993). The described actions of the leaders met the criteria for the first two elements of management noted by Rost (1993), wherein "management is an authority relationship, [and] the people in this relationship include at least one manager and one subordinate" (p. 145). The leaders also demonstrated an authoritative relationship between themselves and subordinates when ensuring compliance and collaboration, holding members responsible for meeting norms, ensuring that members were on topic and engaged in the meeting,

and ensuring that the steps of the Data Teams Process were followed. Evidence of Rost's (1993) third element, "manager(s) and subordinate(s) coordinated their activities" (p. 145), was evident in leaders' actions of attending meetings, organizing and facilitating meetings, sharing agendas, and reminding members of deadlines. Additionally, the actions of the leaders demonstrated the fourth element noted by Rost (1993), "The manager(s) and subordinate(s) produce and sell particular goods and/or services" (p. 145). The informal leaders' actions provided evidence that the work of the leaders with their team produced a product. While the agendas and short-cycle data provided hardcopy evidence of the work that was completed, the real product that was produced was positive student academic growth. In seven of the nine cases in the study, formal and informal leaders observed that the data-driven process contributed to student academic growth at their site. However, evidence of the growth for five of those sites was not evident in state accountability reports. In all, only two sites showed growth on state accountability reports.

Qualitative findings that were relevant to leaders' behaviors that reflected transformational leadership were evident in the actions of seven of the nine formal leaders and five of the ten informal leaders. As described by Bass and Riggio (2006), transformational leaders "are those that stimulate and inspire followers to both achieve extraordinary outcomes and, in the process, develop their own leadership capacity" (p. 3). In the study, leaders provided followers with a vision for (a) the implementation of the Data Teams Process, (b) instructional practice, and (c) student learning. To support the school vision, leaders described providing teams and team members with data and feedback on the practices and process being implemented at each site. Transcriptions also revealed that some leaders inspired others in the school to utilize instructional strategies that had been described as effective by welcoming those individuals into their classroom and modeling the use of the strategies. The actions of the

leaders in supporting teams and building follower commitment were focused on the needs of the organization and meeting state accountability requirements. The observation that leaders' actions demonstrated behaviors associated with transformational leadership was supported by the work of Stone et al. (2004), who noted that "the transformational leader's focus is directed toward the organization, and his or her behavior builds follower commitment toward organizational objectives" (p. 349).

According to Bass and Riggio (2006), transformational leadership had four components. The described actions of the leaders participating in this study aligned with descriptions of three of the components. In this study, leaders fostered positive relationships and inspired others to engage in the work of Data Teams. The leaders' actions were also reflected in the component of Idealized Influence, which addressed the charismatic convictions of the leader and the trusting relationship built between leader and follower (Bass & Riggio). These leaders also provided non-evaluative feedback to teams and supported their work by helping members identify changes that were needed to achieve the vision. The leaders' actions were also reflected in the component of Intellectual Stimulation, which described leadership actions that stimulated follower creativity for solving problems by creating environments free of criticism (Bass & Riggio). Additionally, leaders' practice of modeling the use of data, the use of instructional strategies, and the Data Teams Process were reflected in the concept of Individualized Consideration, which described how leaders individualized interactions with followers and personalized the support that was provided to each (Bass & Riggio).

Qualitative findings that were relevant to leaders' use of behaviors that reflected servant leadership were evident in the actions of six of the nine formal leaders and all informal leaders. As noted by van Dierendonck (2011), "A servant-leader works toward building a learning

organization where each individual can be of unique value" (p. 1231). In this study, leaders worked side by side with team members and were present at meetings to support their work. The leaders engaged members in daily informal conversation and built caring relationships. In doing so, leaders created a safe climate for followers to identify and try new instructional practices. To support team members, leaders provided encouragement, materials, time, and advice; answered questions; and shouldered the burden for some of the work that had to be completed for the Data Teams Process.

Leaders in this study demonstrated actions associated with behaviors of servant leadership described in the work of Russell and Stone (2002). In the work of Russell and Stone (2002), existing literature that addressed servant leadership was used to identify 20 distinct attributes of servant leadership. In the study, nine of the nine attributes classified by Russell and Stone (2002) as functional attributes of servant leadership were demonstrated in the described actions of the leaders. The functional attributes that were demonstrated by leaders in the study included (a) vision, (b) honesty, (c) integrity, (d) trust, (e) service, (f) modeling, (g) pioneering, (h) appreciation of others, and (i) empowerment. Furthermore, the actions of leaders in this study demonstrated ten of the eleven attributes that were classified by Russell and Stone (2002) as accompanying attributes of servant leadership. The accompanying attributes demonstrated by the leaders included; (a) communication, (b) credibility, (c) competence, (d) stewardship, (e) visibility, (f) influence, (g) persuasion, (h) listening, (i) encouragement, and (j) teaching. Leaders described the conversations that took place between themselves and team members during formal meetings and in the hallways. Evidence was provided that team members were open to sharing and comparing the data results from their classrooms with the results from other team members' classrooms. Conversations revealed a culture of collegiality that was focused on

the needs of team members over the organization. These findings are also found in the work of Stone et al. (2004), who noted that "the servant leader's focus is on the followers, and the achievement of organizational objectives is a subordinate outcome" (p. 349).

In this study, leaders engaged in actions of management, behaviors of transformational leadership, and behaviors of servant leadership to support the work of data teams. Findings of the study revealed that within the formal meeting structure of the data team, practices and behaviors of management, transformational leadership and servant leadership were intertwined. These findings, supported by the information from the research literature, were used to answer the fifth subquestion, "How do leaders supervise the Data Teams Process?

Subquestion Six. The sixth subquestion How do leaders determine the success of a data team? The answer for the Subquestion six was, Leaders monitored the work of the data team and their incremental successes through the use of Data Teams agendas, notes, or Data Teams forms. The leaders also reviewed and compared the results from the various assessments that were being used by teams. Some leaders compiled and used spreadsheets to identify changes in the data. Team success was also observed in the way teams used the school or district provided resources that described instructional strategies.

The answer for the sixth subquestion was supported by the findings that emerged in this study. The findings used to support the answer to the question described the artifacts and data evidence that leaders utilized to demonstrate data team success. Qualitative findings from the study were supported in the research literature that described data teams.

In this study, leaders at all nine sites described artifacts that were collected and used to support the work of data teams. Eight of the nine sites produced and maintained data team agendas, notes, or data team forms to provide evidence of team success. These findings are

supported by the work of Peery (2011), who wrote "Every time a data team meets, minutes should be taken" (p.18). In four of the cases, findings revealed that the district required teams to use the data team form for recording and tracking data and analysis results. The leaders at the four sites reported that the form also included links to supporting information regarding strategies and videos that demonstrated how each step of the Data Teams Process should be carried out. In the work of Perry (2011) the criteria for proficient and exemplary agendas and minutes were described. The agenda elements described by Perry (2011) guided teams in (a) following the steps of the Data Teams Process, (b) focusing on analysis of student work, and (c) examining previous results and progress made toward achieving the goals (Perry, 2011). Items included in the description of meeting minutes reflected the desired changes in behavior for students and teachers, provided descriptions and models of strategies, provided a record of analysis and strategies used, and included a list of resources that could be used to support the process (Perry, 2011).

To provide evidence of team success, leaders in this study gathered the results from multiple formative and summative assessments. Assessments provided a longitudinal account of student progress and ranges of perspectives. In describing the thinking process for data literacy, Earl and Katz (2006) highlighted a need for "systematically considering an issue from a range of perspectives so that you really feel that you have evidence to explain, support, and also challenge your point of view" (p. 45). In the work of Jacobs et al. (2009), the use of multiple data sources and triangulation of data provided validation of a perceived concern. In this study, artifacts described by leaders included spreadsheets that were used by the leaders and teams to collect or chart data results from the multiple assessments. In five of the eight cases in the study, leaders described using spreadsheets.

Leaders participating in this study included, in their list of artifacts describing team success, the resources that were used by teams to guide the decision-making process. In six of the nine cases, leaders articulated the use of resources that were provided by the school or district that described instructional strategies. In four of the nine cases a formalized framework was used to guide decisions regarding instructional strategies. The framework that was used included descriptions of instructional strategies along with the effect size for each of those strategies. The list was compiled from the work of Hattie (2009), which was based on the results of his meta-analysis, which explored the effect size of multiple instructional strategies. Leaders at the four sites where the framework was used described considering the effect size noted for each strategy to support the decision-making process. The use of the formalized framework was notable in this study because leaders needed to understand how to interpret results reported for each effect size listed in order to effectively utilize the framework. The leaders' use of data to guide decisions about instructional strategies, programs, and processes was supported by the work of multiple researchers (Bernhardt, 2013; Earl & Katz, 2006; Knapp et al., 2006; Love, 2009; Love et al., 2008; Mandinach & Gummer, 2016a; McNulty & Besser, 2011).

In the study, leaders collected multiple artifacts to determine team success. Artifacts collected by leaders included data team agendas or forms, the results of multiple assessments, spreadsheets, and resources that referenced instructional strategies. These findings, supported by the information from the research literature, were used to answer the sixth subquestion, How do leaders determine the success of a data team?

Subquestion Seven. The seventh subquestion was, Why do data teams need to have the support of leaders? The answer to the seventh subquestion was, Leaders are needed to ensure to that team members engage in the Data Teams Process. Leaders are also needed to access district

resources and enforce district expectations that foster academic growth and create a positive change in state assessment results. Furthermore, leaders are needed to foster collaboration and encourage discussions around data. The leaders' expertise gained from Data Teams training is also needed to support the implementation and fidelity of the Data Teams Process.

The answer for Subquestion Seven was supported by the findings that emerged in this study. The findings used to support the answer to the question described the historical, political, social, and personal contexts that surrounded the work of formal and informal leaders in the Data Teams Process. Qualitative findings from the study were supported in the research literature that described data teams and data literacy.

The historical findings used to answer subquestion seven considered how implementation of the Data Teams Process differed between the cases. While training on the process had been provided for each of the sites, the implementation of the steps of the process varied between cases. At some sites, there were missing or incomplete steps. Missing or incomplete steps included (a) step three of the process, Establish SMART Goals, (b) step five of the process, Determine Results indicators, and (c) step six of the process, Monitor and Evaluate results. In the cases where all steps were implemented, findings revealed that the school district provided multiple resources and feedback loops to support the process. This was supported by the work of McNulty and Besser (2011), who recognized the need for district or building level support of teams to create sustainability. There were multiple challenges described by leaders participating in this study that had the potential to compromise implementation and sustainability of the process. These findings are supported in the work of McNulty and Besser (2011), who noted, "There is no shortage of reasons as to why we don't implement well" (p. 19). McNulty and Besser (2011) further posited, "Sustaining the Data Team's journey is a messy process, and there

are many roadblocks to overcome" (McNulty & Besser, 2011, p. 158). Findings of the study revealed that the leaders were needed to help teams overcome roadblocks. This was supported by the work of Campsen (2010), Peery (2011), and McNulty and Besser (2011), who highlighted that the implementation and success of the Data Teams Process was dependent on the active involvement of leaders and their ability to engage others, guide the process, monitor the process, and provide feedback.

The findings that described the political context of the study that were used to answer subquestion seven considered how state and district politics impacted leaders' work with data teams. Findings for the study revealed that teams began their yearly work by examining state assessment scores. The scores from these assessments were compared with other data to drive instructional decisions. Leaders reported that it bothered team members when the school failed to meet state accountability requirements. Leaders also provided team members with encouragement to keep moving forward. The findings are supported by the work of McNulty and Besser (2011), who stated, "It is the formative focus on results that leads to improvement, acceleration, motivation, and change" (p 170).

Data from this study described leaders who were also needed to access district resources and enforce district expectations. In the study, at all nine sites, the school district provided training and meeting times to support the Data Teams Process. Findings revealed that resources that were provided by the school or district and used by leaders and their teams to guide decisions and support the process were different between the two school districts that were represented by the nine schools in this study. Leaders worked to ensure that the protocols for their district were followed and that district provided resources were utilized. These findings are supported by the work of McNulty and Besser (2011), who articulated the need for leaders to act

with authority to ensure the effectiveness of the process.

The findings that described the social context of the study that were used to answer subquestion seven, considered how leaders were needed to foster collaboration and encourage discussions around data. In this study, many of the participants expressed, that without the support of leaders, the Data Teams Process would not be as effective. Data supported that leaders in the study were needed to; (a) lead discussions, (b) ensure all members were heard and acknowledged, (c) keep members focused on data, (d) keep members focused on the Data Teams Process, and (e) create buy-in to the process. Supporting evidence for these findings was found in the work of Campsen (2010), McNulty and Besser (2011), and Peery (2011), who proclaimed that leadership was necessary to ensure (a) the implementation of an inquiry orientation, (b) the use of the five-step Data Teams Process, and (c) implementation of identified strategies by all team members.

Findings that described the social context for this study also revealed that in seven of the nine cases, the leaders and their teams continuously engaged in non-evaluative discussions to review data and instructional practices. Leaders noted team members as feeling comfortable in the sharing of their data with others and asking for advice. The formal leaders described creating a culture where members shared their data results freely with one another. These findings are supported by the work of Peery (2010), who recognized that in order for teams to thrive members must embrace a shared inquiry orientation while using the five-step process.

Findings that described the personal context for this study were related to the leaders' training. In this study the formal and informal leaders in eight of the nine cases, were found to hold at least one master's degree. In the study 18 of the 19 leaders held a master's degree. Additionally, most of the leaders were found to have received training on the Data Teams

Process. The leaders who were trained in the process were employed in the district when data team training was provided. The researcher observed that in schools where both leaders had been trained in the process, leaders described using all of the steps when meeting with their teams. This was supported by the work of McNulty and Besser (2011), who noted, "Learning to use more effective teaching practices requires learning in Instructional Data teams (IDTs), undergoing extensive professional development, and then having the opportunity for extensive practice" (p. 55). In this study, teams that followed this practice observed academic growth in their students.

Implications

This qualitative multi-case study identified how the data literacy of formal and informal leaders in the state of Wyoming contributed to the Data Teams Process. As a result of the analysis of the data from each case and researcher reflection, findings and themes emerged that answered the research questions for the study. In addition, a number of implications emerged from the study. The implications of this study addressed leaders' data literacy and the Data Teams Process.

Implications regarding leaders' data literacy. Formal and informal leaders described actions that demonstrated an understanding or use of the subcomponents of data literacy. While evidence of the subcomponents was identified, the leaders' depth of understanding of each component was not revealed. The leaders' understanding of teaching and learning appeared to play a greater role in their work with data than did their understanding of statistics or statistical practices. It further appeared, that the use of online programs that provided reports with various statistical results negated the need for leaders to have an extensive statistical background.

Implications regarding the Data Teams Process. While this study focused on the school building leaders' work with data teams at each school site, the influence of the school district on the process was apparent. There was an observed difference between the two districts in the way data teams were implemented and supported. The district with the most cohesive Data Teams Process required (a) the use of a district-created data team form for recording meeting notes and student data results, (b) a district-created resource that briefly explained the work of Hattie (2012), and (c) a district quarterly feedback loop for submitting and checking the work of each team. This observation implies a need for a solid district data team structure and the support of district leadership when implementing data teams.

Implications regarding leadership and management. The findings that formal and informal leaders engaged in practices of management, and engaged in behaviors associated with transformational leadership and servant leadership suggest that multiple approaches are necessary to successfully lead the Data Teams Process. The finding that formal and informal leaders were described as engaging in many of the same tasks and actions when leading the Data Teams Process suggests that other forms of leadership could be present within the team structure.

Recommendations

Findings from the study and the researcher's experience in conducting the study, were used to provide recommendations. Recommendations for practitioners and others provide a review of additional limitations that emerged during the study that should be considered when conducting research. The recommendations made for future research utilized the findings from this study as a springboard for new research on data teams and the Data Literacy Conceptual Framework.

Recommendations for leaders of Data Teams. When working with Data Teams, leaders need to anticipate the challenges that teams and team members will face when engaging in the process. There are four recommendations for leaders that address some of those challenges.

Leaders' descriptions in the study revealed how important relationships were to the success of their teams. It was important that members felt comfortable sharing information with one another. It should be recognized that in collaborative situations it may be difficult or uncomfortable for some team members to talk about data results and disclose information about personal successes or failures. The recommendation, therefore, is that leaders set norms that ensure team members will not be evaluated on data results that are disclosed during team meetings.

As a result of Data Team discussions, team members will need to make instructional changes in their classrooms. Some of the strategies implemented will be successful and some may not be successful. Thus, leaders should work to create a culture where team members feel safe to experiment with new instructional strategies and seek feedback from others on how to improve on their implementation of these practices.

Team members who lack data training may experience difficulties when attempting to access data, chart data, analyze data, and interpret the various score schemes. It is recommended that leaders take time to demonstrate these practices to ensure that team members are able to fully engage in the work of the team.

As teachers, data team members have numerous responsibilities that consume their attention and time. Within the school setting, teams and easily become distracted with other work and abandon or cheat the Data Teams Process. It is therefore recommended that leaders be

present to keep discussions on track, review notes, and provide regular non-evaluative feedback to the team regarding their use of the process.

Recommendations for researchers. When conducting research within the school setting or with school personnel, the researcher must be aware of the various factors that could impact his or her ability to collect information. In this study, five recommendations for researchers emerged that address those factors.

The first recommendation addresses technology issues that should be considered when conducting research. Firewalls and email settings may block communication between the researcher and potential participants. Therefore, it is recommended that when conducting research in schools or with school staff, communication not be limited to email.

Researchers should also be aware that the security levels for firewalls may vary between schools. If the research project requires participants to use technology, the researcher must seek information about whether email and video communications will be allowed. Participants at each site must also access support from the technology department to ensure that the computers to be used for video conferencing are equipped with proper hardware and software to support the activity. Therefore the recommendation is that when conducting research in a school or with school staff, contact should first be made with the district technology director to ensure that firewalls will not interfere with the work.

When conducting research within schools, researchers must consider how the project will be communicated to prospective participants. A district leader's communication about an upcoming project signals staff that the district approves of their participation. The district leader's message also communicates to staff that the emails they will be receiving are safe and not linked to phishing attempts. Therefore, researchers who plan to conduct research in schools

should request that the superintendent forward his/her permission to all prospective participants before each is formally invited by the researcher.

Aligning the research timeline with the academic calendar year is also recommended. Schools experience yearly staffing changes as well as changes to curriculum and assessments. When providing information for a previous year while immersed in practices of the current year, there is an additional need for clarification of participants' answers to ensure that the information is being provided accurately for the year that is being studied. Therefore, it is recommended that researchers conduct interviews during the same school year for which the study information will be reported.

When research includes school sites that vary by population and grade-level configuration the researcher must have a clear understanding of how these dynamics may impact the study. When a process is implemented in a school, adjustments to that process may be necessary to create a perfect fit for the site. These undisclosed adjustments are not apparent unless additional information is gathered. Therefore, it is recommended that researchers survey participants before interviews are conducted. The purpose of the survey would be to obtain specific information about participant demographics and group configurations and inform decisions regarding study delimitations.

Recommendations for future study. The primary focus of this study was on Data Teams, Data Literacy, and Leadership. In this study, there were five issues that emerged from the three areas of focus. One limitation of this study was the small population and the limited number of teams being described for each site. In this study, the components and subcomponents of the Data Literacy Conceptual Framework that were used by leaders of Data Teams in nine schools from two districts in the state of Wyoming were identified. Participants

interviewed were leaders of successful teams at each site. According to those leaders, the standard of performance varied for each team at their site. Thus, while the study provides a model of school leaders' use of the components and subcomponents of the framework, the qualitative findings cannot be used to describe similar practices at other sites. Therefore, further research is needed on (a) how school leaders learn and demonstrate the components and subcomponents of the Data Literacy Conceptual Framework, (b) how all team leaders at a school site demonstrate the components and subcomponents of the Data Literacy Conceptual Framework when engaged in the Data Teams Process, and (c) how the use of the Data Literacy Conceptual Framework at a particular site compares to its use at other sites.

In this study, descriptions of each teams' use of data results were used to identify the components and subcomponents of the Data Literacy Conceptual Framework. Findings for the study revealed that data results from online programs provided a user-friendly source for data driven practice. In this study, leaders noted using data that was accessed from online programs, assessment sites, and personalized learning platforms. Leaders' use of programs that can analyze the data and produce user- friendly reports brings into question the need for some of the statistical practices identified in the research that have been linked to data literacy. Therefore, further research is needed to identify how the use of online programs support leaders' data literacy.

Another recommendation for research was identified in case eight of this study. In case eight a fine arts teacher and a physical education teacher led school data teams that addressed language arts standards. The findings suggested that teachers in these specialty areas play an important role in students' academic growth and achievement in core content areas. To better understand this phenomenon, further research is needed to identify (a) how schools are using fine

arts and physical education teachers to support core area learning, (b) how fine arts and physical education teachers intertwine language arts instruction into their content area lessons, and (c) what impact the use of these teachers is having on student academic growth in core content areas and the school overall.

The next recommendation addresses leaders' use of management, transformational leadership, and servant leadership. In this study, the actions of leadership and management were described for formal and informal leaders. The findings suggest that the leadership of Data Teams requires formal and informal leaders to use multiple approaches. Further research is needed to determine if this phenomenon exists within a larger population and to determine if each of the leadership or management practices noted is aligned with a particular step of the Data Teams Process.

The final recommendation addresses the school districts' involvement with the Data Teams Process. Findings from the study revealed that district training, established practices, and district-developed resources had a positive impact on the implementation of Data Teams. Further research is needed to understand (a) how districts identify the resources and structures that are used to support Data Teams, (b) how districts ensure that the resources provided to teams are utilized, (c) how districts provide feedback on the work of each Data Team, and (d) how districts ensure the sustainability of the Data Teams Process.

Research Contribution

The research findings for this study contribute to the current body of research on data literacy and leadership, leadership and data-driven decision-making, and leadership within teams. Findings of the study also contribute to the current body of research on the Data Literacy Conceptual Framework and the Data Teams Process.

This study revealed that when engaging in the Data Teams Process, leaders' actions demonstrated their use of the components and subcomponents of the inquiry cycle for the Data Literacy Conceptual Framework, described by Mandinach and Gummer (2016a). In the study, leaders described the practices that were used to identify problems and frame questions. Leaders also described how they supported teams with interpreting and discussing data, identifying instructional strategies, and continuously monitoring student data results, and the work of the team. The findings from this study can therefore be used to provide a model on which longitudinal research can be built. The findings confirm the work of others (Ahearn, 2012; Ainsley 2010; Allison, 2010; Campsen, 2010; Córdova, 2010; Love, 2009; Love et al., 2008; 2010; McNulty & Besser, 2011; Kamm, 2010; Peery, 2010; Piercy, 2006; Ventura, 2010), who have described the Data Teams Process, as well as those (Data Quality Campaign, 2014; Earl & Katz, 2002, 2006; Knapp et al., 2007; Knapp et al., 2006; Gummer & Mandinach, 2015; Mandinach, Parton, et al., 2015; Mandinach & Gummer, 2012, 2016a; 2016b; Piro & Hutchinson, 2014), who have described the need for educators to be data literate.

Conclusion

Under the federal legislation of ESEA and IDEA, there continues to be a need for schools to meet state accountability requirements for student achievement and growth. To achieve that growth, formal and informal leaders of a school must band together to establish cultures where student data is shared and used to identify and support the learning needs of students.

To lead the Data Teams Process, school leaders need to be data literate. This will only happen if they are cognizant of the components and subcomponents of data literacy and how each impacts or drives the work of the Data Team. Leaders must be able to use their understanding of the components and subcomponents of the inquiry cycle for the Data Literacy

Conceptual Framework to build the capacity of each team member to use data. To build others capacity to use data, leaders must provide opportunities for team members to learn about and practice each of the components of data literacy. They must guide their teams in the use of school-adopted resources and programs for collecting, charting and manipulating the data. Additionally, they must teach team members how to access data from software or online programs as well as how to interpret the scores provided by each of those programs.

The learning that takes place to build others' understanding of data literacy must be collaborative. Analyzing student data within the Data Teams Process requires the use of the rich pedagogical backgrounds and teaching experiences of each member. Student learning is complex. Though quantitative data can reveal where additional academic support is needed, the qualitative data shared by team members during team meetings provides the support that is needed to understand the factors that contribute to student data results. Within the Data Teams Process, these rich discussions around student data help foster the changes in instructional practice that are needed to support student learning across each grade-level and the school.

The process of educating students is no longer confined to the silos of individual classrooms. The process of educating students now requires instructional practices that are diagnostic and prescriptive. The Data Teams Process provides instructional teams with a set of sequential steps for reviewing data and making instructional decisions. The Data Literacy Conceptual Framework provides a guide for understanding the depth of data knowledge and understanding about data that is needed to successfully review and take action on student data. When paired with practices of leadership and management, the use of the inquiry cycle for the Data Literacy Conceptual Framework and the Data Teams Process provides a powerful tool for

monitoring student progress, informing instructional practice, and fostering student academic growth.

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Appendix A. Comparison and Alignment of Data Literacy Components

Appendix A- List of Tables

Table A1. Comparison of Related Forms of Literacy.

Data Literacy	**Statistical Literacy**	**Information Literacy**	**Assessment Literacy**	**Data Driven Decision Making**
Identify problems and frame questions (Mandinach & Gummer, 2016a)	Knows why data are needed (Gal, 2002).	Determines the extent of information needed (Association of College and Research Libraries, 2016).	Knows that sound assessments start with a clear purpose (Stiggins, 1995).	Utilizes an assessment and evaluation system Datnow, et al., 2007).
			Focuses on achievement targets (Stiggins, 1995).	
		Uses information to accomplish a specific purpose (Association of College and Research Libraries, 2016).	Selects appropriate assessment methods (Stiggins, 1995).	
Use data (Mandinach & Gummer, 2016a	Knows how data can be produced (Gal, 2002).	Accesses information effectively and efficiently (Association of College and Research Libraries, 2016).	Gathers dependable, quality student achievement information (Stiggins, 2001)	Collects data (Mandinach & Rivas, et al., 2006).
	Understands terms and ideas of descriptive statistics, graphical displays, and tabular displays (Gal, 2002).	Evaluates sources and information critically (Association of College and Research Libraries, 2016).	Knows how to sample student achievement. (Stiggins, 1995)	Organizes data (Mandinach & Rivas, et al., 2006).
	Understands basic notions of probability (Gal, 2002).		Uses assessments that avoid bias and distortion (Stiggins, 1995).	Analyzes data (Mandinach & Rivas, et al., 2006).
	Understands what type of analysis to use or apply (Gray, 2004)			Synthesizes data (Mandinach & Rivas, et al., 2006).
	Knows "how statistical conclusions or inferences are reached" (Gal, 2002,			Utilizes tools for data analysis and acting on data (Datnow, et al., 2007).

	p.10).			
	Utilizes inductive arguments and reasoning in decision making (Schield, 1999)			Prioritizing data (Mandinach and Rivas et al., 2006)
	Can read statistics (Schield, 1999).			Gathering and sharing data Datnow, et al., 2007).
Transform data into information (Mandinach & Gummer, 2016a		Incorporates information selected into knowledge base (Association of College and Research Libraries, 2016).	Communicate results effectively (Stiggins, 2001).	Summarizes Data (Mandinach and Rivas et al., 2006)
		Understands the economic, legal, social, and ethical issues surrounding the access and use of information (Association of College and Research Libraries, 2016).		Sets goals and aligns resources Datnow, et al., 2007)
Transform information into decision (Mandinach & Gummer, 2016a			Uses assessment information to effectively support student achievement (Stiggins, 2001).	Acts on information (Datnow, et al., 2007)
				Utilizes strategies for translating data into action (Datnow, et al., 2007)
Evaluate outcomes (Mandinach & Gummer, 2016a				

Note: Evidence from the literature was used to compare various data practices or forms of literacy

Table A2. Components of Data Literacy Aligned with Cites from the Related Literature.

Identify Problems and Frame Questions		
	• Uses a data coach and a data team.	(Lachat, et al., 2006)
	• Engages in "what Fullan (2001) calls 'knowledge building'" (p. 13). • "Use of data with various stakeholders, such as school staff, the media, and parents" (p. 24).	(Knapp, Swinnerton, et al., 2006)
	• "Data use requires a culture of support" (p. 49). • "Data use creates a sense of urgency and serves as a catalyst for action" (p. 46).	(Jacobs, et al., 2009)
	• "Formulate and answer questions using data as part of evidence-based thinking" (p. 1).	(Vahey et al., 2006)
	• "Formulating and answering data-based questions" (p. 3).	(Hooft et al., 2010)
	• "Know how to identify problems" (p. 14). • Involves stakeholders • "Know how to frame questions" (p. 14).	(Gummer & Mandinach, 2015)
	• "Identify problems and frame questions" (p. 63). • "Articulate and communicate the problem or the question" (p. 63) • "Involve other participants" (p. 63). • "Understand student privacy" (p. 63). • "Understand contextual issues" (p.63). • "Establishing data team and providing data coaches" (p. 22).	(Mandinach & Gummer, 2016a)
	• "Engage in a data-driven and cyclical inquiry process" (p. 1).	(Data Quality Campaign, 2014)
	• "The process of transforming the data begins with a clear purpose of what data are being sought and why" (p. 16).	(Lai & Schildkamp, 2013)
Use Data		
	• Knowing why data are needed and how data can be produced. • Familiarity with basic terms and ideas related to descriptive statistics. • Familiarity with basic terms and ideas related to graphical and tabular displays. • Understanding basic notions of probability. • Knowing how statistical conclusions or inferences are reached.	(Gal, 2002)
	• "Understand a wide variety of tools for accessing, converting and manipulating data" (p. 3). • "Able to think critically about basic descriptive statistics" (p. 4) • "Able to access, assess, manipulate, summarize, and present data" (p.4).	(Schield, 2004)
	• The use of essential questions that guide data analysis • "Using technology that allows purposeful data disaggregation" (p. 17).	(Lachat, et al., 2006)
	• "Thinks about the purpose" (p. 19).	(Earl & Katz, 2006)

	• "Recognizes sound and unsound data" (p. 19). • "Is knowledgeable about statistical and measurement concepts" (p.19). • "Recognizes other kind of data" (p. 19) (quantitative as well as qualitative).	
	• "Ability to understand data tables, interpret statistics"(p. 24). • "Capacity of leaders and others to assemble and use data responsibly in their daily practice" (p. 13). • "familiarity with data sources" (p.13). • Has "more than a trial-and-error experience with data" (p. 13).	(Knapp, et al., 2006)
	• "Understand the distinction between low-and high-capacity uses and responses to data." (p. 128). • "Understand the limitations of tests and the importance of reliability validity, fairness and multiple measure" (p. 128). • "Understand what different levels of student-learning data (aggregated, disaggregated, strand, item and student work) are used in drill down, what can and cannot be learned from each, and how to use each effectively and accurately" (p. 128). • "Uses a variety of data and planning tools" (p. 128). • "Understand basic data analysis and statistics concepts and use them to accurately observe and interpret data" (p. 128).	(Love et al., 2008)
	• "Data use requires sophisticated professional knowledge" (p. 48). • "Data use requires ongoing attention to multiple sources of data" (p. 44).	(Jacobs, et al., 2009)
	• "Use appropriate data, tools, and representations to support this thinking" (p. 1).	(Vahey et al., 2006)
	• "Formulate and answer data-based questions" (p. 2). • "Use appropriate data and tools and representations" (p. 2). • "Develop and evaluate data-based inferences and explanations" (p.2).	(Hooft et al., 2010)
	• "Understand how to use data" (p. 15). • "Understands how to identify data" (p. 15). • "Understand data properties" (p. 15). • "Understand data quality" (p. 15). • "Understands how to apply data" (p. 15).	(Gummer & Mandinach, 2015)
	• "Use data" (p. 62). • "Identifying and examining data to inform their work" (p. 65). • "Identify possible sources of data and Understand how to generate data" (p. 65). • "Understand data properties" (p. 63). • "Understand data quality" (p. 63). • "Understand how to analyze data" (p. 63).	(Mandinach & Gummer, 2016a)
	• "Access and gather relevant data from available sources" (p. 1). • "Synthesize and analyze diverse data" (p. 1). • "Facilitate student understanding of data" (p. 2).	(Data Quality Campaign, 2014)

	• "Know about and use student-level and other types of data beyond assessment data" (p. 1). • "Understand how to use different types of data" (p. 1). • "Use one's own data" (p. 2). • "Know about and be able to use data that are currently applicable for and relevant to practice" (p. 2).	
Transform Data Into Information		
	• "Think critically about concepts, claims and arguments to read, interpret and evaluate information" (p. 4).	(Schield, 2004)
	• "Makes interpretation paramount" (p. 20). • "Pays attention to reporting and to audiences" (p. 20).	(Earl & Katz, 2006)
	• "Understand what data can and cannot tell about students" (p. 24). • Possesses "creativity in assembling relevant data quickly and efficiently" (p.13).	(Knapp, et al., 2006)
	• "Understand what kinds of data are used in collaborative inquiry, why, and how frequently and use each effectively and accurately" (p. 128). • "Distinguish observation from inference and make sound inferences from data" (p. 128). • "Make effective use of graphs and charts to display data" (p. 128). • "Build the capacity of others to engage with data productively" (p. 33).	(Love et al., 2008)
	• "Develop and evaluate data-based inferences and explanations" (p. 1). • "Interpret information from data" (p. 1). • "Use appropriate data tools and representations to support this thinking" (p. 1).	(Vahey et al., 2006)
	• "Use appropriate data tools and representations" (p. 1).	(Hooft et al., 2010)
	• "Transforms data into information" (p.15) (analyzes data, tests assumptions generates hypothesis, considers impact).	(Gummer & Mandinach, 2015)
	• "Transform data into information" (p. 62). • "Consider impact and consequences" (p. 62) (intended and unintended). • "Generate hypothesis" (p. 63). • "Test assumptions" (p. 63). • "Understand how to interpret data" (p. 63).	(Mandinach & Gummer, 2016a)
	• "Communicate about data with diverse internal and external stakeholders" (p. 2).	(Data Quality Campaign, 2014)
Transform Information Into Decision		
	• "Uses assessment data with other types of data "to identify areas of effectiveness and to target instructional improvement efforts" (p. 17).	(Lachat, et al., 2006)
	• "Data use focuses teachers on individual students' needs" (p. 45). • "Data use leads to changes in professional practice" (p. 47).	(Jacobs, et al., 2009)

	• Data use requires analyzing practice "to see if areas of the curriculum need to be retaught or if a new type of instructional strategy may be needed" (p. 46).	
	• "Use data to solve real problems and communicate their solutions" (p. 1).	(Vahey et al., 2006)
	• "Solving real problems and communicate their solutions" (p. 4).	(Hooft et al., 2010)
	• "Transform information into decision" (p. 14). • "Determine next steps and understand the context for the decision" (p. 14).	(Gummer & Mandinach, 2015)
	• "Transform Information into decision" (p. 63). • "Determine next instructional steps" (p. 63). • "Understand context for the decision" (p. 63).	(Mandinach & Gummer, 2016a)
	• "Use data to tailor instruction to diverse groups of students" (p. 2).	(Data Quality Campaign, 2014)
Evaluate Outcomes		
	• "Evaluate outcomes" (p. 15) (test hypothesis, review, scrutinize results, consider feedback loops).	(Gummer & Mandinach, 2015)
	• "Consider need for iterative decision cycles" (p. 62). • "Re-examine original question or problem" (p. 62).	(Mandinach & Gummer, 2016a)

Table A3. Interview Questions: Development, Alignment and Design.

Sub Question	Component	Sub-component	Interview Question
How do leaders initiate discussions about data and create a catalyst for meaningful action?	Identify Problems and Frame Questions	Involve other participant.	1. How do you involve other stakeholders in the use of data to support the decision-making process within the school?
		Articulate or Communicate the Problem or the Question	2. Would you describe the process that is used by you and/or your team to identify each problem or question to be addressed through the data team process? • FUQ #2. How is that problem or question communicated out to other stakeholders?
		Understand Student Privacy	3. What expectations have been discussed with staff and established in your school regarding data privacy? • FUQ #3. How is that expectation put into practice and monitored?
		Understand Contextual Issues	4. What types of data sources do you and your data team use to better understand the contextual factors surrounding an issue (include factors within and outside of your control)? • FUQ #4. Would describe how you or your teams have addressed contextual factors that were found to be impacting student growth?
How do leaders determine the data used to support the work of the data teams?	Data Use	Identify Possible Data Sources	5. When implementing a new intervention, curriculum, instructional strategy, assessment (formative or summative), or data-generating program, how do you ensure that each will provide support for an identified purpose?
		Understand How to Generate Data	6. Would you describe the assessment design and implementation process that is used by your data teams? • FUQ #6a. What types of formative and summative assessments that are used to guide instructional decisions? • FUQ #6b. What do you and your data

			teams consider when choosing and developing assessments? • FUQ *#6c*. What is considered when reviewing each measurement instrument and the scores produced through the use of each instrument?
		Understand Data Properties	7. What data sources do you access or gather to support your daily practice, school decisions, and the data team process? • FUQ #7. How do you evaluate the relevancy of the data for addressing an identified question or problem?
		Understand Data Quality	8. What do you consider when determining the quality, validly, value, appropriateness, and completeness of data results? • FUQ #8. How do you apply your judgments for each indicator to the data team process?
		Understand How to Access Data	9. Would you describe the various data systems and process you use to locate, access, and retrieve data? • FUQ #9. Would you describe the programs that are used to generate data and the recording documents or data tools you use when working with that data?
How do leaders utilize analytical skills to support the work of data teams?	Data Use	Understand How to Analyze Data	10. What formal training have you received on statistics, psychometrics or research methods? • FUQ #10. How extensive was that training? 11. How do you utilize results from descriptive statistics (measures of central tendency variability, i.e. mean, median or mode) when examining and reporting student scores? • FUQ #11. How do you apply this practice to your work with data teams? 12. How do you and your teams use data analysis to guide your decisions about

			programs and processes?
			13. What types of comparative process that you or your data teams use to drill down into data? • FUQ#13. how and when you use aggregated and disaggregated data? 14. What are the systematic systemic processes that are used for managing data (examining data, prioritizing data, organizing data, blending and manipulating data)?
How do leaders build other's capacity to use data effectively	Transform Data Into Information	Consider impact and consequences (intended and unintended)	15. How do you and your team typically address questions or concerns about various concepts, claims and arguments that have potential to impact the results of your work. Include in your description, a time when this has happened?
		Generate hypothetical connection to instruction,	16. What types of questioning or thinking process that is used by yourself and your teams when attempting to identify the root cause of an academic concern? • FUQ #16a. how is this questioning or thinking process used to identify the areas of greatest need within each core area at both the class level and individual student level? • FUQ #16b. How do you utilize that information to guide your team's instructional decisions?
		Test Assumptions	17. Would you provide a description of the process you and your team use to test assumptions about why a particular problem may be occurring? • *FUQ #17.* What impact does this process have on instructional practice?
		Understand How to Interpret Data	18. When presenting data results to stakeholders, how do you determine what information will be presented and what format or data displays will be used for the presentation?
	Transform	Determine	19. How are the instructional strategies used to

	Data Into Decision	Next Instructional Steps	support student growth at the classroom and individual levels determined?
		Understand Context for the Decision	20. How do you support data team members in implementing strategies and interventions that are aligned to learner characteristics, content, pedagogy, educational purpose, and the academic goals of the team and the school?
	Evaluate Outcomes	Re-examine Original Question or Problem	21. How do you and your data teams examine the effectiveness of strategies and interventions that have been implemented? • *FUQ #21a*. How often does this practice occur? • FUQ #21b. What evidence do you have available that could be used to verify the process you have described? • *FUQ #21c*. What evidence do you have available that could be used to demonstrate the impact this process has had on work being done by the team?
		Consider Need for Iterative Decision Cycles	22. How do you and your team proceed with your work when strategies and interventions are found to be effective and ineffective.
How do leaders supervise the data team process	Leadership & Management	Trans-formational Leadership: Servant Leadership: or Management	23. What processes or data tools do you use to help you monitor the work of data teams and provide meaningful feedback to the team and its individual members? • *FUQ #23a*. When and how often is feedback provided? • *FUQ #23b*. What type of feedback is typically provided? 24. How was the school's culture of data use established and what was your role in creating and maintaining that culture? 25. Would you share your perceptions of staff commitment to the data team process and the work needed to foster student growth?

			26. How do you work with your teams to elicit goals and gain team members' commitment to take action? 27. What are some of the successes and challenges you have experienced in working with data teams?
How do leaders determine the success of a data team? Why do data teams need to have the support of leaders.	Success & Support	Evidence of team success & need for support	28. Would you describe the documents, data reports, picture artifacts, and data graphs, that you collect to determine the success of data teams? 29. How do each of the artifacts collected demonstrate the growth and success of the data teams you lead? 30. How does the work of leaders provide support for the data team process in your school? 31. What do you believe the impact to teams would be if formal leaders were not involved in the data team process? 32. What do you believe the impact to teams would be if informal leaders were involved only as teacher participants?

Appendix B – Interview Documents

Appendix B- List of Interview Documents

Appendix B1. Interview Protocol.

Interview Protocol

Instructional Data Teams and Data Literacy:

Data Literacy Used by Leaders Supporting the Work of Instructional Data Teams.

Date: _____, 2017 Time: _____ (am / pm) Subject Code: _____

Leader Type: F / I Male: ___ Female: ___ Interview: 1 FU# _____

Consent Form Signed? _____ Audio Release Signed? _____

Notes to interviewee:

Thank you for your participation. I believe your input to this research will be valuable to this study. Information you provide will contribute to the work being done on this project. There are a few things that I would like to make sure you understand before we get started.

- I will be asking some general questions and writing notes as we proceed.
- You will only be identified as "S" in these notes.
- For your information, only my Doctoral Dissertation Committee Chairman and myself will have access to information about your identity, location, and place of employment.
- To facilitate my note-taking, I would like to audiotape our conversations today.
- All information included on audiotapes will eventually be erased after being transcribed.
- Please sign the release form entitled, Subject Information and Informed Consent. There are two places on this form where you signature is required. The first signature provides consent to conduct the interview and use information provided by you to support the work of this study. The second signature signifies your consent for this interview to be audio taped.

- This interview consists of thirty-two questions intended to gain information about how you and other leaders at this site use data to support the work of data teams.
- I have planned this interview to last approximately one hour. If time begins to run short, it may be necessary to interrupt you in order to push ahead and complete this line of questioning.
- You may choose to skip any question or stop this interview at anytime without any negative consequences.

You have been selected to speak with me today because you have been identified as a leader at this site who has worked with data teams. My research project as a whole focuses on the data literacy used by leaders supporting the work of instructional data teams. The study does not aim to evaluate your techniques or experiences. Rather, I am trying to learn more about the data practices used by leaders that impact the work of instructional data teams

Interviewee Demographic Information

_____How many years have you been employed in education?

_____What is your current job title?

_____How many years have you served in this position?

_____How many of those years have been at this site?

_____How many of those years have you been a leader for a data team(s).

_____When was training on data teams provided to your school?

What is your highest degree? _____

What endorsements do you hold? _____

Interview Questions and Follow Up Questions (FUQ)

1. How do you involve other stakeholders in the use of data to support the decision-making process within the school?

2. Would you describe the process that is used by you and/or your team to identify each problem or question to be addressed through the data team process?
    - FUQ #2. How is that problem or question communicated out to other stakeholders?

3. What expectations have been discussed with staff and established in your school regarding data privacy?
    - *FUQ #3*. How are expectations put into practice and monitored?

4. What types of data sources do you and your data teams use to better understand the contextual factors surrounding an issue (include factors within and outside of your control)?
    - *FUQ #4*. Would you describe how you or your teams have addressed contextual factors that were found to be impacting student growth?

5. When implementing a new intervention, curriculum, instructional strategy, assessment (summative or formative), or data-generating program, how do you ensure that each will provide support for an identified purpose?
    - *FUQ #5*. Would you describe a time when you put this into practice.

6. Would you describe the assessment design and implementation process that is used by your data teams?
    - *FUQ #6a*. What types of formative and summative assessments are used to guide instructional decisions?

- *FUQ #6b.* What do you and your data teams consider when choosing and developing assessments?
- *FUQ #6c*. What is considered when reviewing each measurement instrument and the scores produced through the use of each instrument?

7. What data sources do you access or gather to support your daily practice, school decisions, and the data team process?
    - *FUQ #7.* How do you evaluate the relevancy of the data for addressing an identified question or problem?

8. What do you consider when determining the quality, validly, value, appropriateness, and completeness of data results?
    - *FUQ #8*. How do you apply your judgments for each indicator to the data team process?

9. Would you describe the various data systems and process you use to locate, access, and retrieve data?
    - *FUQ #9*. Would you describe the programs that are used to generate data and the recording documents or data tools you use when working with that data?

10. What formal training have you received on statistics, psychometrics, or research methods?
    - *FUQ #10.* How extensive was that training?

11. How do you utilize results from descriptive statistics (measures of central tendency and variability, i.e. mean, median, mode, standard deviation) when examining and reporting student scores?
    - *FUQ #11*. How do you apply this practice to your work with data teams?
12. How do you and your teams use data analysis to guide decisions about strategies, programs, and processes?

13. What types of comparative process do you or your data teams use to drill down into data?
    - *FUQ #13*. How and when do you use aggregated and disaggregated data?

14. What are the systematic systemic processes that you or your teams use, or have used, for managing data (examining data, prioritizing data, organizing data, blending and manipulating data)?

15. How do you and your team typically address questions or concerns about various concepts, claims, and arguments that have potential to impact the results of your work?
    - *FUQ #15*. Could you describe a time when this has happened?

16. What types of questioning or thinking processes do you and your teams use when attempting to identify the root cause of an academic concern?
    - *FUQ #16a*. How is this questioning or thinking process used to identify areas of greatest need within each core area at both the class level and individual student level?
    - *FUQ # 16b*. How do you utilize information from the root cause analysis to guide your team's instructional decisions?

17. Would you provide a description of the process you and your team use to test assumptions about why a particular problem may be occurring?
    - *FUQ #17*. What impact does this process have on instructional practice?

18. When presenting data results to stakeholders, how do you determine what information will be presented and what format or data displays will be used for the presentation?
19. How are the instructional strategies used to support student growth at the classroom and individual levels determined?

20. How do you support data team members in implementing strategies and

interventions that are aligned to learner characteristics, content, pedagogy, educational purpose, and the academic goals of the team and the school?

21. How do you and your data teams examine the effectiveness of strategies and interventions that have been implemented?
    - *FUQ #21a*. How often does this practice occur?
    - *FUQ #21b*. What evidence do you have available that could be used to verify the process you have described?
    - *FUQ #21c*. What evidence do you have available that could be used to demonstrate the impact this process has had on work being done by the team?

22. How do you and your team proceed with the work when strategies and interventions are found to be effective and ineffective?

23. What processes or data tools do you use to help you monitor the work of data teams and provide meaningful feedback to the team and its individual members?
    - *FUQ #23a*. When and how often is feedback provided?
    - *FUQ #23b*. What type of feedback is typically provided?

24. How was the school's culture of data use established, and what was your role in creating and maintaining that culture?

25. Would you share your perceptions of staff commitment to the data team process and the work needed to foster student growth?

26. How do you work with your teams to elicit goals and gain team members' commitment to take action?

27. What are some of the successes and challenges you have experienced in working with data teams?

28. Would you describe the documents, data reports, picture artifacts, and data graphs, that you collect to determine the success of data teams?

29. How do each of the artifacts collected demonstrate the growth and success of the data teams you lead?

30. How does the work of leaders provide support for the data team process in your school?

31. What do you believe the impact to teams would be if formal leaders were not involved in the data team process?

32. What do you believe the impact to teams would be if informal leaders were involved only as teacher participants?

Post Interview Comments or Leads:_____

_____

_____

Appendix B2. Letter of Invitation to the Superintendent.

Dear (Insert Name of Superintendent)

My name is Vicki Begin. I am a doctoral candidate at the University of Montana working on a doctoral degree. I am writing my dissertation on the *Data Literacy of Leaders Supporting the Work of Instructional Data Teams*. The purpose of this qualitative research study is to identify how the data literacy of formal and informal leaders in the state of Wyoming contributes to the data team process. Additionally, the study will examine the attributes of leadership and management utilized by formal and informal leaders to support the use of data by data team members.

I am aware of the data team training that has occurred in your district, and I am seeking your permission to invite formal and informal leaders from each of the schools in your district to participate in my study. Please note that the name of the district, school, and leaders (both informal and formal) will not be used in the study. By agreeing to allow me access to leaders at each school in your district you are providing me with permission to interview one to three leaders at each school. You are also providing permission for each leader to provide me with a description of documents, data reports, picture artifacts, and data graphs, that are used at each school to determine the success of data teams. Please note that the data recorded from the description of these documents, reports, artifacts, and graphs will be cleaned of all identifying information.

To begin this research, I will need your permission to contact the principals at each of the schools in your district. Each principal that I contact will be invited to participate in the study and to recommend one informal leader at his or her school who will be invited to participate in the study. Please reply to this email to inform me of your decision to grant or deny me permission to contact the principals at each of the schools in your district. If I have your permission to contact the principal and one to two other leaders at each school please forward the names of each of your principals and their associated email addresses to me. The information can be sent to me at [redacted] At the conclusion of my research, I will notify you by email and provide you with the opportunity to request an electronic copy of the study. Should you have any questions regarding this research, please do not hesitate to give me a call or send me an email.

Sincerely,

Vicki S. Begin
[redacted]

Email Attachment: Definitions of Formal and Informal Leaders

Appendix B3. Letter of Invitation to the Formal Leader.

Dear (Insert Name of Formal Leader)

My name is Vicki Begin. I am a doctoral candidate at the University of Montana working on a doctoral degree. I am writing my dissertation on the *Data Literacy of Leaders Supporting the Work of Instructional Data Teams*.

Your district has provided me with permission to invite you to participate in my study. The purpose of this qualitative research study is to identify how the data literacy of leaders in the state of Wyoming contributes to the data team process. Additionally, the study will examine the attributes of leadership and management utilized by formal and informal leaders to support the use of data by data team members.

I would love to have the opportunity to meet with you to discuss how you have supported the work of data teams at your school. The interview will take approximately one hour. I would be willing to set up a meeting time that is convenient for you.

I would also like to interview one informal leader at your school. I would appreciate it if you would provide me with the name and contact information for one staff member who has served as an informal leader of data teams in your school. To assist you in your selection I have included the definition of formal and informal leader as a postscript on this email letter.

I am looking forward to your response. You may provide the information of your acceptance, and the name and associated email address for the informal leader at your school whom you recommend to participate in the study by contacting me at [redacted] Once I receive this information, I will be contacting you to set up a time that we can meet. At that time I will also be sending you a Consent to Participate form to review. At the conclusion of my research, I will notify you by email and provide you with the opportunity to request an electronic copy of the study. Should you have any questions regarding this research, please do not hesitate to give me a call or send me an email.

Sincerely,

Vicki S. Begin
[redacted]

Formal leader. A formal leader is one who gains authority by assignment. His or her powers or

authority are derived through job title or held position (Bass & Bass, 1974/2008; Heifetz, 1994). For the purpose of this research, building principals, vice principals, district curriculum coordinators, instructional facilitators, and data coaches are considered formal leaders.

Informal leader. An Informal leader is one whose authority level is not established by title or assignment (Bass & Bass, 1974/2008; Heifetz, 1994). Informal leaders "take action beyond whatever authority they have (Heifetz, 1994, p. 205). They "experience leadership as an activity performed without authority, beyond expectations" (Heifetz, 1994, p. 206). For the purpose of this research, informal leaders will be those with no formal leadership designation who are identified by building administration as leaders of a building level team.

Appendix B4. Letter of Invitation to the Informal Leader.

Dear (Insert Name of Informal Leader)

My name is Vicki Begin. I am a doctoral candidate at the University of Montana working on a doctoral degree. I am writing my dissertation on the *Data Literacy of Leaders Supporting the Work of Instructional Data Teams*.

Your district has provided me with permission to invite you to participate in my study. The purpose of this qualitative research study is to identify how the data literacy of leaders in the state of Wyoming contributes to the data team process. Additionally, the study will examine the attributes of leadership and management utilized by formal and informal leaders to support the use of data by data team members.

I would love to have the opportunity to meet with you and discuss how you have supported the work of data teams at your school. The interview will take approximately one hour. I would be willing to set up a meeting time that is convenient for you. You may provide your acceptance to this invitation by contacting me at vicki.beginumontana.edu. Once I receive this information, I will be contacting you to set up a time that we can meet. At that time I will also be sending you Consent to Participate form to review. At the conclusion of my research, I will notify you by email and provide you with the opportunity to request an electronic copy of the study. Should you have any questions regarding this research, please do not hesitate to give me a call or send me an email.

Sincerely,

Vicki S. Begin
[redacted]

Email Attachment: Definitions of Formal and Informal Leaders

Appendix C - Permissions

Appendix C – List of Permissions

Appendix C1. University of Montana Internal Review Board Permission.

UNIVERSITY OF MONTANA

INSTITUTIONAL REVIEW BOARD
for the Protection of Human Subjects in Research
FWA 00000078
Research & Creative Scholarship
Interdisciplinary Science Building 104
University of Montana
Missoula, MT 59812
Phone 406-243-6672

Date: May 11, 2017

To: Vicki Begin, Educational Leadership
Dr. William McCaw, Educational Leadership

From: Paula A. Baker, IRB Chair and Manager

RE: IRB #128-17: "Instructional Data Teams and Data Literacy: Data Literacy of Leaders Supporting the Work of Instructional Data Teams"

Your IRB proposal cited above has been **APPROVED** under **expedited review** by the Institutional Review Board in accordance with the Code of Federal Regulations, Part 46, section 110. Expedited approval refers to research activities that (1) present no more than minimal risk to human subjects, and (2) fit within the following category for expedited review as authorized by 45 CFR 46.110 and 21 CFR 56.110:

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Each consent form used for this project must bear the dated and signed IRB stamp. Use the PDF sent with this approval notice as a "master" from which to make copies for the subjects.

School Permissions: A letter/email of permission must be provided to the IRB office from the district superintendent or school principal before any interviews on school premises is conducted.

Amendments: Any changes to the originally-approved protocol, including the addition of any new research team members, must be reviewed and approved by the IRB ***before*** being made (unless extremely minor). Requests must be submitted using Form RA-110.

Unanticipated or Adverse Events: You are required to timely notify the IRB if any unanticipated or adverse events occur during the study, if you experience an increased risk to the participants, or if you have participants withdraw from the study or register complaints about the study. Use Form RA-111.

Continuation: Federal regulations require you to file an annual Continuation Report (Form RA-109) for expedited studies. You must file the report within 30 days prior to the expiration date, which is **May 10, 2018**. *Tip: Put a reminder on your calendar now.* A study that has expired is no longer in compliance with federal regulation or University IRB policy, and all project work must cease immediately.

Study Completion or Closure: Finally, you are also required to file a Closure Report (Form RA-109) when the study is completed or if the study is abandoned. See the directions on the form.

Please contact the IRB office with any questions at (406) 243-6672 or email irb@umontana.edu.

Form RA-108
(Rev. 08/14)

Institutional Review Board
MAY 8 2017
University of Montana

THE UNIVERSITY OF MONTANA-MISSOULA
Institutional Review Board (IRB)
for the Protection of Human Subjects in Research
CHECKLIST / APPLICATION

IRB Protocol No.: 128-17

At the University of Montana (UM), the Institutional Review Board (IRB) is the institutional review body responsible for oversight of all research activities involving human subjects outlined in the U.S. Department of Health and Human Services' Office of Human Research Protection and the National Institutes of Health, Inclusion of Children Policy Implementation.

Instructions: A separate application form must be submitted for each project. IRB proposals are approved for no longer than one year and must be continued annually (unless Exempt). Faculty and students may email the completed form as a Word document to *IRB@umontana.edu*, or submit a hardcopy to the Office of the Vice President for Research & Creative Scholarship, University Hall 116. Student applications must be accompanied by email authorization by the supervising faculty member or a signed hard copy. *All fields must be completed. If an item does not apply to this project, write in: n/a.* Questions? Call the IRB office at 243-6672.

1. Administrative Information

Project Title: Instructional Data Teams and Data Literacy: Data Literacy of Leaders Supporting the Work of Instructional Data Teams.	
Principal Investigator: Vicki S. Begin	UM Position: Doctoral Student
Department: Educational Leadership	Office location:
Work Phone:	Cell Phone:

2. Human Subjects Protection Training

(All researchers, including faculty supervisors for student projects, must have completed a self-study course on protection of human research subjects ***within the last three years*** *and be able to supply the "Certificate(s) of Completion" upon request. If you need to add rows for more people, use the Additional Researchers Addendum.*

All Research Team Members (list yourself first)	PI	CO-PI	Faculty Supervisor	Research Assistant	DATE COMPLETED Human Subjects Protection Course
Name: Vicki Begin Email:	☒	☐	☐	☐	4/23/2017 ✓
Name: Dr. William McCaw Email:	☐	☐	☒	☐	3/2/15 ✓
Name: Email:	☐	☐	☐	☐	
Name: Email:	☐	☐	☐	☐	

3. Project Funding

(If federally funded, you must submit a copy of the abstract or Statement of Work.)

Is grant application currently under review at a grant funding agency? ☐Yes *(If yes, cite sponsor on ICF if applicable)* ☒No			Has grant proposal received approval and funding? ☐Yes *(If yes, cite sponsor on ICF if applicable)* ☒No	
Agency	Grant No.	Start Date	End Date	PI on grant

For UM-IRB Use Only

IRB Determination:

_____ Not Human Subjects Research
_X_ Approved by Exempt Review, Category # _____ *(see memo)*
_X_ Approved by Expedited Review, Category # 7 *(see* **Note to PI***)*
_____ Full IRB Determination
_____ Approved *(see* **Note to PI***)*
_____ Conditional Approval *(see memo)* - IRB Chair Signature/Date: _____
_____ Conditions Met *(see* **Note to PI***)*
_____ Resubmit Proposal *(see memo)*
_____ Disapproved *(see memo)*

Note to PI: Non-exempt studies are approved for one year only. Use any attached IRB-approved forms (signed/dated) as "masters" when preparing copies. If continuing beyond the expiration date, a continuation report must be submitted. Notify the IRB if any significant changes or unanticipated events occur. When the study is completed, a closure report must be submitted. Failure to follow these directions constitutes non-compliance with UM policy.

Risk Level: Minimal

Final Approval by IRB Chair/Manager: [signature] Date: 5/11/2017 Expires: 5/10/2018

SUBJECT INFORMATION AND INFORMED CONSENT

Study Title:

Instructional Data Teams and Data Literacy: Data Literacy of Leaders Supporting the Work of Instructional Data Teams

Investigator(s):

Vicki Begin,

Inclusion Criteria:

Participants will include teachers and school administrators

- who are formal or informal leaders;
- working in selected schools who support the work of data teams at the school or district level;
- who have served in their current position for one full year or more;
- who engage with grade-level, course, or like-content teams that regularly examine student data in order to make instructional decisions;
- working within schools or districts in which collaborative teams use a short cycle review process for examining student data;
- working within schools or districts in which there are at least two certified teachers assigned to each data team; and
- working in a school district where data team training has been provided by consultants associated with the Leading and Learning Center.

Purpose:

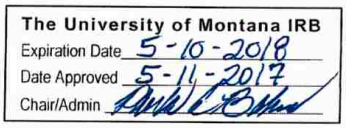
You have been selected to participate in this interview because you have been identified as a leader who has worked with data teams. My research focuses on the data literacy used by leaders supporting the work of instructional data teams. The study does not aim to evaluate your techniques or experiences. Rather, I am trying to learn more about the data practices used by leaders that impact the work of instructional data teams. This study will be submitted to the University of Montana for completion of my doctoral degree in educational leadership. It may be published within a digital database for dissertations. Results may also be presented in professional conferences and publications. At your request, a digital copy of the results from this study will be shared with you.

Procedures:

If you agree to take part in this research study, you will be asked to participate in an interview that consists of series of questions intended to gain information about how you and other leaders at this site use data to support the work of data teams. The interview will last approximately one hour. The interviews will primarily be conducted at the school site or a public venue at a time that is convenient for you.

Risks/Discomforts:

The interview may bring up uncomfortable feelings for you. Additionally, the time needed for face Interviews may create a disruption to your work day.



Benefits:

While there is no direct benefit to you, your participation in this study will provide an opportunity for you to reflect upon your data literacy and how you lead the data team. This information may be used to further support the work being done with data teams in your school or district. Additionally, information provided by this research will contribute to the current body of research on data literacy and leadership, leadership and data driven decision making, and leadership within data teams.

Confidentiality:

Your records will be kept confidential and will not be released without your consent except as required by law. Your identity and the identity where you work will be kept private. If the results of this study are written in a scientific journal or presented at a scientific meeting, your name and the name of your school will not be used. The consent forms, codes of pseudonyms, and audio recordings collected for this study will be stored in a secure area or saved in a password protected digital file that is separate from transcriptions and data analysis. The audiotape of your interview will be transcribed without any information that could identify you. The tape will then be erased.

Voluntary Participation/Withdrawal:

Your decision to take part in this research study is entirely voluntary. You may refuse to take part in the study or you may withdraw from the study at any time without penalty.

Questions:

If you have any questions about the research now or during the study, please contact: Vicki Begin at . If you have any questions regarding your rights as a research subject, you may contact the UM Institutional Review Board (IRB) at (406) 243-6672.

Statement of Your Consent:

I have read the above description of this research study. I have been informed of the risks and benefits involved, and all my questions have been answered to my satisfaction. Furthermore, I have been assured that any future questions I may have will also be answered by a member of the research team. I voluntarily agree to take part in this study. I understand I will receive a copy of this consent form.

_____
Printed Name of Subject

_____ _____
Subject's Signature Date

Statement of Consent to be Audiotaped:

I understand that an audio recording may be made during the study. I consent to the use of audio recording. I understand that the audio recordings will be destroyed following transcription, and that no identifying information will be included in the transcription.

_____ _____
Subject's Signature Date

The University of Montana IRB
Expiration Date 5-10-2018
Date Approved 5-11-2017
Chair/Admin

Appendix C2. Permission Request to use Figures in Mandinach and Gummer (2016).

Vicki Begin
(Doctoral Student, University of Montana)
[redacted]
Wheatland, WY 82201
[redacted]

Title	Data Literacy for Educators: Making It Count In Teacher Preparation Practice
Author/s	Mandinach and Gummer
Page/s requested	Kindle Edition, Location 1128, Chapter 3, Figure 3.2. Original Organization of Data Literacy Conceptual Framework. & Kindle Edition, Location 1174, Chapter 3, Figure 3.4. Domain of Data Use for Teaching
Copyright holder	Published Simultaneously by Teachers College Press and WestEd
Publication date	(2016)
ISBN	978 0 8077 7469 4 (ebook)

A brief description of how the material will be used
The figures will be included as figures in the review of literature in a doctoral dissertation that cites the work of Mandinach and Gummer (2016). The components of data literacy presented in the framework by Mandinach and Gummer (2016) were used to provide a foundation for the work being done in this research project. The research seeks to identify how the data literacy of formal and informal leaders in the state of Wyoming contributes to the data team process. Also to examine the attributes of leadership and management utilized by formal and informal leaders to support the use of data by data team members.

The figure number would be changed from 3.2 and 3.4 to figure 1 and figure 2 when published in the dissertation.

The title of your course, project, book, presentation, etc.
Instructional Data Teams and Data Literacy: How is Data Literacy Used by Leaders to Support the Work of Instructional Data Teams?

The estimated retail price of your product, when applicable
This research is being completed to fulfill the requirements for a doctoral program. It will not be

sold. It will be published and available for review within a digital data base for education.

The name of the publisher, school or organization with which you are affiliated
University of Montana

The estimated number of copies
15-20 copies (possible digital copies for educational data base)

The territory (i.e.: World, US & Canada, state--where will the material be available)
The work is being completed at the University of Montana. Dissertations available through the Proquest digital data base are available world wide)

Editions planned (hardcover, paperback, video, presentation- what type of product)
The completed research project will be hardbound. (also available digitally on Proquest digital dissertations). Also meeting presentation to be included in PowerPoint when the research is presented

Anticipated publication/print date
October 2017

Required term of license (how long you would like to exploit the rights you are requesting)
Currently a one time use to include this in published work. Also Request rights to present the figures on PowerPoint presentation whenever this research project is presented at conferences and other educational settings.

Copy of figures for which permission to use is being sought included below.

Figure 3.2. Original Organization of Data Literacy Conceptual Framework

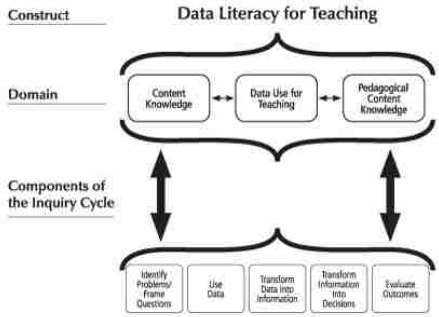
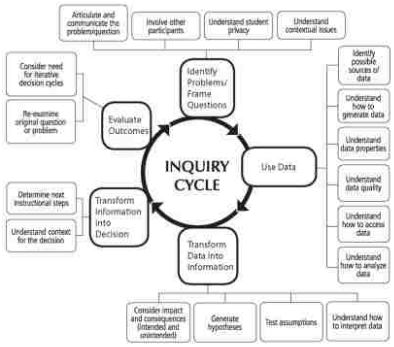


Figure 3.4. Domain of Data Use for Teaching



Domain of Data Use for Teaching Mandinach, Ellen B.; Gummer, Edith S. (2016-04-01). Data Literacy for Educators: Making It Count in Teacher Preparation and Practice (Technology, Education—Connections (The TEC Series) (Kindle Location 1174). Teachers College Press. Kindle Edition.

Appendix C3. Permission Granted by David Kimmis for use of Data Literacy Figures.

November 7, 2017

Vicki Bejin
[redacted]

Dear Vicki,

I am writing to grant permission for you to use the images 3.2 and 3.4 from Data Literacy for Educators: Making It Count In Teacher Preparation Practice as outlined in your reprint permission request.

Best regards,

Dave Kimmis

3524 Kenwood Ave | Kansas City, MO 64109

Note: David Kimmis is the copyright holder for the graphics contained in Mandinach and Gummer (2016

Appendix C4. Permission for use of figures from Stake (2006).

Gmail Vicki Begin [redacted]

attachments for online request

GP Permissions <Permissions@guilford.com> Tue, Jan 2, 2018 at 12:17 PM
[redacted]

Dear Vicki Begin,

Thank you for contacting us with your request, and for sending along the sample figures.

Guilford does not grant blanket permission for all future uses and edition. So, while we can grant permission for use of the material in your dissertation, you will need to request permission again for any subsequent presentations or publications.

One-time non-exclusive world rights in the English language for print and electronic formats are granted for your requested use of the selections below in your dissertation for the University of Montana.

Permission fee due: No Charge

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Best wishes,
Angela Whalen
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