

AMERICAN UNIVERSITY OF BEIRUT

DATA LITERACY FOR SCHOOL EDUCATORS:
TOWARDS A FRAMEWORK FOR IMPLEMENTATION
IN PRIVATE SCHOOLS IN LEBANON

by
SALIA ADNAN HOTEIT

A project
submitted in partial fulfillment of the requirements
for the degree of Master of Arts
to the Department of Education
of the Faculty of Arts and Sciences
at the American University of Beirut


Beirut, Lebanon
January 2024

AMERICAN UNIVERSITY OF BEIRUT

DATA LITERACY FOR SCHOOL EDUCATORS:
TOWARDS A FRAMEWORK FOR IMPLEMENTATION
IN PRIVATE SCHOOLS IN LEBANON

by
SALIA ADNAN HOTEIT

Approved by:



Dr. Lina Khalil, Assistant Professor
Department of Education

First Reader



Signature

Dr. Rima Karami Akkary, Associate Professor
Department of Education

Second Reader

Date of project presentation: January 24, 2024

ACKNOWLEDGEMENTS

Mom, this research paper wraps up the graduate degree that you have long waited for and hoped I would complete one day. As a testament to the strength and resilience you continue to model every day, and which you have steadfastly instilled in us, I finally completed it.

Dad, I wish you were here so I can tell you all about my research interests. In a way, you are, for I carry you in my heart and hear your voice in my mind, pushing me on. I share that inquisitive research nature that you had and hope that I turned out to be as forward-thinking as you always were.

Zad and Neil, the young gentlemen I am proud to call my sons – may this inspire you to follow a lifetime of learning and have faith that it is never too late to do something if you set your mind to it.

Dr. Lina Khalil, thank you for so patiently working with me, providing valuable input and feedback, and for motivating me to consider the next steps after this research. Dr. Rima Karami, thank you for encouraging me to return to the university after all these years to complete this degree, and for facilitating the process so smoothly throughout. You both provided me with the support I needed to persevere and complete this research despite all the obstacles that delayed my work. I am looking forward to future research opportunities with both of you inspiring ladies.

Mrs. Najwa Shammass, I am grateful for all the years of working with you and with the team at Wellspring Learning Community. Your constant drive and commitment to enrich the learning experiences for every learner is inspirational. Together we were able to persist in the challenge to consider the quality of learning and how to make it better for our community of learners. Thank you for believing in me and for supporting my work all throughout.

I am forever grateful for having had the opportunity to work extensively with two prominent figures in the field of education in Lebanon and the region: Dr. Adnan El Amine and Dr. Munir Bashshur. Working with you shifted my interest towards the education sector and provided me the chance to work on multiple research projects addressing the topic of quality assurance, among many others. You have helped shape my education career, and I am honored to have been mentored by both of you.

I am blessed to have people in my life who are always there for me, believing in me, supporting me, and pushing me further. To those loved ones I say thank you from the bottom of my heart for being there.

ABSTRACT OF THE PROJECT OF

Salia Adnan Hoteit

for

Master of Arts

Major: Education

Title: Data Literacy for School Educators: Towards a Framework for Implementation in Private Schools in Lebanon

Data-based or data-driven decision-making in schools has been associated with improved quality of teaching and learning and with school improvement at different levels. Opportunities for data use in schools have become more prevalent with the multitude of digital tools available for recording and analyzing school data. The effectiveness of data use in education, however, depends on various factors. This review study provides a review of literature on data literacy for educators towards the adaptation of a framework that could be proposed for implementation in private schools in Lebanon. The study presents an extensive review of recent literature to explore: (a) what is the role of data literacy and use in schools and how can this relate to private schools in Lebanon; (b) what are the frameworks for data literacy and use adopted internationally and how can they be synthesized for private schools in Lebanon; (c) what are the factors enabling or disabling data use in schools for effective decision making; and (d) which professional development intervention models have been shown to be effective in building school educators' data literacy capacity. Suggestions for adaptation to the local context and implementation are discussed with the proposal of a framework to guide private schools in Lebanon in developing educators' data literacy, along with implications for practice and further research.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	1
ABSTRACT	2
ILLUSTRATIONS	7
TABLES	8
INTRODUCTION	9
Importance of Data Literacy	10
Context of Lebanon	13
Purpose and Research Questions	14
Significance	14
Overview	15
METHODOLOGY	17
ROLE OF DATA USE IN SCHOOLS	21
Data for Decision Making in Schools.....	21
Data-Based or Data-Driven Decision Making	21
Impact of Data Use in School	22
Types and Sources of School Data	23
Quantitative and Qualitative Data.....	24
Educational Data and Learning Analytics	27
Issues Related to Data Use.....	28
Data Sensemaking and Equity	28
Data Ethics	31

The Context of Schools in Lebanon	33
Overview of Education in Lebanon	33
International Programs and Examinations	34
International Accreditation and Evaluation Models	39
Teacher Education and Training	48
DATA LITERACY AND USE FRAMEWORKS	50
Defining Data Literacy	50
Frameworks and Models for Data Literacy and Use	53
Data Literacy for Teachers Framework	53
The Data Use Intervention Model	58
The DBDM Theory of Action	60
Continuum of Data Literacy for Teaching.....	61
The Data Wise Process	64
Integrated Conceptual Framework for the Context & Practices of Data Use.....	65
Data Literacy Elements and Support Structures Framework.....	66
EDL Competence Framework	67
Data Literacy Assessments	68
Teacher Data Use Survey	69
NU Data Knowledge Scale	70
3D-MEA Inventory	70
DDDM in Schools Scale.....	71
FACTORS AFFECTING DATA USE IN SCHOOLS	73
Types of Factors.....	73
Individual-Level Factors.....	77

Beliefs and Attitudes Towards Data	77
Knowledge and Competence	80
Organization-Level Factors	82
Organizational Structure	83
Accountability.....	84
School Leadership.....	85
Professional Learning Communities.....	91
Other Organizational Aspects.....	91
DEVELOPING CAPACITY FOR DATA LITERACY.....	93
Data Literacy Capacity Building	93
Pre-service Data Literacy Training.....	97
In-service Data Literacy Training.....	103
Data Literacy Professional Development	104
The Data Use Intervention.....	107
FRAMEWORK PROPOSED FOR PRIVATE SCHOOLS IN LEBANON	112
Data Use Context.....	114
Organizational Setup.....	117
Data Literacy Training.....	120
Data Use Cycles.....	122
Data Stories.....	123
CONCLUDING REMARKS	124
Limitations.....	124

Implications for Research and Practice	124
Conclusion	127
APPENDIX	129
REFERENCES	130

ILLUSTRATIONS

Figure

1. Framework for Teachers’ and School Leaders’ Sensemaking of Formal Achievement Data.....	30
2. IB Framework	43
3. Cognia’s Continuous Improvement System	47
4. Organization of Data Literacy Conceptual Framework.....	54
5. The Domain of Date Use for Teaching.....	56
6. The Eight-Step Data Team TM Procedure	59
7. Links between the Concept of Data literacy and the Data Use Intervention	61
8. Continuum of Data Literacy for Teaching.....	63
9. The Data Wise Improvement Process.....	64
10. Integrated Conceptual Framework for the Context and Practice of Data Use....	65
11. Data Literacy Elements and Support Structures	67
12. Types of Data Use and Influential Factors	74
13. Impact of the Factors Influencing Data Use	75
14. Interaction of Leadership, Teacher, and Team Factors to Go from Ineffective to Effective Data Teams.....	87
15. Leadership Behaviors Important for Data Teams.....	90
16. Description of Pathways from Data Use PDIs to Teacher and Student Outcomes	104
17. Proposed Data Use Elements Tapestry	113

TABLES

Table

1. International Accreditation Frameworks and Areas of Standards	41
2. International Accreditation in Educational Institutions in Lebanon	42
3. Enabling and Hindering Characteristics for Data Teams	76

CHAPTER 1

INTRODUCTION

Data-based or data-driven decision making in schools has been associated with improved quality of teaching and learning and with school improvement at different levels such as student, classroom, school or larger system levels (Schildkamp, 2019). Educators are “increasingly expected to use data to inform, shape and strengthen school policy and instructional practice” (Goffin et al., 2022, p. 2). The effectiveness of data use in the school setting, however, depends on various factors (Schildkamp et al., 2017). Opportunities for data use in schools have become more prevalent with the multitude of digital tools available for recording and analyzing school data. Data-based decision making has evolved from focusing on standardized assessment data as a single data source and on student achievement as a single outcome measure to using a variety of data sources and range of outcome measures (Mandinach & Schildkamp, 2021b).

The law passed in the United States in 2015, Every Student Succeeds Act (ESSA), helped shift the perspective from data use being focused on compliance and accountability to being a source of evidence to drive decision making (Mandinach & Gummer, 2016a). The ESSA, with its expectation that data be used at all levels, also emphasized the need for professional learning opportunities for educators in the use of data from a variety of data sources, as data was not solely confined to summative assessment data, but rather was widened to include sources related to behavior, motivation, attitude, and others.

Data-based decision making, adapted with an equity lens that extends to diverse data sources influences the whole educational process. “Adapting an equity lens may

well be the most important contribution that the DBDM field can make in education; that is the shift to understanding the whole child, with context and other variables helping to enhance the interpretation of student performance through cultural responsiveness” (Mandinach & Schildkamp, 2021a, p. 7).

Importance of Data Literacy

With the increased focus on the important role of data use at schools, the development of educators’ data literacy has become more crucial. Data literacy knowledge and skills influence the ability of educators to work with data and use it to inform decision making. According to Brown et al. (2017), the pitfalls associated with data-based decision making include the need for educators to be data literate and to have expertise to be able to meaningfully identify potential causes of a problem that was informed by data and the best course for improvement.

In fact, a study by Reynolds et al. in 2019 on pre-service elementary teachers in the United States showed patterns of common errors in how teachers articulated claims regarding student content mastery based on assessment data, highlighting how the underdevelopment of teachers’ data literacy could be a barrier to data-driven decision making. These errors in formulating evidence-based claims regarding student condition included providing evidence that was nonspecific and irrelevant to support the claims, and even misinterpreting some of the statistical evidence (Reynolds et al., 2019).

“The ability to analyze and comprehend data is a critical twenty-first century skill” (Mahmud & Wong, 2022, p. 7). Examining stakeholders’ perspectives of twenty-first century skills, Mahmud and Wong (2022) noted data literacy as being of value for employability, yet there is a gap between what students are taught at universities and what they need when they are employed, with concern expressed that many employees

do not have the knowledge and skills to understand data and use it to make decisions. Data literacy as a twenty-first century skill directly contributing to students' employability was confirmed in a study by Yang and Li (2020), who additionally suggested that the data literacy of all stakeholders – students, faculty members, professional and support staff, and employers – in fact contributed to student success.

Mandinach & Gummer (2016a) explain that it is expected that having teachers be more skilled in data use will help develop more effective classroom and instruction, which ultimately should lead to an improvement in student performance and achievement, making a case for teacher training in using data and becoming data literate, to match the modern practice of evidence-based decision making.

In the context of datafication, Raffaghelli (2020) contends that data literacy could be examined in the role of being a catalyst of social justice, exploring the role of pedagogical data literacy, civic data literacy, personal and ethical data literacy, and critical data literacy for social data justice.

Ifenthaler (2022) highlighted the need to support educators in distance education in educational data literacy as a key competence, which “includes ethically responsible collection, management, analysis, comprehension, interpretation, and application of educational data” (p. 336).

According to D'Ignazio (2017), data literacy should be developed for people in non-technical fields to bridge the gap between what she describes as “the data-haves and data-have nots” to refer to those individuals who are able to work effectively with data and those who cannot (p. 6). D'Ignazio suggests data pathways for non-technical learners as an approach to cultivate creative data literacy for empowerment.

“A crucial stakeholder in the whole data use process is the school leader” (Schildkamp, 2019, p. 268). The role of leadership in fostering cultures of data use has been demonstrated in several studies. Data cultures were found to range on a continuum from democratic data cultures to blended data cultures to “need to know” data cultures, with the democratic type prevalent in institutions that most commonly had a distributed leadership model which encouraged its member to share information and collaborate to use data to be able to inform change (Brower et al., 2020).

While educators have increased access to data of variable types, this access is unlikely to inform instruction if educators do not have the understanding of how to operationalize and use the data and are not getting the support needed to do so (Berglund & Tosh, 2020). There is a growing need for developing educator data literacy to make best use of the data available in a school setting, to improve the learning and teaching process and to ultimately improve student performance (Gummer & Mandinach, 2015).

Several frameworks or models have been developed internationally to address these needs (Conn et al., 2020), and a number of professional development interventions around data use in education settings have been studied or analyzed for effectiveness and applicability (Ansyari et al., 2020). Developing educator capacity to use data is not just related to individual learning or delivery of professional development sessions; instead, data-related professional learning needs to be considered in the larger level of the organization as a whole to make it less temporary and more beneficial (Jimerson & Wayman, 2015).

With the increasing need to develop data literacy for educators in line with the changing international landscape, and for schools to become more data-driven, the

private schools in Lebanon would benefit from adopting this approach as they continue to develop to meet international standards and best practices.

Context of Lebanon

With the public education sector in Lebanon struggling with the socioeconomic and political issues that have impacted the country and with delayed reform measures, and in the absence of quality assurance measures by official authorities, the private sector has had to develop and find ways to secure quality learning and teaching. Private schools in Lebanon have considerable autonomy and flexibility in what programs they offer, how they deliver them, what resources to use, and how they recruit and train teachers. There is limited oversight of the government over the private education sector in these areas, and no inspection of curriculum or assessment schemes.

Official national examinations in Lebanon take place in grade 9 upon completion of middle school, and in grade 12 for entry into higher education. In the past few years, the grade 9 examinations have either been cancelled or severely reduced in content coverage. Students in secondary have the option of not following the national curriculum track and opting instead for international school-leaving examinations that would be considered as equivalent to the national baccalaureate. Across K-12, students could also be exempt completely from following the national requirements if they are able to meet the conditions set by the Ministry of Education and Higher Education.

To teach the skills needed for the 21st century, private schools have resorted to integrating all or parts of international curricula into their educational programs. In efforts to meet accountability needs and provide internationally recognized seals of quality assurance, some schools have opted to seek accreditation by international agencies. Accreditation standards set requirements and criteria for the schools in several

areas, which propels schools to engage in continuous cycles of reflection, learning, and improvement. To meet the needs for internationalization and the advancements in technologies for teaching and learning, private schools in Lebanon have the challenge of developing their educators' data literacy if they are to become data-driven institutions that can match the levels of international schools elsewhere. Doing so, however, requires a clear plan that takes into consideration all the variables at play. As this research topic is new to the country, and to the Arab region in general, the schools need a framework to guide them in this planning and development process.

Purpose and Research Questions

This review study was conducted to provide an overview of literature on data literacy for educators towards the adaptation of a framework that could be proposed for implementation in private schools in Lebanon. This research paper presents an extensive review of recent literature to explore: (a) what is the role of data literacy and use in schools and how can this relate to private schools in Lebanon; (b) what are the frameworks for data literacy and use adopted internationally and how can they be synthesized for private schools in Lebanon; (c) what are the factors enabling or disabling data use in schools for effective decision making; and (d) which professional development intervention models have been shown to be effective in building school educators' data literacy capacity.

Significance

There is a shortage of research on the topics of data literacy and data use in Lebanon and the region. Given the context of schools in Lebanon, and with the variety of frameworks or models prevalent elsewhere in the world, it is unclear how best a school can adapt any of these frameworks to the unique context of private schools in

Lebanon. This research review was undertaken to synthesize recent findings and evidence of best practices into a framework that could be used to initiate conversations among educators as they consider how to develop data use cultures at their institutions. The findings presented in this research could form a starting point for schools in Lebanon to select frameworks and professional learning approaches that could be best adapted to their needs and vision. By having a clear guiding framework with elements that are relevant to the context of the private schools in Lebanon, the schools can begin the process of reflection and planning to develop data literacy capacity. As the schools engage in data use cycles using the guiding framework, they can work towards improved outcomes for all stakeholders. This could help improve the quality of education provided by these schools and subsequently enhance the learning opportunities that would be available to the students at these schools in Lebanon. This could ultimately lead to stronger K-12 programs in the private schools, paving the way for access to more competitive higher education institutions and greater international mobility of the students.

Overview

Following Chapter 2 on methodology, the findings from the research are presented in four chapters: Chapters 3 and 4 in relation to the first research question, Chapter 5 to address the second question, and Chapter 6 for the third. Chapter 3 provides research-based evidence on the role of data in schools, explain the structure of education in Lebanon and the most common international programs and international accreditation models adopted by schools in Lebanon. Chapter 4 describes how data literacy has been defined in the literature and what frameworks and models for data use are most prevalent in the research studies. Chapter 5 details the factors that could either

enable or hinder data use at schools, depending on the extent of their implementation. Chapter 6 describes how data literacy capacity building has been evidenced in the research and summarizes teacher education and professional development initiatives that have been examined in the studies for their effectiveness in developing educators' capacity in the use of data. Chapter 7 discusses the findings and presents a framework of elements for schools in Lebanon to reflect on in their individualized contexts to develop their data use capacity. The study is concluded in Chapter 8 with limitations and recommendations for further research and practice.

CHAPTER 2

METHODOLOGY

The purpose of this extensive review of literature is to synthesize recent research findings and evidence of best practices into a framework that could be used to develop data use cultures at private schools in Lebanon. The findings presented in this research could form a starting point for the schools to select frameworks and professional learning approaches that could be best adapted to meet their needs and overarching vision and aims for data use.

The methodology adopted for the review was an informal scoping review approach, to identify what exists in the literature as evidence related to the topic and research questions in general and to private schools in Lebanon in particular, and to identify what aspects need to be considered in the framework to be proposed and in the implications for next steps in practice and research in the context of private schools. Since it was not clear what the literature could contain as a knowledge base on the topic, the review methodology did not take on a formal type. Rather, it aimed to provide an extensive literature review as exploratory background for future research that could be systematic, scoping, or integrative in nature.

The research review was undertaken in seven phases of work, with multiple cycles of coding and themes emerging as the literature was analyzed and findings synthesized:

Phase 1 involved search of the American University of Beirut's libraries catalogue for books and dissertations related to 'data literacy' or 'data-driven decision-making', in addition an extensive search of the Scopus database, filtering for

publications within the social sciences. Results were limited to all open access titles, with database query for ‘data literacy’ in the title, then searched for ‘data-driven decision-making’, ‘data-based decision-making’, ‘data culture’, and ‘data use’. The publication date range was set from 2015 onwards. The reason for choice of this date range was the fact that data literacy models and interventions that are more recent would be more suitable for adaptation and more relevant to current data use with all the digital changes that were brought to the school systems in the past few years, sometimes forcefully so with the onset of the pandemic and the ensuing digital learning environments. AUB ScholarWorks were also searched in a similar manner for theses and dissertations. Titles and abstracts were scanned to assess eligibility. The preliminary screened list of articles, books, reports, and dissertations exceeded 130.

In **Phase 2** the list was then further filtered as abstracts were reread. The remaining records were coded and organized into categories that ranked in importance and direct relevance to the topic in general, or to a sub-topic or a perspective on one particular aspect of the research study (see Appendix for Bibliography Coding Sample). Labels were added to indicate the type of reference and to highlight the ones that included details on research instruments that could be potentially beneficial for Chapter 4. Key phrases were added for themes, to highlight research methodology and scope (especially for systematic literature reviews), or to mention educational setting or level. This open label coding was continuously refined all through the remaining phases.

Preliminary scanning of the research articles and their references led to a snowball procedure in **Phase 3** of sourcing an additional set of references that were considered to be of importance in addressing the research questions, and those were then obtained through the databases ERIC, SAGE, ProQuest, or Taylor & Francis.

Phase 4 was dedicated to finding other sources of references that could provide context for Lebanon, as there was nothing in the research records found so far on data literacy that cover this region of the world. The Shamaa database, the Arab Educational Information Network, was searched for any publication in Lebanon or the Arabic region that relates to the above-mentioned keywords or that can provide information on the context of Lebanon in regard to private schools, accreditation models, or international programs. Search of Shamaa was done for English or Arabic records. Google search was similarly performed on these topics to attempt to source any information on Lebanon. The websites of the Lebanese Ministry of Education and Higher Education and Center for Educational Research and Development, and each of the accreditation agencies and international program providers were explored for the information needed for Chapter 3.

Phase 5 entailed reading the compiled bibliography, keeping journal-form entries for each item with summary descriptive information, key highlights, scope and indications for use in the research compilation. From this phase, the themes were further refined, and sub-themes emerged. A number of records was excluded at this stage as some initial possible angles were removed as they were too tangential to the main topic areas.

As this process was ongoing from end 2022 through 2023, to ensure that the most recent publications are included, in **Phase 6**, the search process in Step 1 was repeated for publications in year 2023 only, and relevant references were added and similarly coded and tracked.

For **Phase 7**, the records were clustered thematically and then each theme group was used to address the relevant heading in the paper as it had been mapped out. While

the findings were being compiled into the writing draft and the structure of the synthesis was becoming clearer, some records were excluded as they were found to be no longer directly relevant. Originally a few PhD dissertations had been included in the references list but at this point the decision was made to exclude them, focusing the research evidence cited primarily to studies published in refereed journals.

The final list of references retained after all the phases of work include 98 references that were cited in this paper, from the bibliography of 170 entries. Evidence from the literature review shaped the headings and sub-headings of the findings in Chapters three to six, providing research-based context for the role of data in schools, frameworks guiding data literacy and use, factors impacting data use, and initiatives for data literacy capacity building. Discussion of the findings ensues in Chapter seven with the proposed framework for adoption in private schools in Lebanon and concludes in Chapter eight.

CHAPTER 3

ROLE OF DATA USE IN SCHOOLS

Chapter three presents findings from the literature to define the concept of data-based or data-driven decision-making, to explore the role of data use as linked to school improvement and student outcomes, to define types and sources of data at schools, including digital data and learning analytics, and to describe some issues related to data use for educators.

Data for Decision Making in Schools

“Data are typically used for three purposes: accountability, school development and instruction” (Brown et al., 2017, p. 157). According to Schildkamp (2017, p. 243), for data-based decision making to lead to increased student achievement and to school improvement, “it is crucial that data are also used for school development and instructional purposes”.

Using data in schools is needed for decision making, and can have several positive impacts as explained in the following sections.

Data-Based or Data-Driven Decision Making

Various terms are being used in association with data and decision making, often interchangeably, such as data-based decision making (DBDM) and data-driven decision making (DDDM), with both acronyms becoming common in the literature and in everyday use. Conn et al. (2022) distinguish between the two in that “data-based decision making, as opposed to data-driven decision making, emphasizes using data to inform decisions through careful interpretation of data and surrounding contextual elements. It does not require decisions to be solely driven by data results” (p. 3).

According to Schildkamp et al. (2016), data-based decision making refers to the actual use of multiple types of data by school staff to guide decisions, which can be generally called data use. In broad terms, educator's ability to implement data-based decision making can be referred to as data literacy (Kippers et al., 2018).

Impact of Data Use in School

Data-based decision making can lead to improved effectiveness of instructional measures that can impact improvements at the school level, at the class level, and at the individual student level (Schildkamp et al., 2013 cited in Schildkamp et al., 2018).

Grabarek and Kallemeyn (2020) undertook a systematic review of literature, analyzing 39 quantitative, qualitative, and mixed methods studies found that 38% of the studies identified positive relationships between data use and student achievement, and 26% showed mixed relationships. Exploring the studies further, the authors concluded that positive effects on student achievement were related to the presence of specific elements, highlighting the positive influence of comprehensive data use interventions that include ongoing professional development and that target multiple leverage points using multiple types of data for equitable practices.

Data use interventions in teams have been associated with improved student outcomes. A study by Poortman and Schildkamp (2016) showed how data teams were able to solve the student achievement problem they had chosen, through the data use intervention. The data teams in the study had identified specific problems such as matching the average central exam grade in a subject to the national average or increasing the number of students passing from the third to the fourth or fifth year of secondary, as examples, and had set forth target levels that they were able to achieve.

Exploring data-based decision making interventions that were explicitly focused on student performance, Visscher (2021) presented the results of interventions implemented at schools in the Netherlands and showed how four of the six interventions had significant positive effect on student performance, as was demonstrated by standardized tests. Visscher argued that for data-based decision making to be effective, student progress data must be analyzed and used at various levels in schools – class level, school level, board level – with feedback and goal setting acting as underlying principles, leading to differentiated instruction and improved student achievement.

In what they called bringing “together the best of two world” (p. 167), Brown et al. (2017) proposed that data-based decision making and research-informed teaching practice, both important for school and teacher improvement, can be integrated into one framework – Evidence informed School and Teacher Improvement – where a combination of personal judgment, school data, and research evidence can be used in systematic inquiry cycles for improving learning.

Types and Sources of School Data

Mandinach and Gummer (2016) noted the diversity of data sources mentioned in Every Student Succeeds Act, in that it included all types of data from sources such as assessments, behavior, motivation, attitude, and climate. This would provide a wider scope that “allows teachers to gain a complete understanding of students from performance to context” (Mandinach & Gummer, 2016, p. 44).

As Mandinach and Schildkamp (2021a) emphasize, diverse data sources would allow educators to consider the student as a whole. “This increasing complexity of students, their backgrounds and circumstances should be an impetus for the use of a

broad definition of data use that includes all types of qualitative and quantitative data, formal and informal data” (Mandinach & Schildkamp, 2021a, p. 7).

Quantitative and Qualitative Data

Schildkamp et al. (2017; 2018) provide examples of various types of data classified into four general types: (a) input data from student and staff characteristics, (b) process data from instruction and assessment processes, (c) context data from parents’ perceptions and involvement, school culture, curriculum, facilities, and resources, and (d) output data on student learning and satisfaction. Examples of data related to school culture is information collected on relationships between students and teachers and between teachers themselves, and on beliefs related to learning and instruction.

Data collected at school can be quantitative, describing numbers and figures such as test scores or survey responses, or qualitative, describing non-numerical areas such as behavior, opinions, and experiences derived from interview and observation data, for example (Schildkamp et al., 2018). Academic data includes standardized tests and teacher-made assessments, while non-academic data related to attendance, behavior and disciplinary records, and social emotional learning areas (C. A. Conn et al., 2022). Data related to student performance “form the central source of data for teachers, but now teachers need surrounding and contextual information from which to understand each student and to inform how they can design instructional steps to help that student” (Mandinach & Schildkamp, 2021a, p. 5). Data related to teacher performance is also needed to address gaps in teacher instruction and performance (Mandinach & Schildkamp, 2021a). According to the National Center for Systemic Improvement (NSCI), examining qualitative data, such as that collected through surveys, interviews,

or focus groups, is important for “approaching data literacy with an equity mindset means that we are looking beyond the disaggregation of quantitative data sets to identify achievement gaps” (NCSI, 2021b, p. 1). From that perspective of equity, the NCSI called on school leaders to consider the use of data to measure and improve inclusive and culturally responsive practices, drawing on data from students’ achievement, cultural and linguistic backgrounds, as well as from educators’ demographics (2021b).

Examining two decades of research on data use in education to explore how principals used data to inform their leadership practice, Drake (2022) found that student achievement data was the type of data most used by principals, including summative data, interim assessment data, diagnostic assessment data, performance data such as classroom tests, assignments and homework, standardized assessment scores and graduation rates. Principals were reported to use achievement data at various frequencies and for different purposes, ranging from being used for grouping or placing students, for diagnosis, support, and intervention, for school improvement or for compliance and accountability, with the latter purpose being the most common purpose. The study also reported that principals used other types of data such as student attendance and behavior data. Qualitative data on student learning was collected via walkthroughs and hallway conversations with teachers. Discussions with teachers on student data related to academic performance, engagement, and social-emotional needs.

Additionally highlighted in Drake’s (2022) research review is principals using teacher data in the form of teacher evaluations. Drake referred to “human capital management processes” whereby principals used data on teacher effectiveness to inform

decisions related to “teacher hiring, assignment, development, and retention” (Drake, 2022, p. 6).

According to Mekhitarian (2022), formative data can be leveraged to inform school improvement, proposing that leaders take advantage of the recent influx of technology in education and the increased technological expertise during distance learning to use a real-time data approach to inform planning and instruction, as opposed to relying mainly on summative data which take time. “Actionable formative data accessibility and use can accelerate learning and shorten response times for reaching students who need additional support” (Mekhitarian, 2022, p. 5).

As evidenced in a study by Albiladi et al. (2020), administrators and teachers varied in their perceptions of the value of what was described as formal data and informal data, with teachers reporting informal data that they collected from classroom observation and instruction, anecdotal information, and informal assessment to be most valuable to them, while administrators more often used formal data to guide decisions, such as those collected from academic achievement results, standardized assessments, and reports on attendance and behavior.

Ho (2022) emphasized that qualitative data plays a critical role in teachers’ decision making processes, informing their professional judgment, and guiding their actions, and argued that this role must be acknowledged in considered while supporting teachers in their data use practices, as teachers integrate qualitative data in their daily practice. In a case study of high school teachers, Ho (2022) explored how the teachers made instructional decisions based on qualitative evidence and showed that teachers often rely on classroom observation as a primary source of data collection, on knowing their students through their understanding of student growth and challenges, and on

conferring with colleagues in formal and informal exchanges on student progress and behavior.

Kim and Yu (2023) highlighted the connection between teacher data literacies practice and pedagogical documentation in early childhood education, a practice from the Reggio Emilia approach, whereby educators document student learning data from multiple sources to help make children's thinking and learning visible.

Educational Data and Learning Analytics

The proliferation of digital data from digital platforms, with increased use in online learning, has led to research focused on educational data literacy related and on learning analytics, the usage of data in digital contexts. Additionally, the role of Big Data in education has been a topic of research. Mertala (2020) describes the datafication of education as being a hidden curriculum, capable of transforming education, as “the advent of automatically collected and analyzed (big) data in education has exploded both the breadth and depth of data collection to unprecedented levels” (p. 32). With a large amount of data that has become available in this age of digitalization, the integration of digital media and learning data has impacted pedagogy and, in its potential for supporting individualized instruction, can contribute to developing inclusive schools (Hase et al., 2022).

Findings from a study using a workshop design with pre-service teacher, Prestigiacomo et al. (2020) suggested that learning analytics are viewed as enabling technologies for learning design and can be used to track students' dispositions to learning and their learning needs so that teachers can design learning activities accordingly. In parallel, Ndukwe and Daniel (2020) explored the relationship between learning analytics, teaching analytics, and learning design and suggested that teaching

analytics can foster teachers' data literacy skills to support evidence-based teaching, providing useful data to teachers from their teaching, which can be useful to improve instruction and to optimize the learning environment to meet the diverse needs of the learners.

Using a mixed Delphi design conducted with international experts in learning analytics along with a literature review on the impact of learning analytics in supporting learning and teaching, Ifenthaler et al. (2021) concluded that, while learning analytics can be used in various ways to provide support for learning and teaching, and can be used to inform decision making for improvement, there was a general lack of knowledge and understanding regarding this use. Along with the development of knowledge and skills to select and use analytics for learning-focused decision making, the authors suggested that the literacies of graphicacy and educational data literacy should also be developed.

With the various types of data available to educators to use at schools, there are issues that need to be considered in relation to equity and ethics.

Issues Related to Data Use

Two issues are discussed here, those related to the process of sensemaking from data and its implications on equity, and to the ethical principles associated with data use.

Data Sensemaking and Equity

Grabarek and Kallemeyn (2020) identified the use of multiple types of data during data use as an equity strategy in studies that demonstrated a positive connection between teacher data use and improved student achievement, citing the use of achievement data, student background information, feedback from instruction, teacher

professional judgment, among others for a more holistic understanding of students. In their systematic review the authors also explored other equity strategies and principles such as using data with an aim for improvement, including all students, challenging assumptions and beliefs, or using data for flexible groupings of students.

While using multiple types and sources of data could lead to increased knowledge of students, there are challenges faced in how meaning is constructed from data that could lead to bias or inequity. Vanlommel and Schildkamp (2019) described how teachers apply rational and intuitive processes of data use and showed how the largest group of teachers in their study use intuitive processes to make conclusions with data collected spontaneously and with little proof of triangulation or consideration of alternative explanations. The authors showed that, in the study context of high-stakes decision making, teachers not only heavily relied on data collected intuitively, but also interpreted data collected rationally by predefined personal criteria.

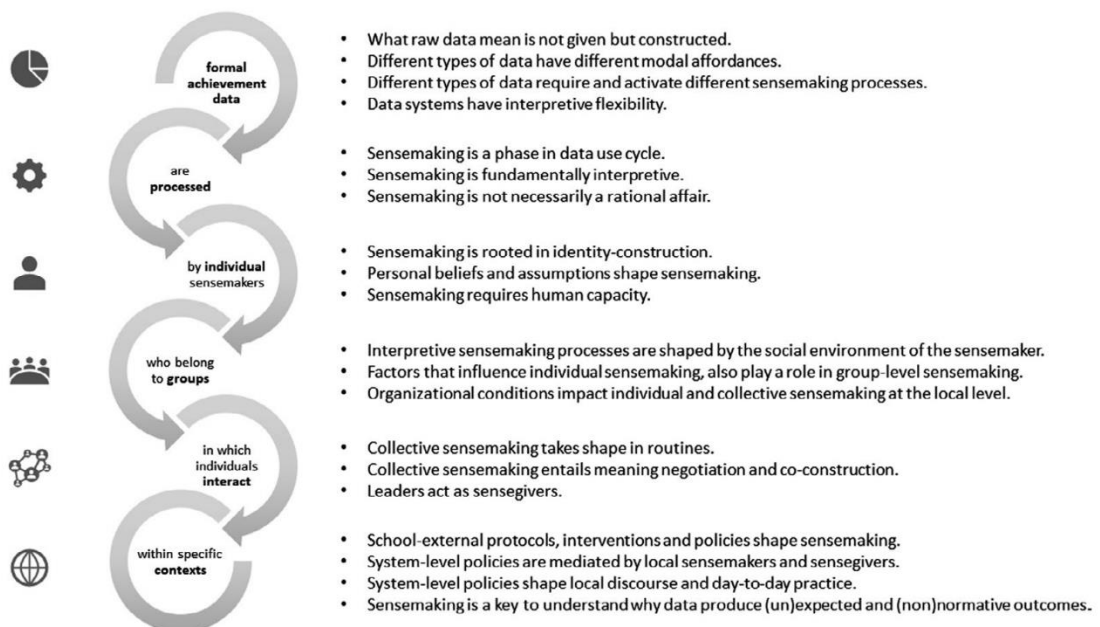
Bertrand and Marsh (2015) highlighted the aspect of equity in teachers' sensemaking in the education of students who were categorized as being English language learners (ELLs) or students in special education. The authors presented a theoretical framework in which they showed that both attribution theory and sensemaking theory influences how teachers understand and use data, and this process not only is influenced by the teachers' beliefs and past experiences, but also continuously reshapes them. Using findings from a study on middle school, the authors demonstrated how sensemaking and attribution are connected, as teachers attributed student outcomes to instruction, student understanding, the nature of the test, or to student characteristics. While attribution to instruction was the model most common, the fact that the teachers attributed student characteristics to explain some results "may

have both reflected and reinforced low expectations for ELLs and students in special education” (Bertrand & Marsh, 2015, p. 887).

Exploring educators’ engagement with formal achievement data related to student and school performance in a conceptual review of research studies, Goffin et al. (2022) highlighted challenges in sensemaking – the way they make sense of the data – in how data is understood, explained, positioned, and used to determine a decision or course of action. In their “Framework for teachers’ and school leaders’ sensemaking of formal achievement data”, as seen in Figure 1 below, the “Framework for Teachers’ and School Leaders’ Sensemaking of Formal Achievement Data” (Goffin et al., 2022, p. 26).

Figure 1

Framework for Teachers’ and School Leaders’ Sensemaking of Formal Achievement Data



Note. This figure shows educators’ data sensemaking processes. From “Teachers’ and school leaders’ sensemaking of formal achievement data: A conceptual review,” by E.

Goffin, R. Janssen, and J. Vanhoof, 2022, *Review of Education*, 10, e334, p. 26.

Copyright 2022 by British Educational Research Association.

The authors described the processes that need to be considered for the role of sensemaking in DBDM, and the sensemaking contexts through which the formal achievement data in general is “processed by individual sensemakers” who “in turn belong to groups in which individuals interact”, with sensemaking always occurring “within sensemaking contexts” (Goffin et al., 2022, p. 25).

Roegman et al. (2022) drew on Gutiérrez (2012, as cited in Roegman et al., 2022) framework for dimensions of equity – access, achievement, identity, and power - to examine how conceptions of equity informed data use by 12 principals from four school districts and demonstrated how the dimensions of access and achievement were the ones most focused on by the principals. According to the authors, this focus is problematic as it neglects the two other dimensions which allow for involvement of all stakeholders and the ability “to challenge how things are and work toward new ways of teaching, learning, grouping, assessing, and being in schools” (Roegman et al., 2022, p. 210).

With learning analytics, focusing on its use to support learning as opposed to its use for accountability or testing, among others, could help achieve an equitable system of education (Ifenthaler et al., 2021).

Data Ethics

Using data in a responsible and ethical manner is very important. Educators need to understand how to safeguard data, and protect privacy and confidentiality, as

“even well-intended educators may inadvertently engage in data breaches” (Mandinach & Gummer, 2016, p. 45).

Clear policies and guidelines for data practices need to be in place at schools to protect “the privacy and confidentiality of student, teacher, and administrator data and ensure that systems are secure” (Data Quality Campaign, 2018, p. 3). Similarly with educational data and learning analytics, standards for ethical design and use need to be in place to ensure quality, security, and privacy (Ifenthaler et al., 2021). Data ethics educational data literacy (EDL) competence includes the areas of informed consent, data privacy and protection, and data ownership and access (Papamitsiou et al., 2021).

According to Mandinach and Jimerson (2021) data ethics is “the ability not only to use appropriate data for appropriate purposes, but to apply reasons that prioritize the long-term benefit of students” (p. 12). The authors argued for the need to couple data literacy with an ethical approach to using data, and for the need to consider data ethics beyond data privacy protection and data confidentiality to appropriate and effective data use, as “responsible data use is about an equity model, using data responsibly to address the diverse needs of all learners” (Mandinach & Jimerson, 2021, p. 14).

The role of data use in schools, as well as the types and sources of data and issues that can arise with their use are all applicable in the context of the private schools in Lebanon as they implement international programs and undertake accreditation by international organizations. In the following section, the general structure of education in schools in Lebanon is explained, followed by brief descriptions of the international programs and accreditations that could be present in the private schools. A brief description of teacher preparation is also provided.

The Context of Schools in Lebanon

This section provides a brief overview of the educational system in Lebanon and the international educational programs and examinations delivered by some private schools, followed by a description of some of the international accreditations and evaluations that are adopted by private schools in Lebanon. These descriptions outline the context for considering the needs for data use and for developing educators' capacity for data literacy, situated within the schools' delivery of quality learning and evaluation to meet international requirements.

Information on education in Lebanon as discussed in this section is synthesized from the Center for Educational Research and Development (CERD or CRDP, www.crdp.org) at the Ministry of Education and Higher Education (MEHE, www.mehe.gov.lb), and from Wikipedia, as well as from personal knowledge and professional experience as an educator in the field.

Overview of Education in Lebanon

The Lebanese educational system consists of three school divisions encompassing five cycles of three years each for students aged 3-18: preschool education (Kindergarten 1 to 3), basic education which includes both elementary (two cycles: grades 1 to 3 and grades 4 to 6) and intermediate (grades 7 to 9) levels, and secondary education (grades 10 to 12). The basic education level is the compulsory one only, with a national examination (Brevet) administered by the Ministry after grade 9, allowing students the option to pursue a vocational and technical track afterwards instead. For private schools, however, formal education covers all 15 years of schooling for subsequent entry into higher education. In secondary education, students have four track options to choose from depending on their areas of strength. Upon completion of

the secondary level, students sit for the official national examination to obtain the Lebanese Baccalaureate Certificate of Secondary Education.

According to CERD's Statistical Bulletin for 2022-2023 (Center for Educational Research and Development, 2023), the total number of students enrolled in all sectors in Lebanon for the academic year 2022-2023 was 1,079,048. Student enrolment was distributed as such: 28.00% in public schools, 11.80% in public subsidized schools, 56.66% in private schools, and 3.54% in UNRWA schools for refugees students. Almost 49% of the students enrolled were in the elementary grade-levels.

Statistics for 2022-2023 for Lebanon show that, of the 2780 schools, 41.83% were categorized as private schools, in addition to another 11.70% as private subsidized schools (CERD, 2023). UNRWA schools make up 2.30%, and the remaining 44.17% of the schools are public ones.

Schools in Lebanon teach English and/or French as foreign languages, teaching them early on and using them to teach math and sciences. Regarding language of instruction, 54.24% were in schools teaching in English, while the rest were in schools teaching in French. English was taught more than French in subsidized schools (53.50% English versus 46.51% French), and private schools (56.77% English versus 43.23% French). In contrast, French was the dominant language of instruction in public schools (56.17% French versus 43.83% English). UNRWA schools, on the other hand, almost all adopted English as the language of instruction (98.73% English versus 1.27% French) (CERD, 2023).

International Programs and Examinations

Private schools in Lebanon generally have autonomy in designing their educational tracks and curricula to meet their needs. Schools can run a "Foreign

System/Curriculum” whereby they include international curricula into grade levels or school levels of their choice. Schools also have flexibility in organizing the structure of their educational divisions, with some schools opting to replace the 3-3-3-3 model with 3-5-5-2, 3-5-3-4, 3-6-3-3, or any other model that best aligns with their needs while meeting the necessary national requirements for their local students.

While there seems to be no research that would give a comprehensive overview of the international educational programs and curricula adopted by private schools in Lebanon, it is common knowledge within the educational community that there are schools that offer the French programs leading to the French Baccalaureate, schools that offer any part of American-based programs embedded into their curricula as their version of a “high school” program, schools that offer one or more of the International Baccalaureate programs, and a few schools offer parts of the Cambridge programs. Many schools offer combinations of programs or track options, especially at the secondary school level, usually with the Lebanese Baccalaureate option also offered in parallel for those students who wish to pursue only the national program track. The school database available online on the CERD website include these elements in their search criteria; however, the fact that many schools have combinations of programs makes the directory search slightly unclear.

Specific requirements set by the Ministry of Education and Higher Education (MEHE) allow some Lebanese students to obtain exemption from having to pursue the national curriculum track and sitting for the Lebanese Baccalaureate examinations. The equivalence committee at MEHE recognizes other academic programs as equivalent to the Lebanese Baccalaureate and allows students formal entry into higher education institutions and professional syndicates, with the exception of the syndicate for Law

which requires students to be holders of the Lebanese Baccalaureate or the French Baccalaureate.

International Baccalaureate. The International Baccalaureate Organization (IB, www.ibo.org) offers four programmes of which three are available in Lebanon: the IB Primary Years Programme (PYP) for ages 3-12, the IB Middle Years Programme (MYP) for ages 11-16, and the IB Diploma Programme (DP) for ages 16-19. With over 5,000 IB World Schools globally, the programmes have become increasingly recognized internationally and more schools in Lebanon have been seeking to implement one or more of the three programmes. In fact, very recently in August 2023 a collaboration was announced between the IB and the Lebanese Ministry of Education and Hariri Foundation to introduce the PYP in Lebanese public schools.

The online directory of the International Baccalaureate's website (www.ibo.org) shows that there are 26 IB World Schools in Lebanon, authorized to offer one or more of the IB programmes. Of the 26 schools, 1 school is listed as authorized to offer the PYP only, 3 schools to offer both PYP and DP, 1 to offer both MYP and DP, 18 to offering only DP, and 3 schools to offer all three programmes PYP, MYP and DP. The larger number of schools offering DP only is most likely attributed to the fact that these schools offer it as an option track for students after grade 10, in parallel to other academic tracks, making it possibly easier to introduce into existing academic structures. Implementing PYP and/or MYP requires a more systemic change that might not be easy for schools to adopt, especially in terms of teaching and assessment styles. Schools that opt for all three programmes develop that continuum of learning across the grade levels, taking on an "IB identity" across the board.

The three IB programmes rely on formative and summative assessments, with focus on the IB Learner Profile attributes and Attitudes to Learning (ATLs) serving as throughlines connecting the programmes. The PYP does not follow a grade-based assessment structure, requiring a more holistic approach of supporting students in their learning journey. The MYP is criterion-based, with each subject graded on four criteria (out of 8 each), and a final achievement level (1 to 7) that follows a best-fit approach. Of the three programmes, the DP is the most clearly structured in terms of assessments and their weighting, with achievement levels (1 to 7) outlined and percentages for weights of internal and external assessments listed.

Students completing the MYP have the option of taking the E-assessments. For students in grade 12, to obtain the full diploma, they must meet all pre-set conditions. Official IB examinations take place in spring, testing students on the full course content over grades 11 and 12. Until a few years back, Lebanese students who had no exemption were unable to pursue the IB DP and obtain equivalence with the Lebanese Baccalaureate. This changed, however, in 2017 when a new law granted Lebanese students the opportunity to pursue IB DP and obtain equivalence, within specific conditions. This has expanded access to the DP for Lebanese students and opened the possibility of other schools choosing to offer it.

American High School. The term “High School” program is a vague umbrella title used in private schools in Lebanon to refer to their adaptation of American-based curricula into their curriculum design. Requirements for graduation per Ministry guidelines only stipulate a certain number of school years (15 years) and a High School Certificate or Diploma from the school itself. Generally, these schools focus on preparing their students to take the College Board International SAT exams, which are

university entry requirements for several universities in Lebanon. The SAT exam is widely known in the country, with 18 official testing centers available for students to take the exam across different geographical locations in Lebanon.

Some schools opt for the formal approach of introducing the College Board Advanced Placement Program (AP) courses for their secondary students. According to the AP Course Ledger on the College Board website (www.collegeboard.org), there are 8 schools in Lebanon officially authorized to offer AP courses.

Cambridge Assessment International Education. The website of Cambridge Assessment International Education (CAIE, www.cambridgeinternational.org) lists staff members providing support for Lebanon, among other countries in the Middle East and North Africa region. An online search of the Cambridge school database shows that there are six schools and two centers in Lebanon recognized formally as Cambridge schools. Four of these are associated with the SABIS global education network. The British Council in Beirut, Lebanon, is listed among the results, and its website shows that it is an exam provider for IGCSE and A-level subjects, offering examinations with the two exam boards Cambridge International Examinations (CIE) and with Pearson Edexcel. It is to be noted, however, that an online search of Cambridge qualifications in Lebanon showed that some schools might offer Cambridge-based curricula for their secondary students to sit for the official qualifications without being formally listed as a Cambridge school.

CAIE has several programmes for K-12 schools: Cambridge Early Years, Cambridge Primary, Cambridge Lower Secondary, Cambridge Upper Secondary, and Cambridge Advanced. Of these, it is more likely that the programmes that can be found in a few schools in Lebanon are Cambridge IGCSE or International GCSE and

Cambridge International AS & A Level qualifications for students at the secondary level. Some schools in Lebanon might also align their middle school curricula with the Cambridge (CIE) Checkpoint for better preparation for IGCSEs.

Cambridge IGCSE is aligned with the standards of the GCSE qualification in the UK and is offered to students who are 14-16 years old, which usually is Grades 9-10 in the Lebanese schools. Students taking the program have a choice of subjects from a wide variety, many of which can be taken at either core or extended levels. Cambridge IGCSE assessment is the official examination that takes place at the end of the two-year program, and includes a mix of written, oral, coursework and practical assessments. Grading in the IGCSE is internationally benchmarked and follows an A* to G level.

Cambridge International A Level courses are two-year courses, with half their syllabus content forming the Cambridge International AS Level courses. Schools in Lebanon offering A Levels do so in Grades 11 and 12, with the A Level qualification at the end of the program serving as final examination for entry into higher education. Cambridge International A Level follows an A* to E grading scale, internationally benchmarked with clear guidelines for achievement standards.

For those schools pursuing the programs offered by Cambridge Assessment International Education (CAIE, www.cambridgeinternational.org), to obtain the status of being a Cambridge International School the school follows a process of expressing interest, completing an application form describing how the schools meets Cambridge registration quality standards, and successfully completing an approval visit.

International Accreditation and Evaluation Models

The process of data use is influenced by the school evaluation body (Schildkamp, 2019). From that perspective, it is important to consider the role of

international accreditation in Lebanese private schools to reflect on how adopting their standards and models for continuous school improvement could influence the need for data use cultures and developed practices in private schools in Lebanon.

In the absence of a national accreditation body and limited oversight of MEHE on the quality of education provided in the private schools in Lebanon, schools have turned to international organizations seeking seals of quality assurance that would provide not only status of international quality but also internationally recognized programs and certificates that would allow for international mobility of students and ease of access to schools and universities locally and abroad. Seeking international accreditation also provides schools with the opportunity to join recognized international professional networks and communities of practice and benefit from the resources available to the member schools.

Here also there is no published research on accreditation in Lebanon, and thus personal professional experience was the starting point. The choice of five accreditation agencies was made to further research, based on knowledge of schools that had obtained evaluation or accreditation through them. These organizations are the: (1) International Baccalaureate Organization (IBO), (2) Council of International Schools (CIS), (3) New England Association of Schools and Colleges (NEASC), (4) Middle States Association of Colleges and Schools (MSA), and (5) Cognia.

IB and CIS provide international evaluation or accreditation, while the latter three accreditation agencies provide U.S.-based accreditation. The IB implements programme-specific authorization and evaluation models while the other organizations offer institutional accreditation. Table 1 below outlines the broad areas or domains for the standards from each accreditation framework. The domains and their specific

standards and practices address various aspects of the program or the institution and necessitate collection of evidence from a variety of sources and of different types for triangulation.

Table 1

International Accreditation Frameworks and Areas of Standards

AGENCY	AREAS OF STANDARDS
IB	<p><i>Categories:</i></p> <ul style="list-style-type: none"> - Purpose - Environment - Culture - Learning
CIS	<p><i>Domains:</i></p> <ul style="list-style-type: none"> A. Purpose and direction B. Governance, ownership and leadership C. The curriculum D. Teaching and assessing for learning E. Wellbeing F. Staffing G. Premises, facilities, technology systems and auxiliary services H. Community and home partnerships I. Residential services, boarding and/or homestay
NEASC (ACE Learning)	<p><i>Learning Principles:</i></p> <ol style="list-style-type: none"> 1. Learning Purposes 2. Dimensions of Learning 3. Evidence of Learning 4. Learning Perspectives 5. Learner Autonomy and Engagement 6. Research, Reflection, and Action 7. Inclusion, Diversity, Equity, and Belonging 8. Governance and Leadership for Learning 9. Learning Space and Time 10. Learning Community Wellbeing
MSA	<ul style="list-style-type: none"> - Mission - Governance and Leadership - School Improvement Planning - Finances - School Organization and Staff - Health and Safety - Educational Program - Assessment and Evidence of Student Learning - Student Services - Information Resources
Cognia	<p><i>Key Quality Characteristics:</i></p> <ul style="list-style-type: none"> - Culture of Learning - Leadership for Learning - Engagement of Learning - Growth in Learning

Note. This table shows the areas of standards listed for each of the accreditation agency or organization, compiled from their respective websites.

Some of these agencies have developed collaborative partnerships that allow schools undergoing re-evaluation to undertake the process simultaneously, to simplify the self-study process and to have one joint external evaluation visit taking place. Crosswalks have been developed to connect the various frameworks, with a Memorandum of Understanding in place for how the process takes places within clear guidelines.

To obtain an overview of the number of schools in Lebanon that have been accredited by each organization, research of the respective websites of the accreditation organizations was undertaken to examine their networks of accredited schools in Lebanon. The results are in Table 2 below, showing the number of institutions listed in the online database for each organization.

Table 2

International Accreditation in Educational Institutions in Lebanon

ACCREDITATION AGENCY	# OF INSTITUTIONS IN LEBANON
International Baccalaureate	26
Council of International Schools	5
New England Association of Schools and Colleges	6
Middle States Association of Colleges and Schools	9
Cognia	15

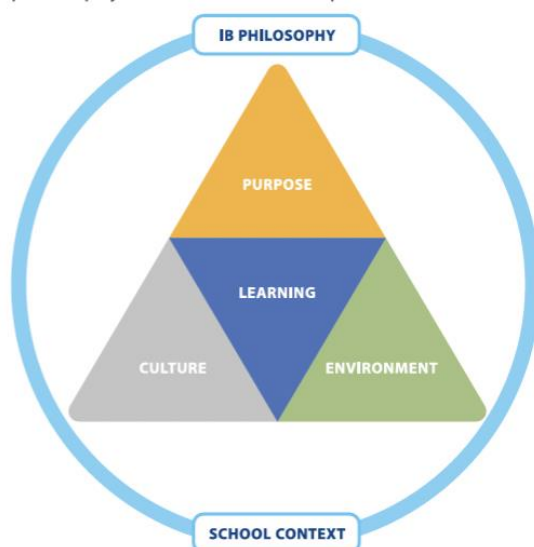
The number of institutions listed in the table shows those institutions that have officially received evaluation or accreditation. While it represents a small percentage of the private schools in Lebanon, the numbers have been increasing with a growing trend for the more prominent schools to seek accreditation. Additionally, there are schools that are candidates for accreditation, or are members of the accreditation organization's

networks and have not yet pursued accreditation. These numbers are not depicted in the search results.

International Baccalaureate. As per the International Baccalaureate website (IB, www.ibo.org), to become an IB World School offering either one of the IB programmes, a school goes through IB candidacy and authorization following a developmental framework: the 2020 Programme Standards and Practices (PSP) that organizes standards, practices, requirements, and specifications for each programme within four overarching categories related to purpose, culture, and environment, with learning placed at the center, as depicted in Figure 2 below showing the “IB Framework for the 2020 Programme Standards and Practices” (International Baccalaureate Organization, 2018, p. 3). IB programme evaluation cycles take place over 5-year periods and can be undertaken in conjunction with other organizations during joint evaluation visits.

Figure 2

IB Framework



Note. This figure summarizes the International Baccalaureate framework for the 2020 Programme Standards and Practices. From “Programme standards and practices”. 2018.

International Baccalaureate Organization. p. 3. Retrieved from <https://www.ibo.org/globalassets/new-structure/become-an-ib-school/pdfs/programme-standards-and-practices-2020-en.pdf>. Copyright 2020 International Baccalaureate Organization.

Council of International Schools. The framework and protocol for the international accreditation provided by the Council of International Schools (CIS, www.cois.org) have four drivers: the overarching purpose and direction, high quality learning and teaching, the development of global citizenship, and wellbeing. The evaluation framework includes 9 domains of standards, with a rubric for developmental criteria outlined for schools at the various stages of the continuous school improvement journey: foundation criteria, preparatory evaluation criteria, team evaluation criteria, and future aspirations.

The 5-year accreditation cycle involves a preparatory evaluation, followed by a self-study process, an external team evaluation, and annual reports on updates on school improvement practices and development. Schools opting for CIS re-accreditation can choose either Pathway 1 where they review a broad set of standards across the CIS four drivers, or Pathway 2 where they take a deep dive into one of the drivers, choosing an area of focus. The online membership directory lists 5 CIS-accredited schools in Lebanon.

New England Association of Schools and Colleges. The Commission on International Education (CIE) at the New England Association of Schools and Colleges (NEASC, www.neasc.org) provides the opportunity for international schools within or outside the United States to pursue accreditation along one of their three accreditation

pathways. The pathways include the ACE Learning Protocol, the Standard Pathway, or the Collaborative Learning Protocol with the International Baccalaureate. Schools commit to meeting established standards and undertake a process of self-evaluation, peer review, and ongoing systematic improvement.

The ACE Learning protocol offers a different approach to school accreditation, requiring schools to reflect not only on their foundational structures and processes but also on their effectiveness as a learning community and the “Learning Impacts” they have on learners as aligned with the 10 ACE Learning Principles. The protocol revolves around schools reflecting on “The 4 Cs”: conceptual understanding, commitment, capacity, and competence in supporting or hindering their ability to realize their vision. Schools are expected to develop a Shared Understanding of High-Quality Learning that is grounded in the learning principles and impacts, and to design Major Learning Plans to meet their strategic objectives for improvement to achieve their desired level of high-quality learning. The NEASC Foundation Standards, on the other hand, are compliance-oriented guidelines that are needed as the foundational base to create safe, effective, and sustainable learning communities (NEASC ACE 2.0).

A search of the NEASC-accredited schools online directory shows a listing of 6 schools in Lebanon, three of which are part of the Learner’s World International Schools (LWIS) Network.

Middle States Association of Schools and Colleges. Schools pursuing accreditation by the Middle States Association of Colleges and Schools - Commissions on Elementary and Secondary Schools (www.msa-cess.org) use one of two protocols for their self-study: the more traditional Designing our Future (DOF) protocol for schools new to the accreditation, or the Excellence by Design (ExBD) protocol. DOF

focuses on growing and improving the school's organizational capacity defined by 12 standards that represent the necessary building blocks for a quality school and educational program.

The membership directory of MSA member schools shows 9 listings for Lebanon: 7 accredited schools and 2 candidate schools. Three of the accredited schools are part of the SABIS network.

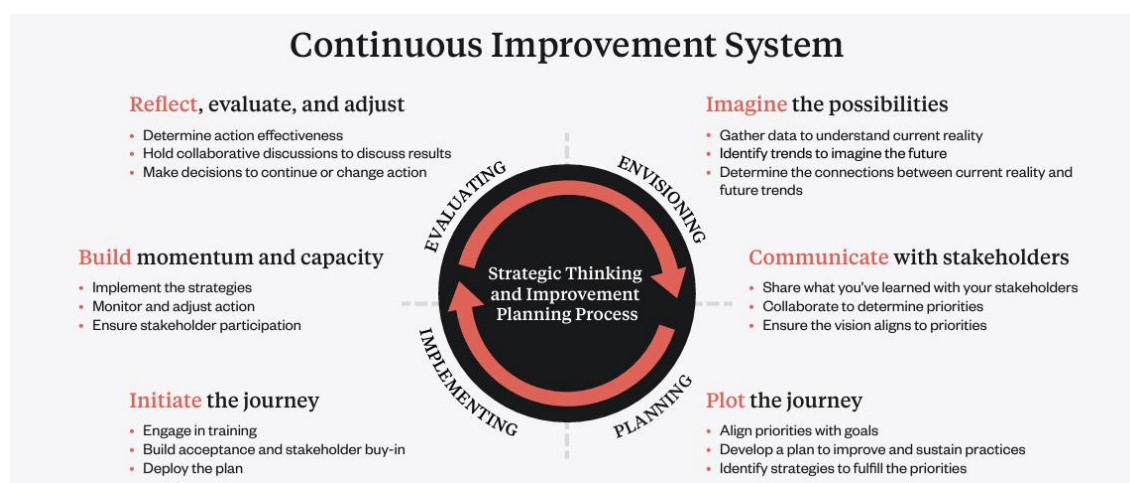
Cognia. Formerly known as AdvancED, Cognia (www.cognia.org) accreditation is awarded by three organizations together: the North Central Association Commission on Accreditation and School Improvement (NCA CASI), the Northwest Accreditation Commission (NWAC), and the Southern Association of Colleges and Schools Council on Accreditation and School Improvement (SACS CASI). Currently 15 non-public institutions in Lebanon are listed on the Cognia website registry as being accredited and certified: 12 listed as schools, 2 as ESA, and one as a corporation system, which is the Al Makassed Islamic Philanthropic Association of Beirut. Al Makassed Association itself runs a network of 13 primary, intermediate and secondary schools across Lebanon, among other educational initiatives (www.makassed.org/education-and-learning).

The latest iteration of Cognia's Performance Standards for K-12 institutions, put into effect early July 2022, describe the standards as being learner-centered, emphasizing the expectation of equity, and addressing learner wellbeing. According to the framework, institutions adopting the Cognia Performance Standards effectively and engaging in its peer review process for accreditation and continuous improvement would exhibit four key quality characteristics: (a) culture of learning, (b) leadership for learning, (c) engagement of learning, and (d) growth in learning. Figure 3 below

visualize Cognia’s model for “Continuous Improvement System” (Cognia, 2022, p. 2), showing how the improvement system continuously cycles in iterations of envisioning, planning, implementing, and evaluating.

Figure 3

Cognia’s Continuous Improvement System



Note. This figure summarizes the Cognia model for school improvement. From “Performance Accreditation Overview”. Retrieved from <https://www.cognia.org/wp-content/uploads/2020/10/Performance-Accreditation-Overview.pdf>. Copyright 2022 Cognia, Inc.

The various accreditation models all share continuous ongoing cycles of school improvement and require schools to reflect, document, and collect evidence from multiple sources. Accreditation naturally puts a school into data use cycles and practices as efforts are made to improve outcomes at all levels and provide evidence to external visitors of improvement cycles and measures implemented. As accreditation agencies refine their frameworks and standards over the years, the scope of the areas covered by the standards have widened to encompass multiple lenses and multimodal data.

Evidence is required from schools to show their systems for monitoring and evaluation of specific areas, in ways that meet international standards and recognition. These are no longer confined to achievement data but have expanded to include measurement and monitoring of the school's guiding statements, for example, and how it implements and supports the development of aspects such as global citizenship, global competence, interculturalism, or wellbeing. Evidence of impact on learners is requested, which is more challenging for schools to address and require multiple data points. For private schools in Lebanon, these can all provide a clear idea of data areas that need to be monitored and put into use.

Private schools in Lebanon not only have autonomy over curriculum and program implementation, but also are in charge of teacher training in the absence of a national certification authority for that.

Teacher Education and Training

Teacher preparation programs at universities in Lebanon vary in their format and depth. Private schools have their own list of professional development requirements based on their needs to deliver the programs that they have designed or adapted, and usually take on the responsibility of providing professional learning and development opportunities for their teachers in various formats. Private schools also have their own hiring requirements and recruit staff locally and possibly from abroad. Whether teachers have recognized teacher qualifications or not is assessed by the schools themselves, and sometimes the decision is made to hire teachers who have the content knowledge but not the pedagogy, selecting to provide that training in-house in the pedagogical approaches needed to deliver the program. Delivery of international programs such as the IB, for example, requires IB-recognized professional development.

As private schools in Lebanon push themselves to implement internationally recognized programs and meet international quality standards, they need to stay up to date with all the developments to ensure best practices. While this is no easy feat, more schools are taking on the challenge and making progress. As they implement curricula from the U.S., the U.K., or elsewhere, and seek accreditation from agencies from around the globe, the schools need to reach international levels. With data literacy and use becoming expected of educators and educational institutions elsewhere, then the private schools in Lebanon also need to take on those practices to remain at levels that could be comparable to other international schools worldwide. Given that the task of teacher training is also required from the private schools if they are to have educators implementing the best-practice instructional methodologies and latest technologies, then data literacy capacity building is also part of the work that schools need to do to upskill their educators.

The following chapter explains what it means for an educator to be data literate and what frameworks the school can consider in developing data use cultures across its levels.

CHAPTER 4

DATA LITERACY AND USE FRAMEWORKS

This chapter summarizes findings from the literature on how data literacy can be defined and what it means for an educator to be data literate. The chapter presents several conceptual frameworks or models for data literacy for educators currently adopted in the review studies, with a brief description of their constructs and components, as well as a number of instruments that have been referenced in relation to data literacy and data use assessments. Presented is a selection of eight frameworks and models for data literacy and use, along with four instruments associated with data literacy assessments, that can be adopted or adapted in schools in Lebanon or elsewhere to develop data literacy competence and a culture of data use.

Defining Data Literacy

The most widely referenced definition for data literacy in the research studies is that presented by Gummer and Mandinach as a construct they called data literacy for teaching (DLFT), and which they defined as:

Data literacy for teaching is the ability to transform information into actionable instructional knowledge and practices by collecting, analyzing, and interpreting all types of data (assessment, school climate, behavioral, snapshot, longitudinal, moment-to-moment, and so on) to help determine instructional steps. It combines an understanding of data with standards, disciplinary knowledge and practices, curricular knowledge, pedagogical content knowledge, and an understanding of how children learn. (Gummer & Mandinach, 2015, p. 2)

A Data Quality Campaign brief for state policymakers proposed the following definition of data literacy: “Data-literate educators continuously, effectively, and ethically access, interpret, act on, and communicate multiple types of data from state, local, classroom, and other sources to improve outcomes for students in a manner appropriate to educators’ professional roles and responsibilities” (DQC, 2014, p. 6)

The Data Quality Campaign also provided an abbreviated definition to be used for communication: “A data-literate educator possesses the knowledge and skills to access, interpret, act on, and communicate about data to support student success” (DQC, 2014, p. 6).

In addressing misconceptions about data-based decision making, Mandinach and Schildkamp (2021a) clarify that data literacy does not equal assessment literacy, as it goes beyond that to levels that require educators to select and collect data for identified problems of practice or research questions, to understand it and make effective and responsible use of it, and to interpret it and make decisions accordingly to inform instruction. Assessment literacy has been defined as “including the ability to design and make use of assessments as appropriate” (Data Quality Campaign, 2014, p. 5). A qualitative study by Conn et al. (2022) demonstrated how the participants viewed the terms assessment literacy and data literacy synonymously, and further found that this could be related to the fact that the term data literacy was less commonly used and instead participants referred to data analysis.

Gould (2017) proposed that the definition of statistical literacy be broadened to include an understanding about data at the level of data literacy, to consider, for example, who collects data, why and how it is collected and stored, how to analyze and interpret the data, and how to represent it. Gould argued that all people need to have a

certain level of statistical knowledge, which could be enhanced with data literacy knowledge and skills, to recognize the role played by data in everyday life.

A broader framing for data literacy proposed by Gebre (2022) synthesizes conceptualizations of data literacy in the literature and suggests that data literacy be reframed to integrate conceptions, competencies and contexts that extend beyond technical competence and the classroom. Accordingly, four orientations can be seen for data literacy as: (1) developing competence or technical skills, (2) data-driven inquiry, (3) raising awareness about personal data and data sensing, and (4) fostering civic engagement, with personal and situation elements of learning contexts “animating” data literacy development (Gebre, 2022, p. 1086).

Educational data literacy (EDL), on the other hand, involves the similar elements of data literacy but applied in the context of educational data and the digitalization of learning and teaching processes (Papamitsiou et al., 2021).

Conn et al. (2020) used Mandinach and Gummer’s definition of data literacy as a foundational base to compile a resource guide of useful frameworks, instructional resources, and measures to develop data literacy capacity for pre-service and in-service teachers. According to the authors, “being data literate includes a large subset of skills that allow for data to be understood and used in an appropriate and effective manner”, which could include the skills of “statistical literacy and graphical competency” (C. Conn et al., 2020, p. 10). The resource guide outlines learning outcomes for teaching data literacy and statistical literacy from a variety of references published between 2011 and 2016. The authors highlight the importance of teachers being able to understand the data context to fully use the results, and the need for foundational statistical literacy

knowledge and skills that would provide the necessary numeracy competencies for them to be able to comprehend, analyze, and interpret data.

Kennedy-Clark and Reimann (2022) explored the development of data literacy from a theoretical approach using a combination of various theories and proposed that teachers' data literacy knowledge acquisition can be viewed as “knowledge in sets, knowledge as pieces, and knowledge as interconnected rhizomes” (p. 43), especially for pre-service teachers, allowing them to develop their capacity for data-driven decision making over time.

While definitions vary in their level of detail, they share common elements. To explore what constitutes data literacy knowledge and skills, or competences, the frameworks and models for data literacy and data use presented or mentioned in the review of the literature were explored and accordingly a selection is presented.

Frameworks and Models for Data Literacy and Use

The frameworks and models described in this section are in no way an exhaustive list. The selection has been made to present the research-based frameworks that were more commonly cited in the literature or were used as the base for teacher training programs or professional development interventions for school educators, along with additional frameworks or models that built on the existing ones, providing what could serve as interesting angles or connections for schools to consider as they develop their data use cultures.

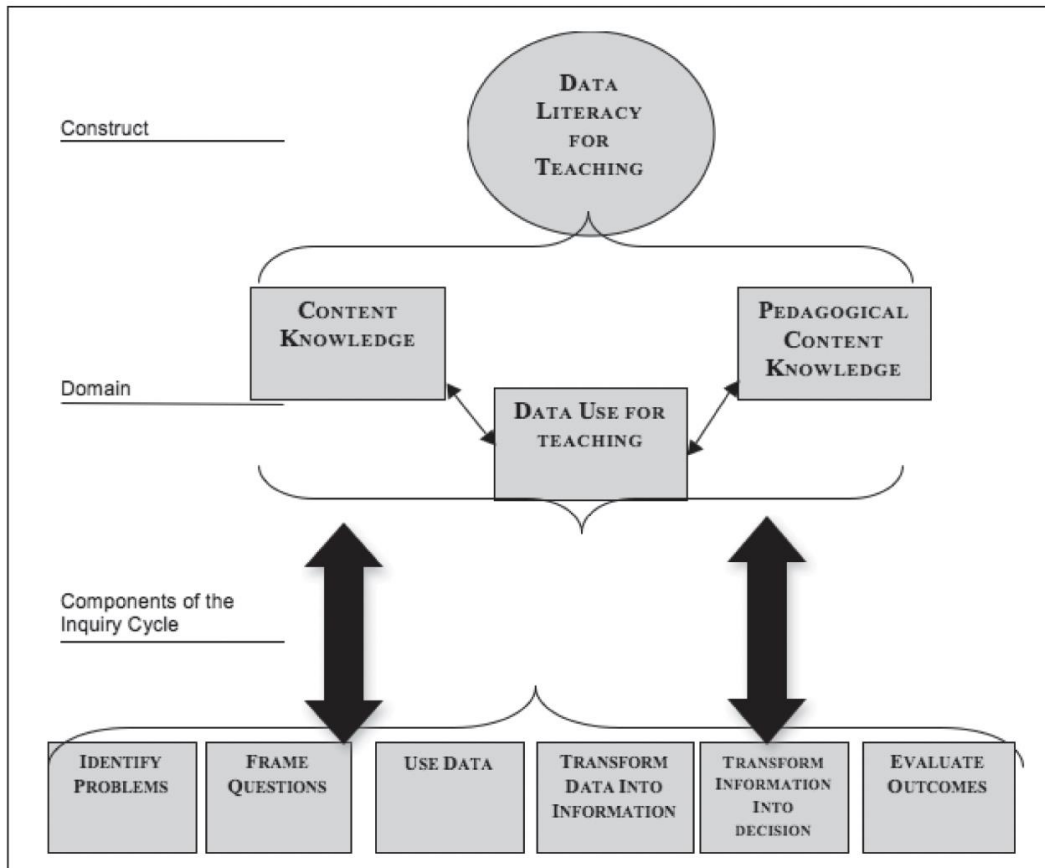
Data Literacy for Teachers Framework

Cited as “leading authors in the area of data literacy for educators”, Mandinach and Gummer are researchers whose names appear often appear in link to their operationalization of data literacy into a detailed framework. Their publication in 2016

is described as being “a valuable resource for teacher educators for developing measurable learning objectives for teaching key data literacy competencies” (C. Conn et al., 2020, p. 12).

Figure 4

Organization of Data Literacy Conceptual Framework



Note. This figure shows the organization of the data literacy conceptual framework as construct, domains, and components. From “Building a Conceptual Framework for Data Literacy,” by E. S. Gummer and E. B. Mandinach, 2015, *Teachers College Record*, 117, p. 13. Copyright n.d. by Teachers College, Columbia University.

The Data Literacy for Teaching (DLFT) conceptual framework emerged from a sequence of qualitative studies. DLFT revolves around three primary interacting

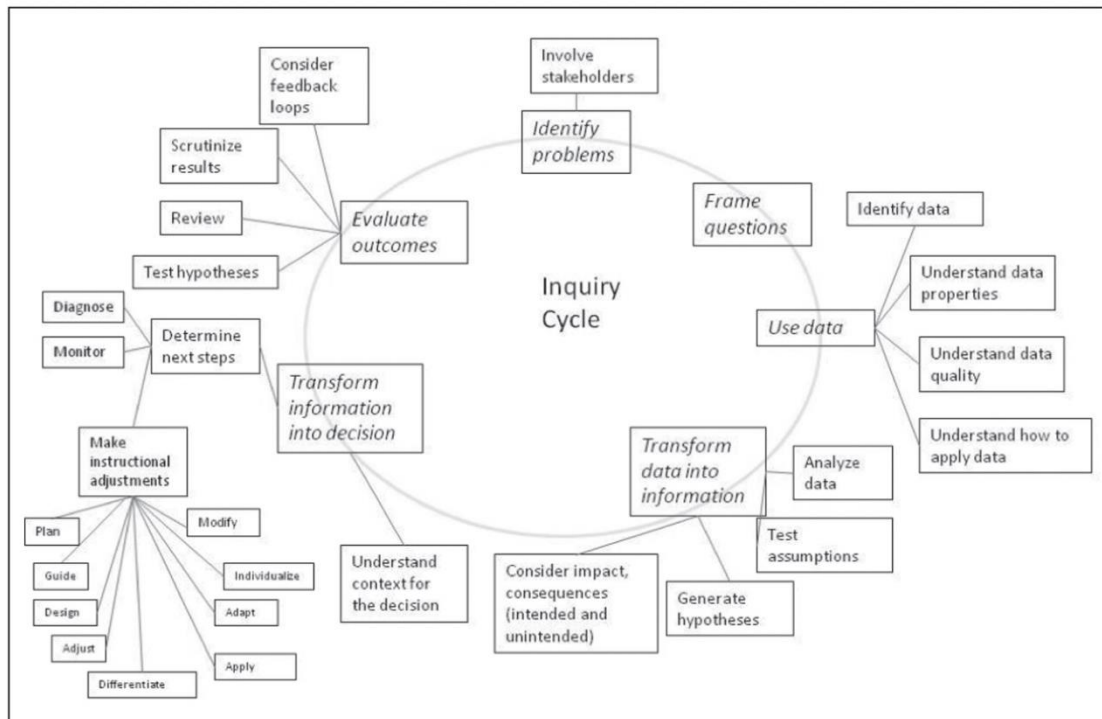
domains: (a) discipline-specific content knowledge; (b) data use for teaching; (c) pedagogical content knowledge; and other domains that give a more holistic view of the learner, such as learner characteristics and context (Mandinach & Gummer, 2016). The “Organization of data literacy conceptual framework” (Gummer & Mandinach, 2015, p. 13) shown in Figure 4 above explains how the framework is organized to link the construct with the domains and components.

According to the authors, teachers create a balance of these domains as they develop their instructional plans, incorporating the data, their pedagogical discipline-specific content knowledge, and their understanding of how best to help their students learn. To be reflective of classroom practices, the authors posit that data has to be interpreted through its content domain for sensemaking context and be used to develop instructional plans that then are implemented in the classroom by connecting to the teacher’s pedagogical knowledge.

The DLFT framework has five components comprising over fifty specific skills make up the needed skills to transform data into instructional actions, with the inquiry cycle for “The domain of data use for teaching” (Gummer & Mandinach, 2015, p. 15) in Figure 5 below launched by (1) identifying a problem of practice and framing a question, (2) using the data by selecting the ones that are appropriate and actionable to the problem of practice, (3) converting the data into information by managing the data, analyzing and interpreting it to identify patterns and trends, (4) transforming the information into a decision that informs instructional adjustments, and (5) evaluating outcomes by examining the results and the feedback loop on learning impact (Gummer & Mandinach, 2015).

Figure 5

The Domain of Data Use for Teaching



Note. This figure shows the data inquiry process according to the data literacy for teaching framework. From “Building a Conceptual Framework for Data Literacy,” by E. S. Gummer, and E. B. Mandinach, 2015, *Teachers College Record*, 117, p. 15. Copyright n.d. by Teachers College, Columbia University.

Mandinach and Gummer (2016b) additionally layered dispositions as aspects of data literacy, naming three: (a) belief in data use, (b) responsible and ethical use of data, and (c) collaboration through data teams or professional learning communities, all of which necessitates an enabling school culture.

Zooming in on the largest component in the inquiry cycle, the ‘Use data’ component and its subcomponents, the DLFT framework further elaborates elements and sub-elements that are not depicted in the figure (Gummer & Mandinach, 2015).

Using data begins with identifying data, which requires understanding the purpose of different data and which data would not be applicable. Understanding data quality follows, reflecting on data to understand problematic data and accuracy and completeness of data. Understanding data properties requires the use of quantitative and qualitative data from multiples sources. Generating data requires understanding, developing, and using sound formative and summative assessments. The last component is understanding how to apply data, which involves accessing data, managing data (organizing, examining, manipulating, etc.), and using technologies to support data use.

To transform data into information, another important process, the data needs to be analyzed, summarized, explained, interpreted, and used to draw inferences and conclusions. Analysis of data requires use of statistics, understanding of data displays and representations, ability to assess patterns and trends, and the synthesis of diverse data. Transforming data into information also includes probing for causality, testing assumptions, generating hypotheses, and considering impact and consequences, whether intended or unintended (Gummer & Mandinach, 2015).

McDowall et al. (2021) proposed a revision of the DLFT component for data use for teaching and suggested that the “use data” component in fact be at the center of the inquiry cycle, in a cyclical model rather than the original linear model. In a study on how pre-service teachers use data to inform and evaluate their teaching practices, data use was identified as being the most important of the five DLFT domains and as being central to the ability of teachers to work with all other domains. According to the authors, how the teachers understood and used data shaped their ability to use their knowledge (pedagogical and/or content) to inform learning goals and teaching practices. The authors argue that this is especially applicated in pre-service teacher training and

the context of teaching placement, where teachers begin “their use of data to inform teaching by evaluating the data available to them, rather than beginning by framing a question” (McDowall et al., 2021, p. 499). As such, the proposed revision of the component moves the “use data” component to the center of the cycle as the “heart of data literacy” (p. 500) and keeps the remaining surrounding around it as four entities: (1) identify problems/frame questions, (2) transform data into information, (3) transform information into decision, and (4) evaluate outcomes (McDowall et al., 2021).

The Data Use Intervention Model

The Data Use Intervention adopts the Data Team™ Procedure developed by researchers at the University of Twente in the Netherlands and is one of the most widely researched models in the past few years for professional development interventions in the research papers reviewed, with its authors leading several research studies on its implementation and effectiveness. The university supervised schools in the Netherlands implementing this data use method as part of a research project (Schildkamp et al., 2018).

The Data Team™ Procedure is explained in detail in a manual, describing each of its eight steps, starting with defining a problem to formulating a hypothesis and collecting data, checking for its quality, analyzing, and interpreting it to draw conclusions, implementing improvement measures, and evaluating the process and its effects (Schildkamp et al., 2018). The manual also provides two case studies as examples of how this procedure was implemented to address high school graduation rates and English language results. Additionally, the manual explains how to integrate the procedure into a school, whether in introducing it at the beginning or in maintaining

sustainability of working with it for data use. Figure 6 below visually presents the cycle for “The eight-step data teamTM procedure” (Schildkamp et al., 2018, p. xvii).

Figure 6

The Eight-Step Data TeamTM Procedure



Note. This figure summarizes the eight steps of the data use intervention procedure developed at the University of Twente. From *The Data TeamTM Procedure: A Systematic Approach to School Improvement* (p. xvii), by K. Schildkamp, A. Handelzalts, C. L. Poortman, H. Leusink, M. Meerdink, M. Smit, J. Ebbeler, and M. D. Hubers, (2018), Springer. Copyright 2018 by Springer International Publishing.

Poortman and Schildkamp (2016) explain what each step entails. In defining a problem in Step 1, teams need to develop a concrete and measurable problem statement,

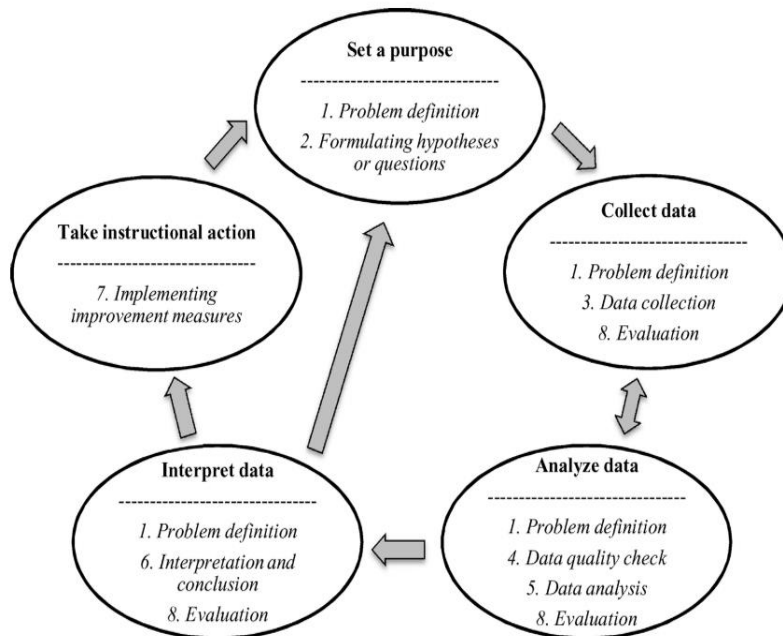
with its possible causes discussed to “choose the most plausible cause that can be influenced and researched” for Step 2 (Poortman & Schildkamp, 2016, p. 427). Data related to the selected hypothesis is then collected in Step 3, checked for quality in Step 4 to assess validity, reliability, and need for any additional data collection. Data analysis in Step 5 is done using a range of analytical methods as needed, from basic to advanced, to test the hypothesis. In Step 6 the team interprets the data and makes conclusion. If their original hypothesis is deemed acceptable, then they continue onwards to Step 7. If the hypothesis is rejected, then the team goes back to Step 2 and starts a new round. In Step 7, the team sets the measures that can be put in place to address the cause of the studied problem, and set goals for those measures, with their effectiveness evaluated in Step 8 to determine if the problem has been solved.

The DBDM Theory of Action

Aligning the general data literacy components that educators use to implement data-based decision making (setting purpose, collecting, analyzing and interpreting data, taking instructional action) with the steps of the data use intervention developed by the University of Twente, Kippers et al. (2018) showed how educators use the five data literacy components several times as they follow the eight steps, as depicted in Figure 7 below in theory of action showing the “Links between the concept of data literacy and the data use intervention” (Kippers et al., 2018, p. 22). The five data literacy components interact at several points and lead to iterative cycles with multiple reflection points.

Figure 7

Links between the Concept of Data literacy and the Data Use Intervention



Note. This figure shows the links between the concepts of data literacy (in bold) and the eight steps of the data use intervention model. From “Data literacy: What do educators learn and struggle with during a data use intervention?,” by W. B. Kippers, C. L. Poortman, K. Schildkamp, and A. J. Visscher, 2018, *Studies in Educational Evaluation*, 56, p. 22. Copyright 2017 by Elsevier Ltd.

Continuum of Data Literacy for Teaching

Basing their work on the DLFT conceptual framework developed by Mandinach and Gummer, and the data use model from the Netherlands, Beck and Nunnaley (2021) developed a continuum for data literacy for teaching, presenting the knowledge and skills that teachers need for DLFT from pre-service to in-service teacher education that would provide educational institutions with guidance on how to foster DLFT across the range. Using Gummer and Mandinach’s construct of DLFT, Beck and Nunnaley

positioned DLFT as a meta construct to include the construct of assessment literacy, and a wider variety of behavioral and affective data collection domains that would allow for more holistic assessments of growth. While the authors recognized the importance of the dispositions from the DLFT framework, they did not consider them to be a part of the continuum; however, they do describe them as “a necessary context for enactment of DLFT along the continuum” (Beck & Nunnaley, 2021, p. 5).

The “Continuum of data literacy for teaching” (Beck & Nunnaley, 2021, p. 2) presented in Figure 8 below lists five main components along a 4-phase rubric for users progressing from being novice users to developing, developing expert, and expert users. The components are first to (a) identify the issue or opportunity and set goals, then (b) to collect, manage, and organize high quality data, (c) transform data into information, (d) transform information into decision, and (e) evaluate outcome.

Beck and Nunnaley describe novice users as being at the earliest stages of DLFT development, building foundational knowledge and skills and developing awareness of the needed dispositions and beliefs, and “may not understand data use beyond compliance and a deficit model” (Beck & Nunnaley, 2021, p. 5). Developing users are described as beginning to build their knowledge and confidence in data use, may be able to identify a problem of practice, and begin to make connections between data and instruction, while developing expert users have established proficiency in these areas, along with an understanding of data ethics. Expert users, on the other hand, are “data leaders” with “a deep understanding of the data inquiry cycle and collaboration around data use” (Beck & Nunnaley, 2021, p. 6).

Figure 8

Continuum of Data Literacy for Teaching

Component	Novice User (Shulman: Preparation)	Developing User (Shulman: Representation)	Developing Expert User (Shulman: Instructional Selections & Adaptation)	Expert User (Shulman: Adaptation and Tailoring of Instructions)
Identify Issue/ Opportunity and Set Goals	Recognize there is an issue.	Correctly identify the issue, potentially with the assistance of relevant stakeholders. Recognize there might be some mitigating contextual factors at the student and/or school level. Set a goal that may or may not be specific or achievable.	Correctly identify the issue. Involve relevant stakeholders. Go more in-depth with the mitigating contextual factors at the student and/or school level. Set a goal that is specific and achievable.	Identify the situation. Understand the context of the student. Understand the overarching situational context. Involve stakeholders as appropriate while protecting student privacy. Set a goal at the classroom or building level that is specific and achievable.
Collect, Manage, and Organize High Quality Data	Unable to identify relevant and appropriate data sources. Does not use multiple and diverse data sources. Fails to understand the differences among forms of assessment and their uses. Does not recognize good from bad data as well as different types of data. Is unable to access data from technologies to support data use. Does not know how to organize and ethically manage data.	Able to identify some relevant and appropriate data sources. Begins to use more diverse data sources. Has a basic understanding of the differences among forms of assessment and their uses. Begins to recognize good from bad data as well as different types of data. Knows to access data from technologies to support data use. Starts to understand how to organize and ethically manage data.	Can identify most relevant and appropriate data sources. Uses more diverse data sources. Has an understanding of the differences among forms of assessment and their uses. Can recognize good from bad data as well as different types of data. Becomes more sophisticated at accessing data from different kinds of technologies to support data use. Can organize and ethically manage data.	Can identify relevant and appropriate data sources. Knows to use diverse data sources. Has an in-depth understanding of the differences among forms of assessment and their uses. Can recognize aspects of good and bad data quality (including validity) as well as different types of data. Sophisticated at accessing data from different kinds of technologies to support data use. Can organize and manage data, knowing the importance of ethical and responsible protection of data.
Transform Data into Information	Lacking in the ability to examine and analyze data. Does not make a connection between data use and educational impact. Is unable to draw valid inferences. Fails to summarize and synthesize data in a valid and meaningful manner. Is unable to use data displays.	Nascent ability to examine and analyze data. Begins to make connections between the data and educational decisions. Starts to use data displays in a meaningful manner. Begins to understand how to summarize and synthesize data. Attempts to articulate conclusions from the data.	Moderate proficiency to examine and analyze data. Makes connections but not always completely valid or relevant. Knows how to use data displays in increasingly relevant ways. Can summarize and synthesize data with increasing sophistication. Begins to draw valid inferences from the data. Starts to connect the inferences to instructional practice.	Proficient at examining and analyzing data. Has sufficient statistical knowledge for data interrogation. Ensuring that there is alignment from data sources to educational issue to the interpretations made on the data (i.e., that the interpretations are valid and relevant to the forthcoming decision). Knows how to synthesize diverse data through the use of appropriate technologies and data displays. Has an understanding that the decision will have educational consequences. Understands the importance of valid inferences and conclusions based on appropriate data sources.
Transform Information into Decision	Fails to understand what the student needs. Fails to take into consideration the context. Is unable to determine appropriate instructional steps based on the use of data. Fails to use the data from which to make instructional decisions. Takes a limited view of what data are relevant to the instructional determination.	Begins to understand what the student needs. Starts to take into consideration the context. Becomes more adept at determining appropriate instructional steps based on the use of data including moving beyond reteaching. Begins to use the data from which to make instructional decisions. Shows a broader view of what data are relevant to the decision.	Understands more fully what the student needs. Takes into consideration some of the context. Uses diverse data in determining somewhat varied instructional steps. Broadens their view of what data are relevant to the decision.	Fully understands a wide range of pedagogical options based on the diverse use of data from multiple sources and the context of the learner and intended content. Understands what the trajectory of student learning might look like and the needed variety of instructional steps within that trajectory. Makes appropriate content-based instructional adjustments based on the data and with the right level of granularity. Takes into consideration the context of the learner and classroom when making the instructional decision.
Evaluate Outcome	Assumes a decision is final and that there is no need for follow up or the iterative cycle of inquiry.	Makes a decision based on superficial knowledge of the original goal. Monitors teacher and student performance superficially. Limited level of introspection on goals.	Makes a decision and returns to consider the original goal. Makes some comparison about pre- and post- outcomes. May start another decision cycle and set another goal.	Makes a decision and definitely returns to the original goal. Compares a robust amount of pre-/post-data. Introspects about and monitors teacher and student performance. Recognizes the importance of iterations on the question to continuously monitor the intended outcomes.

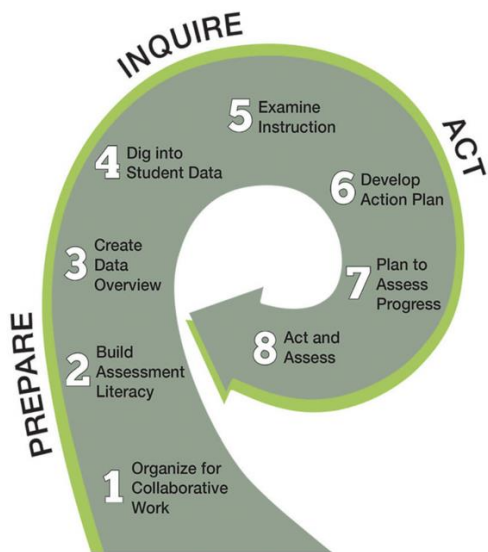
Note. This figure shows the data literacy for teaching components across a continuum of expectations for users from novice to expert. From “A continuum of data literacy for teaching,” by J. S. Beck and D. Nunnaley, 2021, *Studies in Educational Evaluation*, 69, p. 2. Copyright 2020 by Elsevier Ltd.

The Data Wise Process

The Data Wise Project is based at the Harvard Graduate School of Education and offers data literacy courses and aims to help educators to use collaborative data inquiry in a process that could drive continuous improvement of teaching and learning, according to the eight steps shown in Figure 9 below, “The Data Wise Improvement Process” (Data Wise, <https://datawise.gse.harvard.edu/>). Underlying the courses are the three “ACE habits of mind”, with the acronym ACE representing: shared commitment to Action, Assessment, and Adjustment; intentional Collaboration, and a relentless focus on evidence (Bocala & Boudett, 2015, p. 7).

Figure 9

The Data Wise Improvement Process



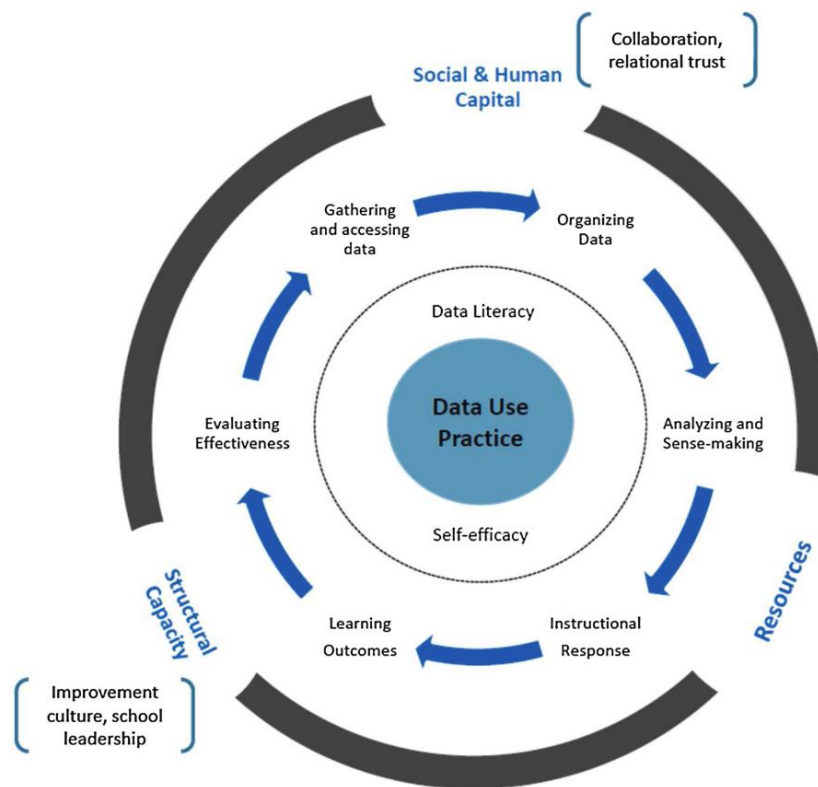
Note. From Data Wise Project. Harvard University. Retrieved from <https://datawise.gse.harvard.edu/>. Copyright 2024 The President and Fellows of Harvard College.

Integrated Conceptual Framework for the Context & Practices of Data Use

Situating the data use process within a structural framework that shows the organizational factors influencing teachers' data use practices, Abrams et al. (2021) proposed an “Integrated Conceptual Framework for the Context and Practice of Data Use” (Abrams et al., 2021, p. 2), visualized in Figure 10. According to the authors, the theoretical elements of the framework focus on the systematic process of data use, closely linked to individual characteristics such as data literacy capacity and educator's self-efficacy, while considering the broader structural context of school capacity.

Figure 10

Integrated Conceptual Framework for the Context and Practice of Data Use



Note. This figure shows an integrated conceptual framework for data use practices. From “The intersection of school context and teachers’ data use practice: Implications for an integrated approach to capacity building,” by L. M Abrams, D. Varier, and T.

Mehdi, 2021, *Studies in Educational Evaluation*, 69, p. 2. Copyright 2020 by Elsevier Ltd.

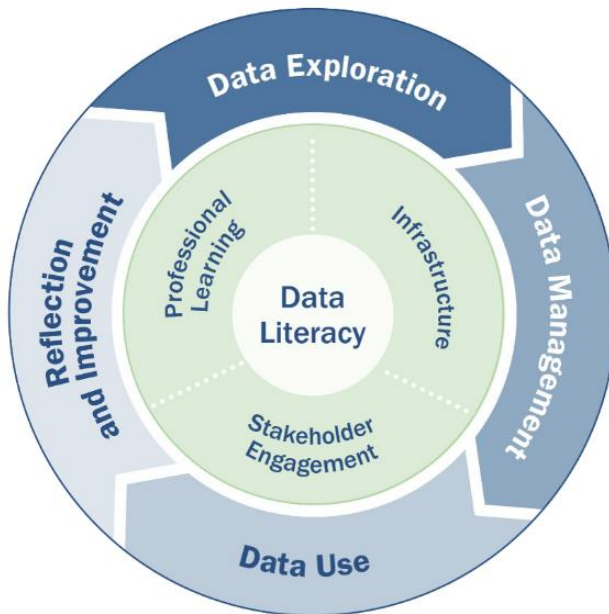
Data Literacy Elements and Support Structures Framework

The National Center for Systemic Improvement (NCSI, 2021), along with three other centers in the U.S., collaborated to build a common understanding of data literacy that could be adopted across all system levels – from educator to school to district and state levels. The culminating framework, the “Data literacy elements and support structures” (NCSI, 2021a, p. 2) depicted in Figure 11 below, identifies four essential elements – data exploration (the “why” or the purpose), data management (getting the right data and storing it), data use, and reflection and improvement – that require three support structures: stakeholder engagement, professional learning, and infrastructure. For each of the four elements, a list of key data literacy activities is provided, with sample guiding questions for consideration, along with tips for successful implementation within each of the three support structures (NCSI, 2021a).

Stakeholder engagement is described as being useful to strengthen all the elements of data literacy, as stakeholders can play a role in the selection of the right data, increasing data access and quality, and improving the efficiency and the effectiveness of the data use (NCSI, 2021a). Having access to ongoing professional learning can support data literacy across various levels and roles. A supportive infrastructure is similarly essential at all levels, to provide teachers and leaders the necessary time needed for data analysis and instructional changes, and the necessary data systems that would facilitate the process of managing, accessing, and using data from multiple sources (NCSI, 2021a).

Figure 11

Data Literacy Elements and Support Structures



Note. This figure identifies the essential elements of data literacy in education along with the necessary support structure. From *Essential Elements of Comprehensive Data Literacy* (p. 2), by National Center for Systemic Improvement (2021). Retrieved from <https://files.eric.ed.gov/fulltext/ED620527.pdf>

EDL Competence Framework

Focusing on educational data literacy, Papamitsiou et al. (2021) proposed a framework for educational data literacy competence development. The EDL framework covers six EDL competence dimensions related to data collection, management, analysis, comprehension and interpretation, application, and ethics. For each dimension, EDL competence statements are listed, covering 21 EDL competences in total.

The models presented are similar in being developmental and iterative, with collaboration playing a key role in development of data literacy and creating a culture of data use. Using data and being immersed in data use practices is highlighted as the means to develop that literacy, as it allows educators to work with authentic and relevant data, and to experience the full cycle that could lead to improved outcomes. While the exact steps might differ in their details, the general progression is similar along the general lines of planning, collecting data, analyzing and interpreting it, acting on it, and evaluating before venturing into another cycle. Along the path, other data inquiry cycles could spring up and be put into action as data is being used. The frameworks and models also emphasize that there are factors to be considered throughout the process, whether at the individual level and/or at the level of the organization.

In the following section, a few data literacy assessments are presented as examples of tools that could be considered by schools to measure and monitor data literacy development.

Data Literacy Assessments

A systematic literature review published this year by Cui et al. (2023) explored the available data literacy assessments to identify their targeted audience, adopted definition of data literacy, competencies focus, format, and validation. The authors found that most of the studies that focused on data literacy for teachers or educational professionals adopted the Gummer and Mandinach definition. Assessment formats were reported to range between self-reflective approaches and objective-measure approaches, with the latter format being more prevalent for educators where data literacy assessments took the form of data literacy tests, mostly with multiple-choice and

constructed-response questions. Self-reported surveys and questionnaires were found to be often used in conjunction with the data literacy tests. The authors noted that the studies focused more on examining effectiveness of the data literacy intervention than on the development and validation of an instrument, leading the authors to emphasize the need for the development of high-quality assessment tools.

Four tools have been selected from those mentioned in the research publications reviewed for this paper, to be described in this section: the first tool because it was developed at the level of the Institute of Education Sciences at the U.S. Department of Education, with Mandinach as one of the authors, and can be used for teachers, leaders, and support staff; the second because it gives a detailed scale of knowledge items; and the third because it provides an example of a self-efficacy instrument. Given that data literacy competence and self-efficacy have been shown to be both important and connected and given that data use assessment is not to be confined to teachers only and needs to be examined at several levels, these three examples could be beneficial for schools to consider in their use of assessment tools in this area.

Teacher Data Use Survey

The Teacher Data Use Survey developed by Wayman et al. (2016) is available in three versions and is to be administered at schools to learn how teachers, leaders (principals and assistant principals), and instructional support staff use data for educational improvement, their attitudes towards data, and the supports that help them to use data. The survey is described as needing 15-20 minutes to complete, with question items related to four forms of data – state data, periodic data, local data, and personal data.

NU Data Knowledge Scale

Using a data-based decision making framework, Trantham et al. (2022) attempted to refine the NU Data Knowledge Scale (NUDKS) so that it could be used to measure teacher data literacy along a data literacy continuum. The NUDKS was developed years earlier by a team of experts as part of a three-year NU Data Intervention Study. The refined scale includes 28 items providing a unidimensional measure of teacher data literacy. In their study Trantham et al. used the Rasch model to examine the psychometric properties of the instrument and found that “it demonstrates promising utility in measuring teachers’ knowledge of data-based decision-making, data use, and data literacy” (Trantham et al., 2022, p. 131). According to the authors, the NUDKS can be used at schools to assess teachers’ data literacy, as well as be used to evaluate a pre-service program on data literacy, suggesting that NUDKS can be used along with qualitative feedback to assess a program’s effectiveness.

3D-MEA Inventory

In a study by Hamilton et al. (2022), the Data-Driven Decision Making Efficacy and Anxiety (3D-MEA) Inventory was applied to collect data from 457 pre-service teachers and 365 in-service teachers in the U.S., to examine the validity, reliability, and invariance of data among the two groups, and was found to be suitable to be used effectively for both pre-service and in-service teachers. The tool was originally developed by Dunn et al. in 2013 (as cited in Hamilton et al., 2022) “as a self-report instrument to measure these important constructs and their subdomains using 20 items and an agreement response format” (Hamilton et al., 2022, p. 483). The 3D-MEA measures four dimensions of self-efficacy related to data-driven decision making: (a) self-efficacy for data identification and access, (b) self-efficacy for data technology use,

(c) self-efficacy for data analysis and interpretation, and (d) self-efficacy for application of data to instruction. The instrument also measures anxiety related to data-based decision making. The study showed structural invariance among the two groups, and was shown to be similarly reliable for both, which signifies its applicability for use with both pre-service and in-service teachers to measure these constructs.

DDDM in Schools Scale

A study by Doğan and Demirbolat (2021) aimed to develop a valid and reliable Likert-type scale that could be used to measure the effectiveness of data-driven decision making. The 23-item Data-Driven Decision in Schools (DDDMS) Scale was constructed within a system theory framework, around the themes of organizational capacity (data usage culture), process capacity (data usage purpose), technological capacity (infrastructure and tools), and professional capacity (data literacy). The dimension of culture of data usage includes items related to behavior, interactions, school goals, support, and time allocation for data use. The dimension of data usage purpose consists of items describing the behavior of educators for data use for school development, education, and accountability. The third dimension, technological infrastructure and hardware, includes six items around accessibility, timeliness, software, and data storage. The fourth and last dimension – data literacy – includes knowledge and skills for data analysis, evaluation, and interpretation that are needed for data use.

The DDDMS instrument was applied to a group of 179 school administrators working in public primary and secondary schools in Turkey and was found to be a valid and reliable measurement tool (Doğan & Demirbolat, 2021). Exploratory factor analysis of the results was described as acceptable, explaining 53.4% of the variance. Reliability

was determined with internal consistency coefficients obtained being greater than 0.60. The authors suggest that the scale can also be applied to teachers and to other schools, such as preschools and private schools.

These instruments show a sample of the different ways in ways data literacy and data use can be measured, exploring several areas relating to attitudes as well as knowledge and use. The areas measured relate to the factors that impact data use, which will be explained in detail in Chapter 5. The types of measurements reflect the ways in which data literacy training or interventions were shown to be effective, as demonstrated in the research studies described in Chapter 6. These include pre- and post-tests, questionnaires and surveys, and self-reporting tools, among others, with quantitative and/or qualitative aspects.

CHAPTER 5

FACTORS AFFECTING DATA USE IN SCHOOLS

The implementation of data use in schools is influenced by a range of contextual factors. This chapter presents findings from the research studies on the factors shaping data use in schools, outlining how different types of factors can act as enabling, supporting, or facilitating of effective data use, or as disabling or hindering of the process. Research evidence is provided on the impact of individual-level factors, which include educators' beliefs and attitudes towards data use as well as their knowledge and competence to use data, and on the impact of organization-level factors, such as the organizational structure, accountability pressures, the type and role of school leadership, the presence of professional learning communities, and other organizational aspects.

Types of Factors

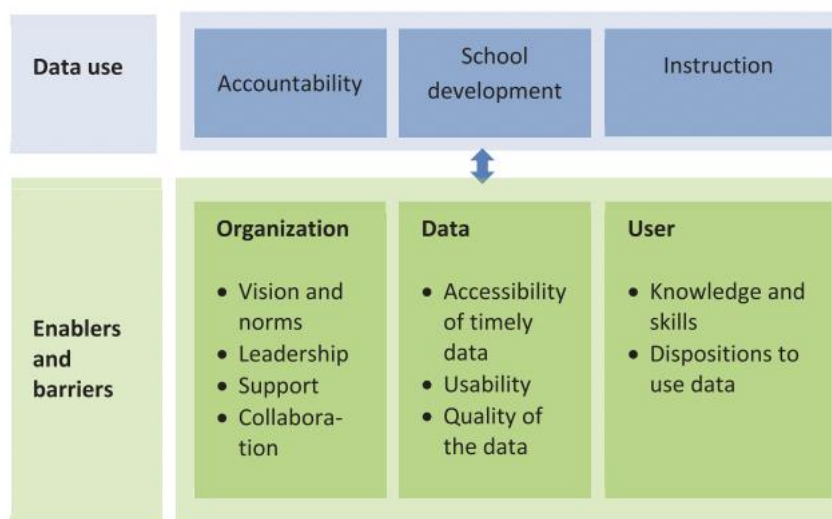
Factors influencing data use in data teams were explored in a case study that followed four data teams from secondary schools in the Netherlands over a two-year period were found to be inter-related and were grouped into three categories: (a) data characteristics (access and availability of high-quality data); (b) school organizational characteristics (leadership, shared goals, training and support, involvement of stakeholders); and (c) individual and team characteristics (data literacy, pedagogical content knowledge, organizational knowledge, attitude, and collaboration) (Schildkamp & Poortman, 2015).

Similarly in a large scale quantitative study in Dutch secondary schools exploring factors promoting and hindering data-based decision making in schools, the influence on data use for accountability, school development, and instruction were

identified for factors related to school organizational characteristics, data characteristics, user characteristics, and collaboration on data use, as the authors depicted in Figure 12 “Types of data use and influential factors” (Schildkamp et al., 2017, p. 244) and Figure 13 “Impact of the factors influencing data use” below (Schildkamp et al., 2017, p. 252). Findings from the study revealed that user characteristics is an important factor influencing data use for instruction, and that school organizational characteristics and collaboration had the greatest influence on teachers’ data use practices.

Figure 12

Types of Data Use and Influential Factors



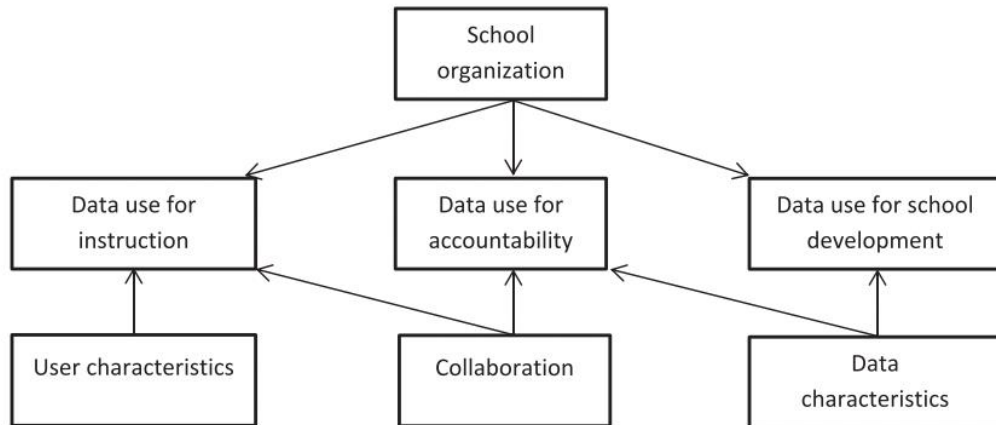
Note. This figure describes how various factors influence data use. From “Factors promoting and hindering data-based decision making in schools,” by K. Schildkamp, C. Poortman, H. Luyten, and J. Ebbeler, 2017, *School Effectiveness and School Improvement*, 28(2), p. 244. CC BY-NC-ND.

As shown in both figures, the influencing factors can each impact different types of data use, and their degree and quality of presence determines whether they serve as enablers

or as barriers of data use, which is elaborated in Table 3 below and will be further discussed in the following sections.

Figure 13

Impact of the Factors Influencing Data Use



Note. This figure describes how different types of data use are influenced by various characteristics. From “Factors promoting and hindering data-based decision making in schools,” by K. Schildkamp, C. Poortman, H. Luyten, and J. Ebbeler, 2017, *School Effectiveness and School Improvement*, 28(2), p. 252. CC BY-NC-ND.

Replicating the studies conducted in the Netherlands on effects of data teams and factors influencing their data use, Schildkamp et al. (2019) collected data from four data teams in schools in Sweden in a qualitative study and found similar results showing that the work of data teams is influenced by interdependent components related data characteristics, team characteristics, and school organizational characteristics. The context characteristics differed, however, given the differences in implementation in the two countries and the external support given to the data teams during the intervention. In Sweden, for example, the municipality supported the data teams with making data

available, providing a data coach, and by organizing reflection sessions, which was not the case in the Netherlands. In both countries, however, the Inspectorate played a role by enabling or hindering the work of the data teams depending on the accountability pressure it exerted. Table 3 below outlines the factors influencing data team functioning in the form they need to be present to act as enablers versus the form that turns them into factors that hinder data teams from effecting functioning (Schildkamp, Smit, et al., 2019). Emphasis on the form is important, and not just on the quantity of the factor presence. For example, under data characteristics, the availability of data is an enabling factor. Increasing that too much, however, is not necessarily a positive thing, as not all data is relevant or of good quality, and data overload can hinder the data use process.

Table 3

Enabling and Hindering Characteristics for Data Teams

	ENABLING FACTORS	HINDERING FACTORS
Data Characteristics	Availability of data Relevant data Good quality data	Lack of data Data overload Lack of quality
User and Team Characteristics	Data literacy Pedagogical content knowledge Positive attitude Shared problem Collaboration Heterogeneity Regular participation	Lack of data literacy Lack of pedagogical content knowledge Negative attitude Problem not shared Lack of collaboration Homogeneity Frequent absence
School Organizational Characteristics	Facilitation Distributed leadership Encouraging school leader Clear goals No turnover of staff Clear vision	Lack of facilitation Hierarchical leadership Lack of encouragement Lack of clear goals Staff turnover Lack of a clear vision
Context Characteristics	Pressure and support Data team coaching Collaboration between schools	Lack of pressure and support Too much or too little coaching Lack of collaboration

Note. This table lists enabling and hindering characteristics for data teams. Adapted

from “Professional Development in the Use of Data: From Data to Knowledge in Data

Teams,” by K. Schildkamp, M. Smit, and U. Blossing, 2019, *Scandinavian Journal of Educational Research*, 63(3), pp. 406-408. Copyright 2017 Scandinavian Journal of Educational Research.

Contextual factors related to the characteristics of individual teachers, teams, the school and wider policies have been found to mediate and moderate teachers’ data use practices (Ansyari et al., 2020). A qualitative study on the perceptions of Estonian teachers’ data use in school development also identified teacher-level and school-level factors that affected teachers’ perceptions and data use practices (Rääk et al., 2021).

Factors at the individual level and at the level of the educational organization are presented through evidence from the research studies. Where deemed useful, the type of research methodology and sample size are provided for context.

Individual-Level Factors

Beck et al. (2020) used semi-structured interviews to explore the perspectives of pre-service teachers on data literacy for teaching and found that the participants had a range of misconceptions and understandings of formative and summative data, perceived challenges related to making sense of the data, ensuring reliability and validity, and having time needed for data use. The teachers in the study also demonstrated a preference for data literacy instruction in authentic contexts and learning from peers, citing the need for ongoing exposure to data use practices.

Beliefs and Attitudes Towards Data

Teachers’ perceptions regarding data use and the impact this has on their data use practices are a recurrent theme in the literature. Participants in data literacy trainings or interventions are often found to have prior beliefs of limited confidence or negative

attitudes, such as “discomfort with understanding data” or “limited ideas regarding data for instruction” (Dunlap & Piro, 2016, p. 7). Practicing teachers’ beliefs or perceived ability and their attitudes towards data use were shown to be associated with their use of data to inform instruction (Schramm-Possinger & Harris, 2021). A study by Bolhuis et al. (2016) showed that the depth of inquiry in conversations of teachers collaborating in data teams was impacted by buy-in or belief in data, with data team members not feeling the urgency to use data to inform decision-making.

Teachers in a study by Anderson (2020) distrusted data in general and believed that their intuition is a better source of knowledge of the competencies and needs of their students, which affected their data use practices as they filtered the data through their own lenses and experiences. Rääk et al. (2021) describe the attitude of teachers involved in their study as being hesitant or negative towards school data, with the majority of teachers feeling insecure about their data literacy skills.

Findings from a study by Prenger & Schildkamp (2018) aiming to explore the psychological factors affecting teachers’ data use in depth, show that the constructs of perceived control, instrumental attitude, and intention regarding data use were significant predictors of data use, with intention action as a mediator between the affective attitude and data use. The quantitative study involved 131 primary school teachers from 25 primary schools in the Netherlands. The authors suggest that the low levels of perceived control among the teachers and their instrumental attitudes could be improved by providing more opportunities for discussions with colleagues and the leadership. Affective attitude such as confidence and enthusiasm to use data was found to be an important predictor of intention to use data and needs to be enhanced as intention was found to be a significant predictor of instructional data use.

Teachers' attitudes similarly were found to significantly influence their behavioral intention and instructional data use in a study exploring the factors influencing the instructional data use with electronic data systems of 243 teachers from twelve middle schools in China (Luo et al., 2022). A study in secondary schools in Switzerland also showed that teachers' digital data use was influenced by their positive beliefs towards digital technologies, as, despite over half of the participants having access to data technologies and an opportunity to use digital student data, only a quarter felt confident enough in using them for improving teaching (Michos et al., 2023).

In the same context of usage of learning data from digital learning platforms, primary school teachers' attitudes towards learning being a significant predictor of intent to use data was also demonstrated in a cross-sectional survey study by Hase et al. (2022) in Germany, using structural equation modeling. The perceptions of behavioral control of the 272 teachers participating in the study significantly predicted their actual usage of the learning data, which showed that their perception of competence influenced their use.

A case study on 16 primary education teachers in Belgium to investigate how teachers make sense of data in a high-stakes decision process revealed that the larger group of teachers used intuitive processes to make inferences from data use, with limited rational data collection and without triangulation or consideration of other explanations (Vanlommel & Schildkamp, 2019). Even when data was collected rationally, the teachers in the study used personal criteria to interpret it, which could lead to biased interpretations and less objective decisions. The authors emphasize the importance of data triangulation and suggest that having teachers follow systematic and collaborative data inquiry in which they share their beliefs and discuss the criteria they

used to make inferences could help overcome what they refer to as “the pitfalls of individual intuitive judgement” (Vanlommel & Schildkamp, 2019, p. 816).

Hoogland et al. (2016) also emphasized the need for teachers to have a positive attitude towards data use, and the confidence and willingness to learn for the implementation of data-based decision making to be effective. Improved data literacy skills following data literacy learning opportunities have positive effects on teachers’ perceptions regarding understanding and analyzing data may result in more self-efficacy with data use (Dunlap & Piro, 2016). A short online data use intervention based on the DLFT framework for pre-service teachers at a university in Germany showed that it had the potential to foster aspects of data literacy and self-efficacy about data-based decision making (Wurster et al., 2023).

Knowledge and Competence

A systematic literature review by Hoogland et al. (2016) along with focus group meetings with experts and practitioners identified teacher data literacy and pedagogical content knowledge as some of the prerequisites of successful data use in the classroom and noted the urgent need for professional development regarding data use. This was reiterated in the systematic literature review by Ansyari et al. (2020), emphasizing the need to develop teachers’ knowledge and skills of systematic data use processes as well as pedagogical content knowledge to help them improve instruction and learning outcomes. Washburn et al. (2022) also emphasized the need for teachers to have pedagogical content knowledge that is specific to their areas of data use so that they feel confident in the data-based decision making process.

Anderson (2020) notes that teachers not only need to possess data literacy skills and knowledge, but need to have the necessary didactic competencies that would allow

them to use the data to inform instructional changes. Including teachers who have a certain degree of pedagogical content knowledge in the composition of data teams is important for teachers to be able to use data to improve student learning (Schildkamp et al., 2018).

In working with electronic data systems, data literacy appeared to directly influence teachers' instructional data use in a study in China, and ICT literacy was highlighted as well as it predicted teachers' behavioral intention which then indirectly predicted their instructional data use (Luo et al., 2022). A survey study of over 1000 teachers in upper secondary schools in Switzerland investigating factors impacting teachers' digital data use also found that data literacy was the central predictor (Michos et al., 2023).

Part of a three-year Swedish national program about data-driven school improvement, a mixed-methods study on groups from 15 schools with 115 teachers, principals and administrators revealed that they faced challenges in finding time and resources, having competence to work with data for decision making, experiencing ethical issues, accessing data through digital systems, and having a common language, with the participants' data literacy identified as being the main challenge (Hegestedt et al., 2023). As the study showed that the participants found difficulty in framing the problem and identifying data types that can be used, or had difficulty in attempting to analyze and interpret results from large datasets for projects with broad scopes, the authors recommended that professional development begin with small, well-defined projects with simple analytical methods, and to have teachers and principals explore digital tools for data collection and analysis to simplify the process and allow for insights into trends over time.

Teachers need clear and detailed explanation and support to break down the data-based decision making process at the micro-level and apply it in their specific instructional context (Washburn et al., 2022). Dunlap & Piro cite contextual uses of data as being an advanced level of data literacy awareness for teachers to apply, that goes beyond declarative and procedural knowledge to “an awareness of when to apply data in specific instances” (Dunlap & Piro, 2016, p. 9). Limited data literacy negatively impacts the depth of inquiry of teachers working in data teams (E. Bolhuis et al., 2016).

Organization-Level Factors

Via a review of the literature on school and district data use, Gerzon (2015) proposed a conceptual framework of five elements that can be used by school and district leaders to guide professional learning for data use at schools, addressing areas of focus for training and support. In the Culture of Data Use Framework, leaders need to: (a) communicate professional expectations for data use, (b) provide resources and assistance to make meaning from data, (c) participate in the flow of information for data use, (d) provide professional development on data use knowledge and skills, and (e) provide leadership to nurture a culture of data use. For each element, the author lists considerations for professional learning and “outlines a range of potential strategic actions that can build internal capacity over time” (Gerzon, 2015, p. 19).

In introducing the Data Team Procedure in schools, Schildkamp et al. (2018) describe school organization characteristics as supporting or inhibiting the work of a data team, and list the following as conditions that are essential: shared leadership for teachers to have autonomy to make data-based decisions, support for data teams in aspects such as time, a clear school vision with measurable goals, assistance from an

external coach and possibly also internal support from a data analyst or similar support staff.

Organizational Structure

To support and facilitate a data-informed evaluation culture, schools need to have a systematic approach to teaching and learning that allows reflection on learning objectives, instruction, and learning indicators, which is not necessarily in place at all schools (Andersen, 2020). Schools that lacked a systematic approach to data use at the leadership level led to teachers having a hesitant attitude about the meaningfulness of data use (Rääk et al., 2021). According to Hooglands et al. (2016), there should be a clear organizational structure and routines in place for data use, with adequate provision of professional development, support, time, and resources access.

A qualitative study by Lasater et al. (2021) on 52 educators from eight schools in Arkansas described how the organizational aspects of data use could influence deficit thinking, with three themes highlighted related to: (a) shifting the focus from instruction to accountability measures, (b) viewing students as numbers rather than people, and (c) creating an unsafe professional environment for the teachers related to the use of data. The authors point to the need for leaders to consider these areas for the development of more equitable schools and to “engage in data practices that directly confront deficit thinking within their schools” (Lasater et al., 2021, p. 9).

Organizational routines for data use, particularly the ostensive aspects such as policy and vision for data use were found to be an important factor in the sustained data use of data teams (Hubers et al., 2017). Similarly, Abrams et al. (2021) found that structural features influenced teachers’ data use and described how principals supported data use by communicating clear expectations and implementing specific procedures

such as establishing team meeting structures and routines, creating protocols and templates for data analysis, and setting expectations regarding the time for data use practices.

Accountability

Accountability pressures can have a negative effect on teachers (Hoogland et al., 2016). Performance-based accountability was most significant to teachers' behavioral intention and indirectly influenced their instructional data use (Luo et al., 2022). By teachers being unable to see the connection between classroom and school data, this could lead to having mixed or negative feelings about data and the fear that it could be used for blaming and shaming (Rääk et al., 2021).

Even for pre-service teachers, who are not yet under school-based accountability pressures, their underlying conceptions about the use of achievement data and accountability could eventually lead to inequitable teaching practices, as suggested by findings from a framed field experiment by Jennings (2023), where participants were found to be predisposed to disproportional allocation of resources to students and differentially allocated resources to those students who were either approaching proficiency or closest to the achievement thresholds in scenarios of increased pressures of accountability.

A study by Schildkamp et al. (2017) showed that schools seemed to focus on using data for accountability and school development more than they did for instructional purposes. The authors warned about the dangers of having a strong focus on data use for accountability as it could have some possible negative side effects where schools focus mostly on improving their status. In a qualitative case study using data from the Netherlands and the United States, Schildkamp and Datnow (2022) studied

data teams that had been less successful in contributing to school improvement and found hindering factors similar in both, related to data use being more focused on accountability rather than improvement, which negatively affected the functioning of the data teams and led to issues of trust, resistance, and lack of ownership and willingness of teachers to work in data teams.

School Leadership

“When it comes to creating a culture of data use in districts and schools, leadership and good practice matter” (Data Quality Campaign, 2018, p. 2).

According to Hoogland et al. (2016) school leaders must support data use and need to be data-literate to be able to fully support the school staff in data-based decision making processes. Principal encouragement and support positively impact the frequency of teachers’ collaborative data use (Schramm-Possinger & Harris, 2021).

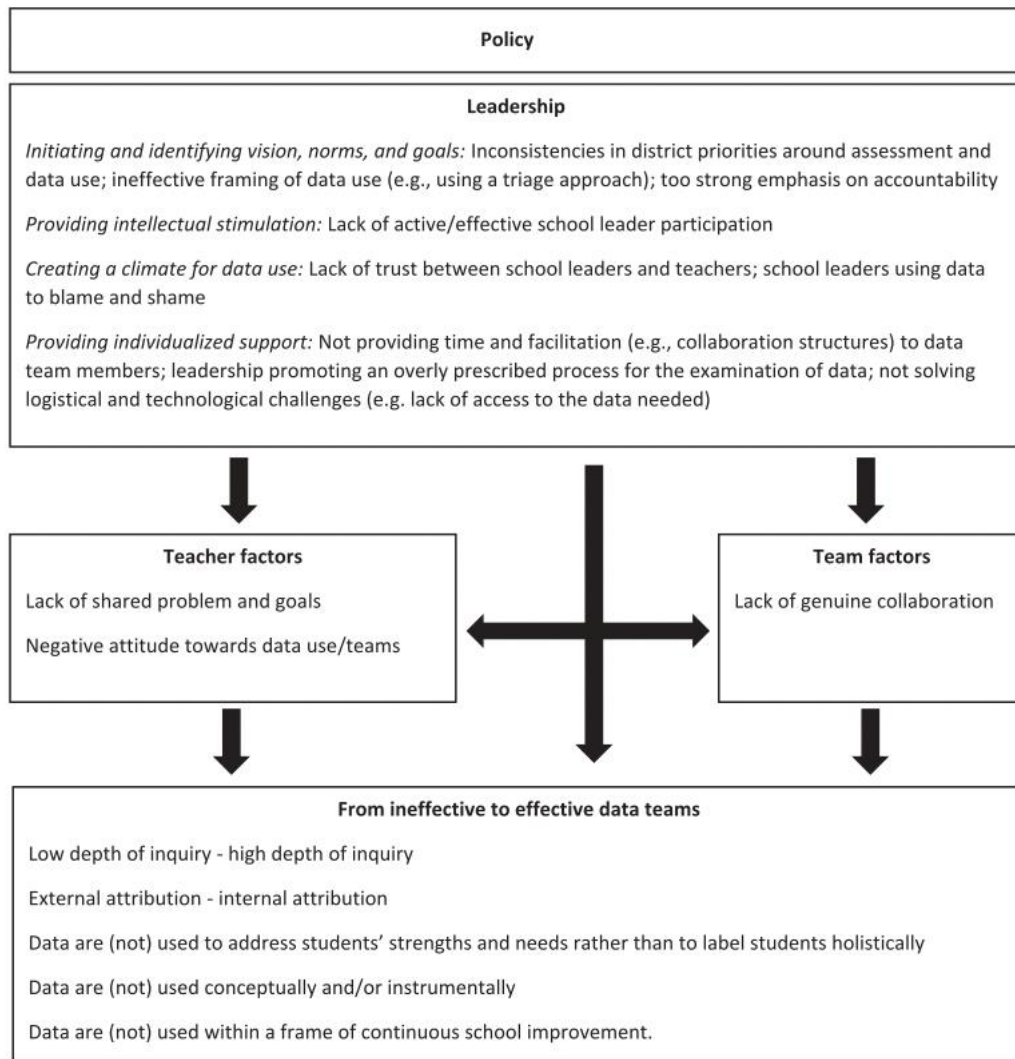
Rääk et al. (2021) highlighted the important role of the school leader in creating and sustaining a collaborative school culture when involving their teachers in school development, whereby schools with vertical leadership practice have more negative attitudes to data and low teacher involvement in data use, with teachers not finding data outside their classroom to be meaningful.

The role of leadership is important in supporting the work of data teams as explained by Schildkamp & Datnow (2022) in the “Interaction of leadership, teacher, and team factors to go from ineffective to effective data teams” (Schildkamp & Datnow, 2022, p. 163) in Figure 14 below, and in helping them become more effective. As described in the figure, within the overarching policy, the role of leadership is crucial in the areas related to having a clear vision, providing intellectual stimulation, creating a climate for data use, and providing individualized support. When these are not present

in the positive forms, and further interact with negative teacher and team factors, the result is ineffective data teams that have low depth of inquiry, external attribution, and that do not use data effectively. On the other hand, when the leadership is present in its positive forms, and helps encourage positive teacher and team factors, the resulting multiple interaction pathways could lead to effective data teams that have high depth of inquiry, internal attribution, and that use data to address students' strengths and needs in the proper manner, within a frame of continuous school improvement.

Figure 14

Interaction of Leadership, Teacher, and Team Factors to Go from Ineffective to Effective Data Teams



Note. This figure describes how the factors relating to leadership, teacher, and team interact to take a data team from being ineffective to being effective. From “When Data Teams Struggle: Learning from Less Successful Data Use Efforts,” by K. Schildkamp and A. Datnow, 2022, *Leadership and Policy in Schools*, 21(2), p. 163. CC BY-NC-ND.

Principals should communicate clear expectations for data use and monitor data use to best support teachers in that aspect (Hubers et al., 2017). Findings from survey data and qualitative interviews in a study by Abrams et al. (2021) suggested that relational trust might be a strong link between data-based instructional practices and the school leadership, with emphasis on communicating rationale and expectations for data use practices. The study described how some school principals applied district-level expectations to cultivate a data use culture at their school, and how they reinforced these expectations by being involved in collaborate data meetings to support teachers and engage in open conversations connecting data use with instructional practices.

In a comprehensive book series on data leadership edited by Mense & Crain-Dorough, several authors contributed to a range of articles describing effective data leadership for K-12 school leaders is using data and in leading the data use process at schools, in what the authors refer to as “a time of accountability, a time where data are prevalent and the use of data is expected” (Mense & Crain-Dorough, 2018, p. xiii). The authors describe the vital role of the school leader to be the data leader, using data with intentionality in various areas, nurturing a culture of data use, and supporting an evidence-based model for school improvement. School leaders need to lead teacher data practices through data teams or professional learning communities, providing data-driven instructional leadership through the data use process, creating systems to build data use capacity and increasing data use efficacy, and leading and supporting data teams in data use.

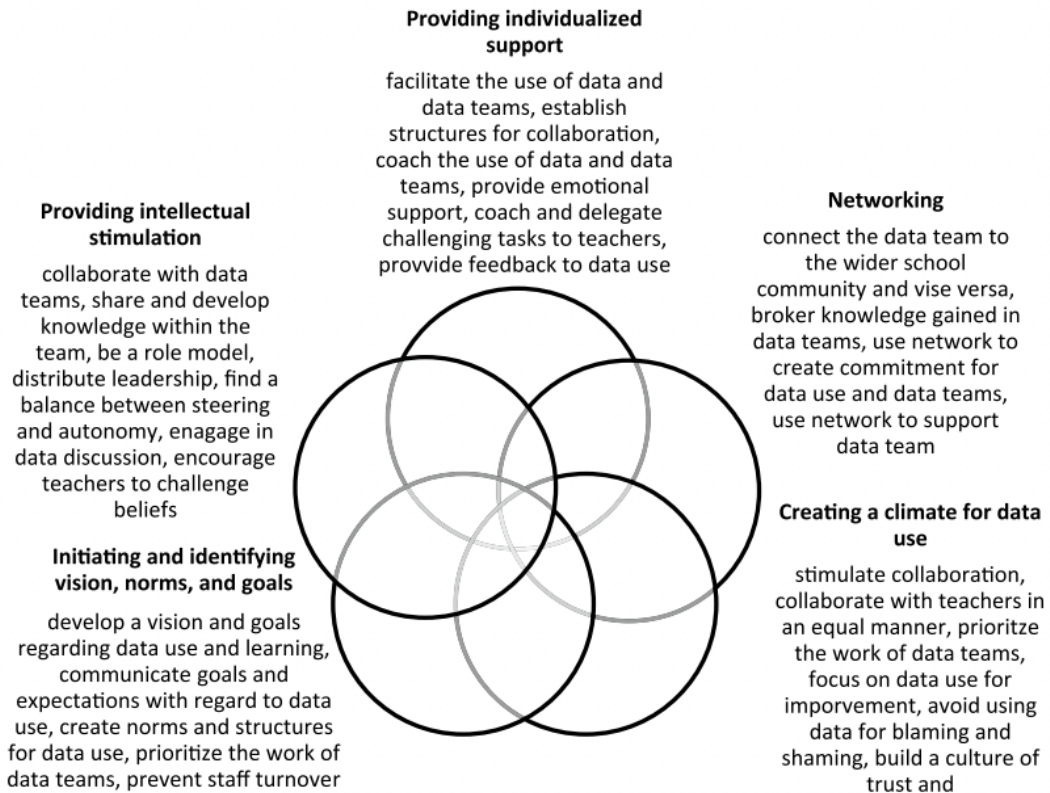
Examining two decades of research on data use in education, Drake (2022) summarized research findings to show how principals support teachers’ data use by: (a) establishing vision, goals, expectations and norms around data use, (b) modeling

effective data use practices, (c) structuring opportunities for teachers to use data, (d) providing time and tools for teachers to use data, (e) providing training, assistance, and professional development for teachers in using data, and (f) developing and facilitating whole school expertise through distributed leadership and teacher teams.

In a longitudinal exploratory multiple case study, Schildkamp et al. (2019) studied the types of formal leadership behaviors for school leaders to build effective data teams and concluded that five “key” and “dynamic building blocks” all are needed for leadership to be transformational and create sustainable data use practices: (1) initiating and identifying a vision, (2) providing individualized support, (3) providing intellectual stimulation, (4) networking, and (5) creating a climate for data use, as depicted in detail in Figure 15 below, the “Leadership behaviors important for data teams” (Schildkamp et al., 2019, p. 321). The authors propose that the “building blocks together can be used in what [they] would like to call a new wave of data-informed decision making in schools, in which teachers and school leaders collaboratively use a multitude of different data sources to improve education” (Schildkamp, Poortman, et al., 2019, p. 321).

Figure 15

Leadership Behaviors Important for Data Teams



Note. This figure describes the interactions between leadership behaviors. From “How school leaders can build effective data teams: Five building blocks for a new wave of data-informed decision making,” by K. Schildkamp, C. L. Poortman, J. Ebbeler, and J. M. Pieters, 2019, *Journal of Educational Change*, 20, p. 321. Copyright 2019 The Author(s).

The evidence from the research presented demonstrates how the role of leadership is crucial in supporting, encouraging, and modeling effective data use practices. Where absent, lacking, or geared in other directions, leadership can equally hinder the data use process, leading to a school climate that is not conducive to effective

data use. Similarly, the presence of strong professional learning communities can play an enabling data use role at schools.

Professional Learning Communities

Focusing on the key role of the school leader in creating data-driven decision making school cultures, Hayes and Lee (in Mense, 2018) proposed practical applications that include the development of professional learning communities (PLCs) which are committed to DDDM and the provision of professional development and experiences to support the teachers in data use to improve learning outcomes.

A systematic literature review by Hoogland et al. (2016) along with focus group meetings with experts and practitioners exploring prerequisites of successful data use in the classroom identified teacher collaboration around the use of data to be essential. Well-structured and facilitated collaboration among teachers is important for increasing student learning (Andersen, 2020). Collaboration influences the effectiveness of data-based decision making by allowing teachers, support staff, and school leaders to share experiences and learn from each other (Hoogland et al., 2016). Supportive relationships among teachers influence their instructional data use and can compensate for the range in skills in ICT literacy and data literacy and help increase self-efficacy in data use, supporting the crucial role of data teams that is suggested by intervention studies (Luo et al., 2022).

Other Organizational Aspects

Other aspects of the organization can also impact data use practices. These include ongoing learning, coaching, adequate time and resources, and accessibility and quality of data, among others.

In its model for essential elements of comprehensive data literacy, the National Center for Systemic Improvement identified support structures that needed to be in place: (a) access to ongoing professional learning, including coaching, (b) supportive infrastructure that allowed for adequate time and resource access, and (c) stakeholder engagement for increased buy-in (NCSI, 2021a). Ansyari et al. (2020) highlighted the significant roles of coaches and so did Bolhuis et al. (2016; E. D. Bolhuis et al., 2016), who suggested that data coaches play an important role in helping data teams develop a knowledge base together, in facilitating the depth of inquiry in conversations of data team members by role modeling, and in giving feedback.

Lack of time has been found to be a significant barrier to effective data use, as even with the availability of beneficial data sources and tools, teachers need sufficient time to explore the data, and reflect on it for data-driven decision making (Albiladi et al., 2020). Access to high quality intervention material and scheduled time for targeted instruction was also highlighted by Washburn et al. (2022).

“Ensuring the quality of data included in the linkages between early childhood and K-12 data systems is critical to building trust in the data used to inform sound decisions in which all stakeholders have confidence” (Data Quality Campaign, 2016, p. 18). In their study Luo et al (2022) found that accessibility of data systems was found to be the most significant factor for the participating teachers’ behavioral intention and indirectly influenced their instructional data use.

Collaborative cloud-based platforms could provide more opportunities for digital data use. Teachers who had access to cloud-based platforms for collaboration showed significant differences in use of digital data and data literacy compared to when they lacked access to these platforms (Michos et al., 2023).

CHAPTER 6

DEVELOPING CAPACITY FOR DATA LITERACY

This chapter explores how data literacy capacity could be developed, citing evidence from the research on various initiatives that were implemented at schools and universities around the world. A selection of higher education teacher preparation initiatives (pre-service level) and professional development interventions around data use implemented at schools (in-service level) has been made based on results that show promising effectiveness. For each, a brief description is provided of context and findings on success of their implementation as cited in the literature, in addition to recommendations made by the researchers to further enhance effective data use. The recommendations provide further research-based evidence of the role of the factors influencing data use as mentioned in the preceding Chapter 5.

Data Literacy Capacity Building

Summarizing research review findings to identify key characteristics of schools with effective data use cultures, Gerzon (2015) listed the need for schools to provide professional learning opportunities that help build data capacity for educators for data and assessment literacy to inform classroom teaching practices, transitioning from identifying and interpreting data to making meaning from evidence and utilizing that to inform instruction.

Mandinach and Gummer (2016) have long called for teachers to be given support to become data literate, all through their journey from pre-service education to in-service professional development. This requires higher education teacher training courses to incorporate data literacy into their programs, as professional development

addresses “only part of the issue” (Mandinach & Gummer, 2016, p. 46). Similarly, Kennedy-Clark et al. (2020) called on teacher education providers to ensure that pre-service teachers develop data fluency by being provided with the sufficient time and resources to develop their skills, with authentic interactions in immersive professional learning experiences that would allow the teachers to follow all the stages of a data research.

Cowie and Cooper (2017) noted the need for developing educators’ mathematical and statistical literacy so that they would be able to understand the range of mathematical and statistical concepts associated with assessment and data literacy, while Bowers (2017) argued that graduate programs in education leadership and administration should not only focus on fundamental statistical research but should also develop data literacy skills that could be applied towards building professional capacity through evidence-based improvement cycles in schools. In a case study by Gonzalez et al. (2022) on 53 aspiring principals who collaboratively developed and implemented school improvement plans through a field experience at a university educational leadership program, the findings showed that there was a need for the candidates to understand the significance and impact of data-driven decisions, and to be able to analyze and present data in ways that could drive the change process.

Through a meta-analysis of 33 studies conducted between 1975 and 2019, Filderman et al. (2021) reported a direct positive impact of data literacy training on both pre-service and in-service K-12 teachers’ data literacy outcomes, with a large average effect on teacher knowledge and skills, and moderate effect on teacher beliefs. Breaking down the belief outcomes further into self-efficacy and the value of data use, the authors reported more negative effects connected to teachers’ beliefs about the value of data

versus their ability to use data, which implies opportunities for development in that area. The authors noted, however, that the rationale behind data use was explicitly targeted in only very few studies, which suggests the possibility of explicit training on the rationale being of support to encourage teachers' data use. Examining what moderates the effects of trainings, findings from the meta-analysis showed that active learning and collective participation had positive moderation effects. Interestingly, the presence of a coach did not moderate effects, which the authors posit to the collaborative component being the more essential one in data literacy training.

A mixed-methods study by Riddles et al. (2017) to determine when best to introduce data literacy training to teachers, at pre-service or in-service stages, showed that participants preferred to learn about data literacy early in their teacher education and to continue to refine their skills as they progress in their education, while having the chance to be exposed to and practice using specific examples from the real world. As a result, the authors proposed the case-based teaching as an effective method to provide for these training needs. "Case-based teaching allows for work with authentic data and provides teacher educators opportunities to teach data-literacy principles using discrete methods that accommodate corrective feedback" (Riddle et al., 2017, p. 133).

Following a systematic literature review on publications issued between 2009 and 2019, Conn et al. (2020) published a resource guide on teaching and assessing data literacy, to be used to support pre-service and in-service teachers. The guide provides a very useful list of explicit instructional resources that can be used to develop training content, with a description of the appropriate levels addressed (early/advanced pre-service/in-service), suggestions for use, time required for implementation, and assessments used. Although the guide provides summary descriptions and limited

reporting of findings on the effectiveness of these instructional resources as depicted in the literature review, the list is nonetheless extremely beneficial as a starting point for researchers and educators to explore the existing data literacy training landscape.

The instructional resources listed in Conn et al. (2020) resource guide include seven listings for pre-service teacher training related to the topics of: (a) probability and statistics for teachers, course-embedded data literacy intervention, and case-based teaching method for early pre-service teachers; and (b) modeling, magnitudes, data and change course, Science inquiry project, data use pedagogical strategy, and data-driven decision making using the CaseMate Tool. For advanced pre-service and early career in-service teachers, the guide lists nine resources: habits of mind, statistical literacy lesson planning task, Data Chat, NAEP Data Explorer application, TISL Hearth Model and Method, data analysis and probability module, data scenarios, statistical literacy workshop, and guided mastery data intervention. Four additional instructional resources are appropriate for early career in-service teachers: professional development standardized testing data intervention, teaching and learning analytics tutorial, data-based decision making intervention, and a school feedback project. Implementation of these resources ranges in time duration from a few hours in single workshops or sessions to two years. The instructional resources cover a range of topic areas related to data literacy, including statistical literacy knowledge and skills, attitudes and beliefs regarding data use, analysis and use of data in collaborative data teams, and using data to inform instructional planning. Assessments used in the listed instructional resources varied from assignments and tasks to surveys and pre- and post- knowledge tests.

Pre-service Data Literacy Training

According to Mandinach & Gummer (2016), providing professional development for teachers in schools to attain data literacy is not enough on its own and preparation must begin much earlier through teacher preparation programs at university.

Several data literacy training courses or programs have been introduced in universities around the world, whether in teacher education and principal training programs, or in courses related to other subject fields or targeting university students in general. Given that such courses might not provide the scope for practical application of data use in the classroom setting, research on data literacy initiatives in teacher education or preparation programs more commonly explores attitudes, prior beliefs, and intent to use data. Attitudes and readiness are considered to be important, as they can influence these teachers' implementation of data practices (Whitesides & Beck, 2020). Inquiring into the effects of a short online data use intervention on motivational beliefs of pre-service teachers, Wurster et al. (2023) found that pre-service teachers reported positive motivational beliefs about data-based decision making after the course.

In an effort to enhance teacher education programs, Schramm-Possinger and Harris (2021) investigated the beliefs and data use practices of 182 K-12 teachers in a variety of schools in southeastern United States. Using the Data Use Survey developed by Wayman et al. in 2016, the authors investigated how the in-service teachers used data in their practice, their beliefs about its use, and the degree and type of support they had in place for data use (Schramm-Possinger & Harris, 2021). Through a principal components analysis, the authors report findings that indicate that an increase in the frequency of teacher data use practices was linked to the increased availability of support and to a culture of trust and respect among the teachers working in the

collaborative data groups, fostered by the presence of social norms. The authors suggest that these findings could help improve both pre-service and in-service teacher data literacy training. For pre-service teacher training the authors propose that authentic scenario-based learning is needed using real-world student data, to be done in collaborative teams and not as individual tasks, so that the teachers will gain the complex social skills that are needed for these interactions. The authors emphasize that such authentic experiences must be structured and development, spread out over time throughout teacher preparation programs. The authors also highlight the importance of pre-service teachers having a strong foundational knowledge in content and pedagogy, as well as in evidence-based instructional practices, so that they avoid relying on intuition when assessing students' knowledge and progress.

In a study to evaluate a virtual data literacy conference in Michigan to develop data literacy as part of information literacy for school librarians and educators, the need was clear for data literacy support and for resources and tools that were readily accessible and easy to implement (Fontichiaro & Johnston, 2020). The virtual conferences were held in the summers of 2016, 2017 and 2018 as two-day events with sessions on various data literacy topics, with 1,730 participants from various career sectors, age ranges, professional experience, and location. The first year focused on concepts of data and statistical knowledge and data visualization; the second year on data management and privacy, big data, and ethical use of data; and the third year on practical implementation tools. The study showed an increase in data confidence (around 70%) for participants, suggesting that the small knowledge increments increased the participants' interest in the subject and openness to further learning.

Almost half of the returning attendees in the second and third years reported increased implementation of data literacy practices.

Over 50 participants enrolled in a pre-service teacher candidate instruction and assessment course in a public university in the United States who completed an embedded instructional intervention called the Data Chat over four sessions had all reported discomfort with data knowledge and the use of data for instruction prior to the intervention (Dunlap & Piro, 2016). Changes in perceptions and beliefs were evident after the intervention, with development in both general and specific skills, related to instruction from data analysis. The authors suggest that data literacy interventions during teacher preparation programs could lead to increased self-efficacy with data use when applied in the professional setting, highlighting that “self-efficacy in data usage is crucial for actually using data in future educational contexts” (Dunlap & Piro, 2016, p. 10). The importance was noted, however, for the need to teach statistical literacy before the Data Chat, and for increased student understanding on how data can inform instruction, and not just be viewed as an accountability measure or a whole school analysis exercise.

Change in perceptions was the focus of a study on 57 pre-service teachers in their final year at a university in Queensland, Australia, after taking a data literacy course that included a 5-week school practicum in which they observed how teachers interpreted and used data (Carey et al., 2018). The study aimed to explore any changes in the pre-service teachers’ perceptions of their data literacy abilities to improve student outcomes, and any changes in their confidence to interpret and use data after completing the course content and then observing it during their school practicum experience. Findings from the pre and post course surveys showed that many student teachers had

initially not been confident to implement data practices and unsure about their data literacy abilities, especially in their prior knowledge and skills to use data towards improving student outcomes. Following the course and practicum, many students reported an increased perception of improvement in basic data literacy knowledge and increased confidence level to interpret and apply data to improve learning outcomes. The authors suggest that such a model might be an effective link between the knowledge and practical components to improve teachers' sense of preparedness to use data, by providing a data literacy university course followed by a practicum and reflection on the teaching and learning process (Carey et al., 2018).

In recognition of the importance of working in collaborative data teams to analyze data to inform instruction, 38 pre-service teachers in the first semester of their senior year at the University of Central Missouri were given the chance to engage in data teams using a mock literacy achievement data set after being provided instruction to analyze achievement data (Danley, 2020). The study showed evidence that the undertaken data literacy initiative helped the teachers to understand how to analyze data sets and provided them with an opportunity to analyze actual sample literacy class data sets. The author suggests the possible benefit of supplementing the data course with modules on teacher communication of achievement scores with students for the purpose of goal setting or student portfolio preparation, and on possible teacher intervention strategies to be applied with students who do not meet the achievement goals.

In an action research framework qualitative study, three pre-service teachers purposefully sampled from a group of 27 teachers participating in a data intervention during a 10-week professional learning experience Australia contributed written reflections and recommendations following the experience (Kennedy-Clark et al.,

2020). The teachers reflected on the importance of developing data literacy skills during authentic professional learning experiences, with the action research element helping develop their confidence in effective teaching skills. The teachers voiced the need for data literacy skills training to be more developed and embedded throughout all stages of teacher training programs to better equip teachers in translating data into information and using that to make data-informed decisions in the classroom. They also highlighted the benefit of mentoring and individual support, and how integrating data collection with existing teaching strategies could help manage time constraints.

Another study grounded in professional learning experience explored the perspectives of 37 pre-service teachers on uses of data to inform their teaching practice, after enrolling in a graduate teacher performance assessment in their final semester at a university in Queensland – a culminating assessment task that includes a focus on data use (McDowall et al., 2021). The authors used Mandinach and Gummer’s DLFT framework, focusing on data use as being the most important domain for the study. Findings suggest that putting data use as the heart of data literacy could help pre-service teachers in their perceptions of preparedness to use data, by connecting the data use to the knowledge components. The authors further propose that teacher education programs must deepen conceptual understandings and include a range of practices around data literacy use, with explicit teaching on how the data can be analyzed to inform teaching.

A case study of pre-service teachers’ perceptions of equity as related to data literacy for teaching while completing an undergraduate, elementary teacher education course at Southwestern State University highlighted the need to focus on equity and equitable data practices in data literacy instruction (Whitesides & Beck, 2020). While

the teachers' understanding of data types developed after the course, they were not always able to identify inequitable data practices. The authors emphasize the need to infuse equity into data literacy for teaching instruction at the preservice level to address the diversity in student populations.

Despite not being addressed only to students enrolled in teacher training programs, another data literacy initiative shows promising results for higher education training. Stemming from their belief in the important role of the librarian in supporting faculty members to provide data literacy instruction to university students, two librarians at Georgetown University Qatar piloted a one-credit course on data visualization and data literacy that combined knowledge on data literacy concepts with hands-on practical application work with data and data visualization software (Usova & Laws, 2021). The rationale behind the project was the awareness of the importance of data literacy instruction for students, while also acknowledging that faculty members themselves have a range of knowledge levels and interest in the technology needed to provide this instruction to students themselves. Considering the role of libraries and librarians in promoting information literacy, this has expanded to “meta-literacy skills, such as data and visual literacy” (Usova & Laws, 2021, p. 85). The course was offered face-to-face over six weeks, with two hours per week and a class size limited to 14 students. Student feedback following completion of the course was very positive, highlighting the skills gained and the benefit of the hands-on approach, leading the authors to suggest that such a model could be effective, especially if taught as a semester-long course and if divided into two different skill-level courses of basic and more advanced. The authors also suggest that librarians could collaborate with faculty

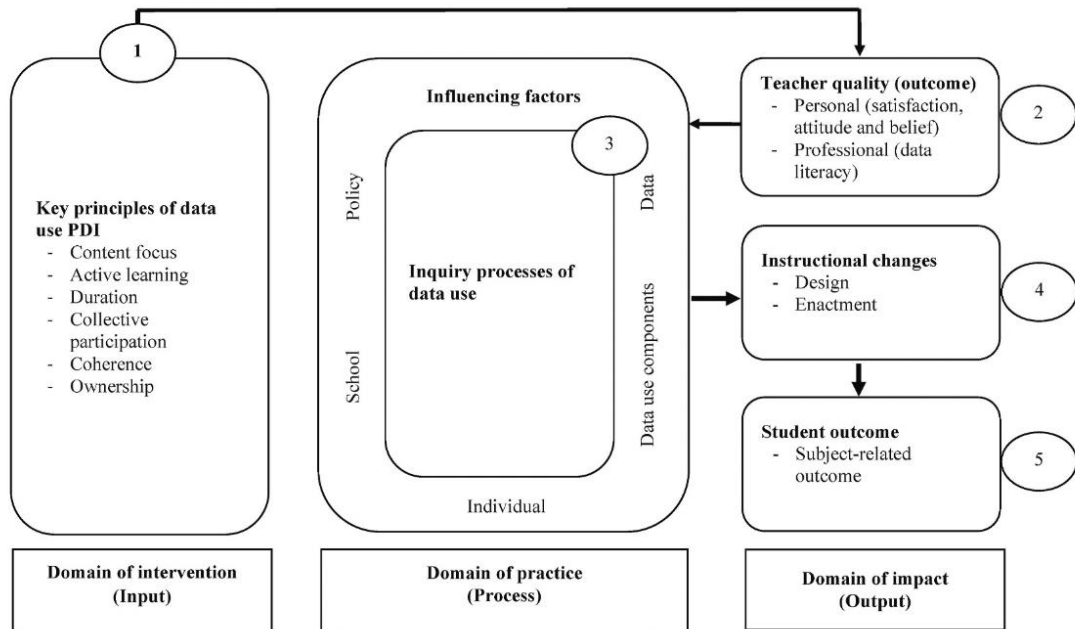
members to integrate this data literacy instruction within course content and co-teach to deliver these components.

In-service Data Literacy Training

A systematic literature review focusing on key features of data use professional development interventions (PDIs), data use practices, and effects on teacher and student outcomes incorporated a framework for evaluating data use PDIs shown in Figure 16 below, titled “Description of pathways from data use PDIs to teacher and student outcomes” (Ansyari et al., 2020, p. 15). Regarding key features, the findings suggest that the PDIs that were comprehensive in their data use included some or all of the following: content focus, active learning, duration, collective participation, coherence, and ownership. Regarding the practice of data use processes, several models follow systematic iterative processes. Effects on teacher outcomes such as data literacy, teacher satisfaction, attitudes, and beliefs were positive. Effects on student outcomes were also positive, but they appeared to be mediated by teacher outcomes, data use practices, and instructional changes. The authors propose that data use PDIs should integrate effective features, incorporate an inquiry process of data use that informs instruction, and be evaluated for impact. In the conceptual framework below, the authors provide their lens for understanding data use PDI pathways and tracking their effects on student outcomes (Ansyari et al., 2020).

Figure 16

Description of Pathways from Data Use PDIs to Teacher and Student Outcomes



Note. This figure describes how data use professional development interventions (PDIs) impact student outcomes and the mediating factors. From “Tracking the process of data use professional development interventions for instructional improvement: A systematic literature review,” by M. F. Ansyari, W. Groot, and K. De Witte, 2020, *Educational Research Review*, 31, p. 15. Copyright 2020 Elsevier Ltd.

Data Literacy Professional Development

A mixed method study examining the outcomes of a professional development program piloted on 28 teachers representing nine teams from six elementary and middle school in the US showed increases in the teachers’ reported data literacy knowledge, and data use confidence and efficacy, with collaboration playing a central role (Abrams et al., 2021). The program was delivered through a three-day summer workshop which introduced the teacher teams to the data use inquiry cycle, engaged them in analyzing

various forms of data from their previous year, and then had them identify a learner-centered question that was to form the base of their data use for the following year. The teams then designed lessons, activities, and an assessment plan revolving around that. The teams received real time support throughout the school year as they worked on their data use cycle. The study also explored the factors that could support data use practices by interviewing 15 school principals, reporting findings on the positive connection between structural school elements such as expectations, policies and routines, and the collaborative team-based data use process. The study highlighted the important role of relational trust among the faculty members and leaders, and that of the leadership at various levels, suggesting that a distributed leadership approach could enhance data use practices. The authors also report findings that suggest that the manner in which principals interacted with the data teams was focused on the practice and process elements of data use, with less focus on communicating how the data use practices connect to the larger school improvement plans. Those principals who had more experience with data use were better able to model evidence-based decision making process and provide more systematic changes to connect the data use practice with school improvement.

To design and implement a professional development series focused on helping primary teachers in data-based decision making in the specific area of reading and supporting struggling readers, a collaborative research project was set up between specialists in literacy and special education, and university researchers and teacher educators at Binghamton University in New York from literacy and special education (Washburn et al., 2022). In Year 1 of the project, which focused on evidence-based instruction and strategies for developing foundational reading skills, 14 school districts

participated with 40 teachers and administrators from K-5 in various team formations. Six workshops were delivered during Year 1, along with two meetings for school administrators. Each participating teacher was asked to choose at least one student from their classroom to act as a focal point to help them learn how to engage in data-based decision making on a small scale first before generalizing to larger groups of students, to build teachers' confidence and capacity in data use. Using a formative and design-based approach, the authors followed a process of creation and refinement for Year 1 of the series to inform subsequent implementation. The authors report three main challenges faced at the micro and macro levels, which led them to refinements in the series, relating to (a) the need to break down the data-based decision making process into more explicit components, (b) the need to create materials specifically to support the teachers in this data process, and (c) the need to identify any barriers that could hinder the teachers' implementation process.

Analyzing data in a longitudinal mixed methods study on a data intervention in teachers' class teams in 11 public schools in Denmark, Anderson (2020) examined changes in attitudes and behaviors in 93 teachers' data use. The two-part intervention involved using a digital learning tool that consists of a game for students and a student learning report for the teacher, as well as a training program for teachers to learn how to use data from that tool in their daily teaching. The training was conducted in three learning loops of three activities each, which gave the teacher the opportunity to design the game items around specific learning objectives of their selection, with students playing the game three times per cycle: at beginning, during, and after the learning cycle. Following that, the teacher was given access to a learning report which they used for a learning dialog with a learning consultant. The study focused on a bottoms-up

strategy to give teachers more ownership of the process, and participation in the intervention was voluntary. Despite that, the findings showed a limited degree of teacher participation in the intervention, with only one third of the teachers using the resulting data. Almost half of the teachers had opted to use the pool of questions available instead of formulating questions for the games themselves based on their teaching. The author cites teachers' beliefs about data and its value for instructional purposes as one of the factors that might have led to this low intervention fidelity. The participating teachers showed distrust of data and relied more heavily on their intuition. The findings from the study highlight the fact that teachers struggle to take instructional actions that are based on data, and that data availability does not necessarily mean data-informed decision making. This shows the need for professional development programs to focus more on supporting teachers in interpreting data to lead to instructional changes, with organizational structures in place to facilitate this process (Andersen, 2020).

The Data Use Intervention

The data use intervention has been explored from different angles in various published studies. As explained earlier in Chapter 4, the intervention is an example of a professional learning community developed by the University of Twente in the Netherlands to support educators in implementing data-based decision making by training them on using data to make decisions that lead to improvement in educational outcomes. In this section, findings reported in four studies on implementation of the structured 8-step data use intervention in the Netherlands will be presented.

Poortman & Schildkamp (2016) studied the effect of a data use intervention on student achievement and reported positive results, with five out of the nine participating

teams solving the achievement problem they had selected – four of which were able to significantly increase student achievement. The data use intervention was undertaken by data teams from Dutch secondary schools, with each team consisting of 4-6 teachers and 1-2 school leaders, and a quality care manager if applicable at the school. The teams work collaboratively to solve a specific student achievement problem that they have selected at their school, meeting every three weeks over two years, and supported by a data coach who helps monitor the process and provide support. The five teams that succeeded implemented corrective measures to address the cause of their problem, ranging from increased student guidance and support to teacher training and modification in scheduling and assessment progress monitoring. The authors thus propose that success could be higher if a subject-focused team explores all three school improvement pillars of curriculum, assessment, and instruction and implement measures accordingly. The four teams that did not succeed in solving their educational problem had not implemented measures within the support period or had not continued with the process after the support had ended. The authors also note that the necessary school organizational characteristics that positively influence the data use intervention may have differed across the schools and hindered the effectiveness of the process.

A mixed-methods quasi-experimental study in secondary schools in the Netherlands on the effects of the data use intervention showed positive results, with participants developing their data literacy skills, showing more positive attitudes towards data use, and reporting satisfaction with the support they received to implement the intervention (Ebbeler et al., 2017). For the study the experimental group consisted of 10 schools with data teams, while the comparison group was 42 schools without data teams. Knowledge tests and data use questionnaires were administered pre and post the

study which spanned around a year and a half. Measurements during the intervention included observations recorded for the data teams and evaluations with an external data coach. Additional instruments included an educator satisfaction questionnaire and semi-structured interviews. Findings from the study show that the data use intervention can contribute to improving data use capacity building, with important elements being that the data is used from the teachers' context with a problem from practice, and that data use is collaborative. The authors emphasize the need to make all the data use steps concrete and explicit. Also important is that data teams share their data literacy skills with other colleagues and not just with their small teams, to influence the sustainable use of data at schools on the long run. Furthermore, the authors note the need for sustained professional development over extended time durations to allow for not just the development of the data literacy skills but for the shift in attitude needed, "because educators need to feel the urge to use data" (Ebbeler et al., 2017, p. 101)

Another mixed-methods study conducted on an intensive data use intervention in six Dutch secondary schools over one year examined the development of the educators' data literacy pre and post intervention through a data literacy test (Kippers et al., 2018). Interviews with participants and notes from the logbook kept by the coach during evaluation meetings also provided feedback on what the educators had learned about data literacy and what they were struggling with. The data teams were subject-focused, with two teams focusing on English, two on Dutch, and the remaining two on Math, each working to solve an educational problem selected for their school. Results from the study showed that the educators' data literacy skills were significantly higher after the data use intervention. Scores on the data literacy post-test overall were significantly higher for four of the five data literacy components assessed: collect data, analyze data,

interpret data, and take instructional action. However, for the first data literacy component – set a purpose – the percentage of correct answers were 30% on the pre-test and 29% on the post-test, showing that educators struggled with setting a concrete purpose. The educators seemed to struggle to formulate a hypothesis regarding the cause of a problem and instead formulated a problem definition or question.

In schools applying the data team intervention, Hubers et al. (2017) investigated factors impacting the sustainability of schools' data use, namely how schools developed organizational routines. A longitudinal mixed-methods exploratory case study on six Dutch secondary schools studied the schools' development of organizational routines over three years, the first two years when a data coach was supporting the data team, and in the year following that, when support was no longer applied. The authors focused on studying four sub-behaviors to determine whether the schools sustained their data use through the data team intervention: (a) continued engagement in the data team intervention, (b) implementation and evaluation of actions for improvement designed by the members of the data teams, (c) using data use for school improvement in general, and (d) using data use for improvement of instruction. The results indicate that schools struggled to develop organizational routines to sustain data use, leading the authors to suggest that this aspect should be more clearly targeted during the data use intervention process. The authors distinguish between the ostensive and performative aspects of organizational routines to indicate sustainability, where the ostensive relate to how behaviors should occur (as evidenced in rules, procedures, norms, and plans), and the performative relate to how they actually take place in practice. Findings show the need for increased focus on the development of the ostensive aspect of organizational routines for data use, as the schools had limited or lacking policy and vision for the

behaviors under study and this remained constant over time. In the absence of clear guidelines to use the data, the authors suggest that this means the performative aspect then becomes heavily reliant on the teachers' capacity for data use, which likely would not lead to sustained school-wide improvements. The authors point to the role of school leaders in nurturing a data use culture and supporting the work of data teams.

In this chapter, the research evidence cited demonstrated how data literacy capacity building can take on various forms of training methodology and initiative implementation. While the modality, duration, and context differed from one initiative to the other, there seems to be promising positive results, of varying degrees, associated with any initiative or intervention. Being immersed in data literacy training or data use in any shape or form could have the potential to impact educators' attitudes and/or knowledge and skills. Any positive development in either of these areas is a step forward for educators in their disposition towards and ability to use data.

As seen by the research methodologies adopted in the studies presented and relating to the factors presented earlier in Chapter 5, building capacity for data use needs to be explored via both its quantitative and qualitative elements, as it cannot be measured solely by data literacy knowledge and skills, but by a change or shift in mindset, attitudes, and dispositions. Changes in beliefs or behaviors require measurement and observations through a qualitative research approach, to complement the quantitative for a more holistic perspective.

The research findings presented in Chapters 3 to 6 have explored the different facts of data literacy for educators and will form the synthesis for the areas that need to be considered by a private school in Lebanon as it considers how best to approach development of data literacy among its educators and creating a data use culture.

CHAPTER 7

FRAMEWORK PROPOSED FOR PRIVATE SCHOOLS IN LEBANON

Chapter seven presents a discussion of the research findings and synthesis towards a framework that could be proposed for consideration and adaptation in the context of private schools in Lebanon to assist them in developing their educators' data literacy capacity and the institution's culture of data use.

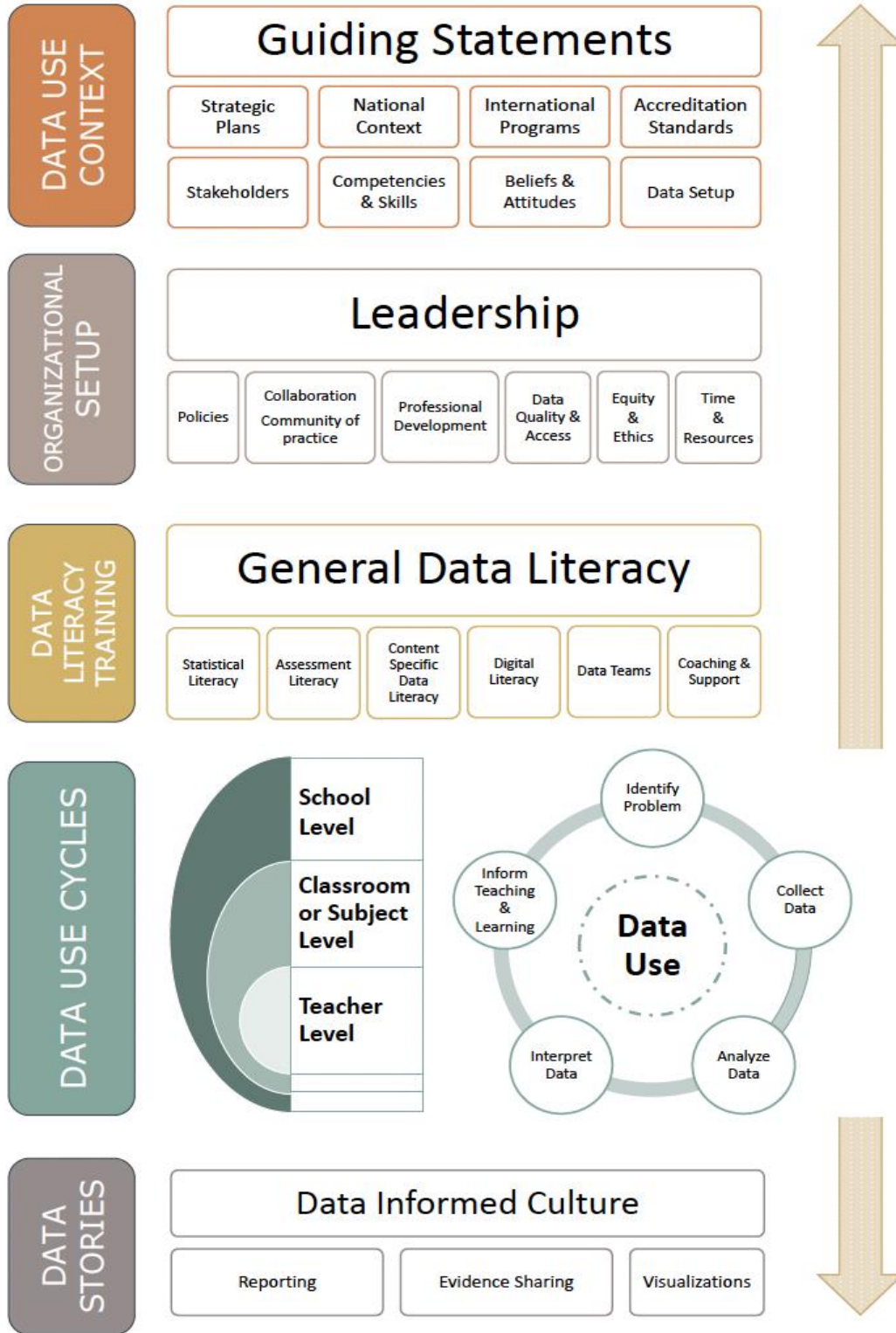
The extensive review undertaken of the research on the topic culminated in the recurring themes from the research-based evidence and practices, which made up the headings and subheadings of Chapters three to six. These themes and subthemes have been synthesized into the elements presented in the framework proposed.

“Understanding disciplinary specific knowledge and practices together with pedagogy are the warp across which the wealth of information from data are woven to illuminate the tapestry of learning” (Mandinach & Gummer, 2016, p. 45). Inspired by this weaving metaphor and the image of a tapestry, the proposed framework suggests that the elements to be considered for data use at a school can be visualized as a tapestry of sorts, represented in Figure 17 below.

A woven tapestry brings together several elements into a broader picture that captures a ‘whole’. Within a tapestry, the use of particular threads, yarn, fabric or other material, in specific quantities and in specific locations and arrangements culminates in a unique ‘whole’. One can give several people the same material, identical weaving looms, and detailed instructions and still get different outputs that do not look identical, just as no two schools are identical even if they essentially are composed of the same elements.

Figure 17

Proposed Data Use Elements Tapestry



The interactions and the dynamics make the fabric of the school dynamically organic. This reiterates the concept of the rhizome and its growth being part of the context and relationships in which it is planted, in relation to knowledge development and how it is shaped by experiences (Kennedy-Clark, 2020).

The tapestry elements are grouped into broader categories to guide schools in their planning, relating to the areas of (a) data use context, (b) organizational setup, (c) data literacy training, (d) data use cycles, and (e) data stories.

Data Use Context

The data use context provides the school with the general direction of its data use towards development, improvement, and accountability.

To determine the context within which a school is considering a data use model, the starting point is examining its **guiding statements** as that determines the desired long-lasting outcomes and impacts for the school. Private schools set their own guiding statements and direction. The vision, the mission, and whatever constitutes its guiding statements, such as guiding principles, values, key definition – all will provide an overarching lens for the school to consider where it currently stands versus where it wants to be. Accordingly, the school can identify problems or frame questions that could drive data use cycles towards improvement. “The strength of most DBDM approaches is that school-specific vision and goals are used to identify a context-specific problem, thereby addressing a real need in the field” (Brown et al., 2017, p. 158). When a data team starts with a problem the school chose, this creates a sense of ownership as they are living the problem every day at school. They can hypothesize about the possible causes, and even use their experiences and intuition along with their

knowledge. Making data-informed decisions can lead to context-specific solutions and context-appropriate actions. (Brown et al., 2017).

The school's **strategic plans** provide goals for the coming period and the indicators with which to measure them. These are usually broken down further into action plans. Both strategic and action plans can provide detailed problem areas to tackle. Having a clear vision for its educational aims, with clear and measurable goals would allow a school to use data to determine which goals have been achieved and which have not, which can be used to being cycles of data use (Schildkamp et al., 2018).

The school's **national context** includes the areas of a school's work that relate to requirements set by the Ministry in terms of curriculum expectations or national examinations as well as its social context, status, and presence as a solid entity in the competitive educational market in the country. These areas could set expectations that would impact some decision making areas to be informed by data.

A private school competing in the Lebanese field looks at the international arena to bring in **international programs** and **accreditation standards** that would help it distinguish itself. Despite the lack of clear information about international programs and their implementation in Lebanon, it is a well-known fact that private schools try to bring in any international component that they can, be it part of a curriculum, or a textbook series, etc. This is especially the case considering that foreign languages are strongly used at all private schools, whether English or French, or even both. Implementing international programs that have their own expectations for assessments and examinations requires the school to constantly reflect on where it stands in comparison to international benchmarks, and that provides impetus for several areas for data use for

improved student achievement outcomes. Accreditation and evaluation models and their standards help structure the work of the organization with clear directions for quality and criteria to measure against. With their iterative cycles of reflection for self-study reports, and external evaluation visits, the accreditation schemes provide a long list of areas that could drive data use cycles, and these do not just focus on curriculum and assessment but extend to cover all other data areas and sources, such as wellbeing, inclusion, global and cultural competence, financial plans, facilities and technology, teacher and staff appraisals, among many others.

The school is its people and the people affecting it. Knowing the school's **stakeholders** and identifying their characteristics, their needs, and their expectations can provide data areas to drive data cycles to ensure that these needs and expectations are being met to the maximum of a school's abilities. This entails knowing the characteristics, needs and expectations of the students, the teachers, the staff, the leadership, the parents, the board of trustees if present, and the community partners. Without grounding it in knowledge of content, students and learning, data use would just be a skill (McDowall et al., 2021).

Knowing its people can help a school understand where its stakeholders stand in terms of **competencies and skills** for data literacy and **beliefs and attitudes** towards data use. The instruments presented in Chapter 4 can be considered to assess these areas, or any similar instruments or combinations of tools. The results would identify the baseline, which itself can drive data use cycles for improvement and inform training needs. It can also help to identify where the school leaders, teachers and staff are on the data literacy continuum suggested by Beck and Nunnaley, so that training is differentiated and so that the educators who have become more proficient in data

literacy can become data leaders in the school community. With the critical role of perceptions in hindering effective data use, knowing how the educators perceive data and its use and make sense of it early on will help to understand the baseline data culture. Affective attitude predicts intention regarding data use, which in turn predicts instructional data use (Prenger & Schildkamp, 2018). Beliefs and attitudes do impact, but they can be reshaped by the data use process (Bertrand & Marsh, 2015). Self-efficacy in data use is crucial (Dunlap & Piro, 2016).

The data use context for a school is impacted by its general **data setup**, as in, what are the types of data that can be collected, at which frequency, from which sources, and through which physical or digital means. The data setup can clarify which data points are to be examined, to help educators avoid being overwhelmed by data overload. Clarity of the data setup is key to ensure that the educators know what data is relevant, how and where to collect it and store it, and how to access it. Any ambiguity in this area is detrimental as it could lead to limited access to the relevant data, poor data collection and storage, and general confusion about the vision for data use and the associated processes.

Once the context of data use has been set and clarified, the school's organizational setup is to be reflected on to consider the factors that could possibly hinder the data use process.

Organizational Setup

Effective data cultures need an organizational setup that would be conducive to data use, with influencing factors acting as enablers rather than inhibitors or disablers. Among these factors, and as clearly evidenced in the research and the results of the professional development interventions, the role of **leadership** is crucial. Leaders at all

levels in the school can facilitate data use and support the decision making process, maintaining its alignment with the needs determined from the data use context elements. Leadership structures also play a role, as the research pointed to the role of distributive leadership in positively influencing data use at schools.

Derived from its overall guiding statements and aims, the school **policies** in place play a role in defining data types, sources, and expectations for data use, which include those for data management. Each school has its set of policies, some of which are specifically required to be in place to meet accreditation standards.

Collaboration is key to the data use process and was a recurrent theme in the literature and findings from professional development interventions. Schools that have professional learning communities as part of its culture fosters collaboration as **community of practice**. Collaboration in data teams enriches the data use. Collaborative data inquiry that allows educators to share together and discuss helps make the intuitive part of the sensemaking process more visible (Vanlommel & Schildkamp, 2019) so that it can be limited in any possible bias. The data use process is not linear, and with different feedback loops that data teams go through, their levels of depth of inquiry go higher (Schildkamp et al., 2016).

Ongoing opportunities for **professional development** are crucial, as clearly evidenced in the research, to develop capacity along the data literacy continuum and to provide training as identified for teachers, leaders, administrators and support staff members to develop the data literacy competencies and skills. Schools need to have professional learning and development as an integral part of their organizational setup to develop their data use capacity.

Data quality and access are essential for educators to be able to make sound decisions. As part of its organizational setup, a school needs to ensure that the data collected is of high quality and that educators are able to access the data via multiple modalities and sources. This is also tightly connected to professional development to help teachers make use of the data. Teachers' having access to high quality data does not actually guarantee the use of this data (Andersen, 2020). Teachers need access to high quality data (DQC, 2016) but if they do not know how to understand and use data, then access to data will not influence teaching and learning (Berglund & Tosh, 2020).

The issues of **equity and ethics** have been brought to the forefront, more so with the need to view the learners in a holistic manner and with the increased availability of digital data. "Adapting an equity lens may well be the most important contribution that the DBDM field can make in education; that is the shift to understanding the whole child, with context and other variables helping to enhance the interpretation of student performance through cultural responsiveness" (Mandinach & Schildkamp, 2020, p. 7). Data needs to be used responsibly. "To be an ethical data user means using the right data in the right ways for the right purposes" (Mandinach & Jimerson, 2021, p. 9). Using ethics scenarios like those presented by Mandinach and Jimerson (2021) could be beneficial for professional learning in a school setting to consider how best to make ethical use of the multitude of data available.

The availability of **time and resources** for educators to engage with data use is essential for the school to plan for. Without proper time available to do this work, and accessible high quality resources that could support in data collection and analysis, the level of inquiry and decision making would remain shallow and superficial, if not altogether limited. Being data literate does not mean being able to effectively use data,

if there is no sufficient time allotted to do so for educators on the individual level or in data teams.

With clarity in data use context and organizational setup to ensure influencing factors play an enabling role in the data use culture, the school can then delve into training its educators on data literacy and other associated literacies, while setting up data teams and a data coaching and support model.

Data Literacy Training

With clear purpose and vision, and a foundational organizational setup, data literacy training involves several elements. Data literacy encompasses understanding data, communicating about data, and using data to make decisions, with a common understanding of data literacy be constructed across all levels of the system (NCSI, 2021a).

Once a school defines what it means for its members to be data literate and identifies their individual needs, **general data literacy** training sessions can provide the essential knowledge needed and begin to develop the skills to progress along the data literacy continuum. Here, for example, Gummer and Mandinach DLFT detailed list could be of use as a reference. Given that teacher training programs at universities in Lebanon cannot be assumed to have prepared the educators to be data literate, schools have to compensate for that and provide the training components that need to be covered at the pre-service level. This could be done during induction sessions before the beginning of the academic years, using data scenarios, for example. Case-based teaching could support data literacy teaching (Riddle, 2017). School-level vignettes could provide case studies that are pertinent to the context that the educators will be working in (Gerzon, 2015).

Foundational **statistical literacy, assessment literacy**, as well as **content specific data literacy** also needs to be provided depending on the individual needs initially assessed. It is important to teach statistical literacy before implementing data use interventions and to help educators connect data to instruction as they develop their understanding of the inter-relation between data, standards, assessment, and instruction (Dunlap & Piro, 2016). Numeracy competency is directly tied to the data literacy challenges for teachers (Conn, 2020). Data literacy needs to be tied to pedagogical content knowledge for teachers to decide on the changes needed in instruction. Teachers need to learn “how to transform data into actionable instructional steps while integrating their knowledge of content and pedagogy (Mandinach & Schildkamp, 2021, p. 7).

Digital literacy is essential for educators in the current digital world and era of datafication. It is important to build teachers’ capacity in use of digital data (Michos, 2023, and to couple ICT literacy skills for electronic data systems use with data literacy skills (Luo, 2022).

The role of **data teams** in the school setting was the topic of various studies showing how effective they can be given the right conditions. Setting up data teams at a school could be done in various capacities and at different levels, with essential agreements established for their operation. The constitution of data teams depends on the needs of the school and the levels of competencies and skills identified in its members. The research has also show that data teams in a distributed or shared leadership model are more effective, especially when given the autonomy needed in the decision making process.

Throughout the training and the data use cycles, educators need to have ongoing **coaching and support** mechanisms in place. This could exist in various forms at a

school, whether in the presence of data coaches or in having staff members as data leaders, or even a combination of both. Coaching and support also do not need to be tied only to individuals formally given titles for that, as every member at the school has a role to play in coaching and supporting others while collaborating around data use. From the research, it was shown that educators need more support in interpreting the data and in connecting the information to inform specific changes in instruction (Anderson, 2020). Sometimes educators are able to describe instructional action that could be taken based on data but might not have the skills to make the changes (Kippers et al., 2018). Support in data use could also be in helping educators see the relevance of the generated data to their everyday practice and knowing what to do with it (Anderson, 2020).

With all the preceding elements considered and established, the school can now actively nurture its data use culture by immersing its educators into iterative cycles of data use at all levels.

Data Use Cycles

Data use cycles are ongoing iterative cycles that can take place at various levels of the school. Data use can happen at the **teacher level**, at the **classroom** or **subject level** in grade-level or subject-level groups of educators, or at the **school level** for larger scopes. Depending on the data use model that the school chooses, such as the ones provided in Chapter 4, the school defines the steps to be taken in the data use cycle. While different frameworks or models detail out the steps in their own way, the overall principles are common, with identifying a problem of practice, collecting, analyzing and interpreting data, and using that to inform changes in teaching and learning. Learning here is not confined to the student level but to all levels of the school as a learning

organization. The cycle involves evaluation of effectiveness for subsequent cycles of data inquiry. Data use is at the heart of data literacy (McDowall et al., 2021). It is with effective data use that a school would be able to properly develop data literacy capacity of its educators.

With data use practices in place within the school's overarching vision and aims for data use, the school can develop its evidence sharing modalities as it presents its data stories and reports on the outcomes of its data use processes.

Data Stories

Data storytelling can bring the elements of the data use tapestry to life in a school setting, by making data stories visible and available to the stakeholders. Sharing data stories highlights the prevalence of data in the school surrounding and displays how it was used to drive decision making. Data stories are themselves evidence of data use. As a school develops its **data informed culture**, it can showcase this through **reporting** to stakeholders and through **evidence sharing** with the community, in the form of **visualizations** or other media. Data visualization strategies can be used to share data and engage stakeholders (NCSI, 2021). Some other examples could be those that D'Ignazio (2017) describes, such as data biographies and data murals.

The data stories feed back into the other elements of the tapestry, as they highlight the results of the data-driven decision making processes and encourage the stakeholders to become more engaged in further practices. The tapestry maintains this dynamic interaction of all the elements, strengthening the data use foundation of the school and continuously developing its data use culture to meet its vision and needs at all times as it steadily improves.

CHAPTER 8

CONCLUDING REMARKS

The final chapter presents limitations, recommendations, implications for research as well as for practice, and conclusion.

Limitations

There are limitations in the selection of the research studies, as the search was confined to particular databases and to a defined range of publication date. As such, there might have been relevant studies that were omitted due to this search process. The published literature on the data use intervention in the Netherlands dominated the geographical distribution of the studies cited. It is unclear whether this is due to the search process itself or to the actual reality of publications on data use since 2015.

Additional limitations pertain to the section providing the information related to Lebanon which relied heavily on personal professional experience and knowledge as an educator in the field, given that research publications on this topic and that of education in general in Lebanon are very limited. The focus on international programs and accreditation in private schools in Lebanon was limited to those in English. The sector of private schools following French models has not been approached in this study, and thus the scope of the programs and accreditations described in Chapter 3 are to be taken only as a small sample.

Implications for Research and Practice

The dearth of literature on Lebanon and the Arab region in general is a strong indicator of the need for researchers and practitioners to undertake research regarding all the aspects of data literacy and data use that were tackled in this study. Each aspect

needs to be examined in the context of schools in Lebanon. This also extends to university education and preparation programs at the undergraduate and graduate levels for school teachers and leaders, to contribute to the knowledge and research base, as well as to consider their role in building capacity at the preservice learning to prepare educators to be at least baseline ready with the necessary knowledge, skills, and attitudes and mindsets. Courses that have practical components or field experiences could also be connected to the data literacy development and data use cycles in developing school improvement plans that are authentic.

In preparing students to be future ready, research on data literacy development for students across the K-12 curriculum is also needed. A continuum of competencies could be mapped into existing curricula and tracked over time.

Private schools in Lebanon have the autonomy to launch their data use journey. Documenting these experiences and using them as case studies or vignettes would help other private schools follow suit in their own development. Having a clear vision for data use would help the school align data use practices with its overall guiding statements of vision, mission, guiding principles, and values to meet the needs of its stakeholders. The international accreditation cycles naturally put schools in the context of continuous reflection in search of evidence, using data of several types and from various sources. Application of international programs or examinations also provide context for regular data use. International examinations do not need to be considered solely in the traditional subject context. While international exams and benchmarks for math, language learning, and science are applied at some private schools in Lebanon, the general international trend towards wellbeing, global citizenship, and international mindedness, can also be considered.

The frameworks, models, and examples of initiatives and interventions described in this research can be used as reference and learning from best practices. While the effectiveness of the interventions varied, it was interesting to note that all the interventions did have some sort of positive impact, even when short in duration, which shows that schools do not need to do a massive reform to reach a point when they can show impact from data use. Small steps can make a difference and any intervention might help, especially in changing perceptions towards the value of data use and self-efficacy. The experience of the Netherlands, where data use interventions were introduced within a national vision to promote data use in all schools, is one that holds a lot of learning and takeaways. As the model from the Netherlands was replicated in other countries, the results showed how the factors that could enable or hinder a team's data use were similar despite the change in context.

Until teacher education programs at universities in Lebanon have developed data literacy capacity in pre-service teachers, schools have to compensate for that and take on the foundational literacy training for the educators they recruit. They also need to build in opportunities for professional learning and development regarding data use along the in-service continuum, with embedded support systems, and help develop data leaders who can themselves facilitate the collaboration, learning, and depth of inquiry of data teams.

The potential of technological systems and tools to provide educators with data in real time, and also over time, holds great promise in the ability to really capture the learning happening and simultaneously find ways to make it better. Building learning portfolios over years makes use of the richness of data and in its use, whether these

portfolios are for the learners, the teachers or leaders, the teams, or the institution itself. Effective data use cultures lead to more stories of learning to tell.

Conclusion

While the tapestry in Figure 17 might seem flat and vertical, it is, in fact, multidimensional. Just like a hung tapestry, the eye is drawn to the various elements in stages of visual attraction and attention. Large elements are as important as the small ones. Elements placed higher up are as important as the ones elsewhere. If one element is taken out, the whole piece changes.










There are no knots at the back of a woven piece as all threads are taken in at the back, interconnecting them with intricately with the rest so that they cannot be seen, and the piece does not unravel. This work at the back is very tedious yet incredibly important. Such is the work done in learning organizations. Solid interweaving of elements ensures a strong foundation, interconnected, interrelated, and even possibly unseen. The absence of knots could signify the absence of a fixed mindset, which is detrimental to a change process. Yet one small thread being out of place can very slowly leave a hole, weakening the piece, and if untended, can make the piece unravel altogether. But if tended, then the organic nature of the piece allows it to be mended and woven back together again, not exactly like it was before, but to something new and maybe even better.

















Data literacy is an essential literacy that needs to be developed at all levels of a learning organization. To become data literate, people and institutions need to use the data and be immersed in iterative cycles for informed decision-making. As private schools in Lebanon take on the challenge of fulfilling their guiding statements and meeting international standards for quality teaching and learning, it is time they embark

on the development of data use in a systematic manner for learning, improvement, and accountability. The framework proposed in this research review can launch conversations within school communities to assess where the school stands in regard to each element, and what its strengths and needs are to best align data use with its vision and mission.

APPENDIX

Bibliography Coding Sample




Rank: Core references, secondary, tangential
 Done
  Very important reference
 Book
  Report/Thesis/Diss.
  Article
  Useful for tools and measurements

#	Rank	Label	Reference
1.		PDI In-service 	Abrams, L. M., Varier, D., & Mehdi, T. (2021). The intersection of school context and teachers' data use practice: Implications for an integrated approach to capacity building. <i>Studies in Educational Evaluation, 69</i> . https://doi.org/10.1016/j.stueduc.2020.100868
2.		Data cultures Factors	Albiladi, W. S., Lasater, K., & Bengtson, E. (2020). Data Use Among Principals and Teachers: Divergent Paths or Common Ground? Implications for the Leadership Preparation Programs. <i>Journal of School Administration Research and Development, 5</i> (2), 63–76. https://doi.org/https://doi.org/10.32674/jsard.v5i2.2240
3.		Factors PDI 	Andersen, I. G. (2020). What went wrong? Examining teachers' data use and instructional decision making through a bottom-up data intervention in Denmark. <i>International Journal of Educational Research, 102</i> . https://doi.org/10.1016/j.ijer.2020.101585
4.	 	Systematic Lit Review PDI	Ansyari, M. F., Groot, W., & de Witte, K. (2020). Tracking the process of data use professional development interventions for instructional improvement: A systematic literature review. <i>Educational Research Review, 31</i> . https://doi.org/10.1016/j.edurev.2020.100362
5.	 	DLFT continuum Factors	Beck, J. S., & Nunnaley, D. (2021). A continuum of data literacy for teaching. <i>Studies in Educational Evaluation, 69</i> , 1-8. https://doi.org/10.1016/j.stueduc.2020.100871
6.		DLFT Factors	Beck, J. S., Morgan, J. J., Brown, N., Whitesides, H., & Riddle, D. R. (2020). "Asking, Learning, Seeking Out": An Exploration of Data Literacy for Teaching. <i>Educational Forum, 84</i> (2), 150–165. https://doi.org/10.1080/00131725.2020.1674438
7.			Berglund, T., & Tosh, K. (2020). <i>Educator Access to and Use of Data Systems</i> . RAND Corporation.
8.		Sensemaking Equity	Bertrand, M., & Marsh, J. A. (2015). Teachers' Sensemaking of Data and Implications for Equity. <i>American Educational Research Journal, 52</i> (5), 861–893. https://doi.org/10.3102/0002831215599251
9.		Data Wise	Bocala, C., & Boudett, K. P. (2015). Teaching Educators habits of Mind for Using Data Wisely. <i>Teachers College Record, 117</i> , 1–20. https://doi.org/10.1177/016146811511700409
10.	 	Data Team Pre-service	Bolhuis, E. D., Schildkamp, K., & Voogt, J. M. (2016). Improving teacher education in the Netherlands: data team as learning team? <i>European Journal of Teacher Education, 39</i> (3), 320–339. https://doi.org/10.1080/02619768.2016.1171313

REFERENCES

- Abrams, L. M., Varier, D., & Mehdi, T. (2021). The intersection of school context and teachers' data use practice: Implications for an integrated approach to capacity building. *Studies in Educational Evaluation, 69*.
<https://doi.org/10.1016/j.stueduc.2020.100868>
- Albiladi, W. S., Lasater, K., & Bengtson, E. (2020). Data Use Among Principals and Teachers: Divergent Paths or Common Ground? Implications for the Leadership Preparation Programs. *Journal of School Administration Research and Development, 5*(2), 63–76. <https://doi.org/https://doi.org/10.32674/jsard.v5i2.2240>
- Andersen, I. G. (2020). What went wrong? Examining teachers' data use and instructional decision making through a bottom-up data intervention in Denmark. *International Journal of Educational Research, 102*.
<https://doi.org/10.1016/j.ijer.2020.101585>
- Ansyari, M. F., Groot, W., & De Witte, K. (2020). Tracking the process of data use professional development interventions for instructional improvement: A systematic literature review. *Educational Research Review, 31*.
<https://doi.org/10.1016/j.edurev.2020.100362>
- Beck, J. S., Morgan, J. J., Brown, N., Whitesides, H., & Riddle, D. R. (2020). “Asking, Learning, Seeking Out”: An Exploration of Data Literacy for Teaching. *Educational Forum, 84*(2), 150–165.
<https://doi.org/10.1080/00131725.2020.1674438>
- Beck, J. S., & Nunnaley, D. (2021). A continuum of data literacy for teaching. *Studies in Educational Evaluation, 69*, 1–8. <https://doi.org/10.1016/j.stueduc.2020.100871>
- Berglund, T., & Tosh, K. (2020). *Educator Access to and Use of Data Systems*.

- Bertrand, M., & Marsh, J. A. (2015). Teachers' Sensemaking of Data and Implications for Equity. *American Educational Research Journal*, 52(5), 861–893.
<https://doi.org/10.3102/0002831215599251>
- Bocala, C., & Boudett, K. P. (2015). Teaching Educators habits of Mind for Using Data Wisely. *Teachers College Record*, 117, 1–20.
<https://doi.org/10.1177/016146811511700409>
- Bolhuis, E. D., Schildkamp, K., & Voogt, J. M. (2016). Improving teacher education in the Netherlands: data team as learning team? *European Journal of Teacher Education*, 39(3), 320–339. <https://doi.org/10.1080/02619768.2016.1171313>
- Bolhuis, E., Schildkamp, K., & Voogt, J. (2016). Data-based decision making in teams: enablers and barriers. *Educational Research and Evaluation*, 22(3–4), 213–233.
<https://doi.org/10.1080/13803611.2016.1247728>
- Bowers, A. J. (2017). Quantitative Research Methods Training in Education Leadership and Administration Preparation Programs as Disciplined Inquiry for Building School Improvement Capacity. *Journal of Research on Leadership Education*, 12(1), 72–96. <https://doi.org/10.1177/1942775116659462>
- Brower, R. L., Mokher, C. G., Bertrand Jones, T., Cox, B. E., & Hu, S. (2020). From Democratic to “Need to Know”: Linking Distributed Leadership to Data Cultures in the Florida College System. *AERA Open*, 6(1), 233285841989906.
<https://doi.org/10.1177/2332858419899065>
- Brown, C., Schildkamp, K., & Hubers, M. D. (2017). Combining the best of two worlds: a conceptual proposal for evidence-informed school improvement. *Educational Research*, 59(2), 154–172.
<https://doi.org/10.1080/00131881.2017.1304327>

- Carey, M., Grainger, P., & Christie, M. (2018). Preparing preservice teachers to be data literate: a Queensland case study. *Asia-Pacific Journal of Teacher Education*, 46(3), 267–278. <https://doi.org/10.1080/1359866X.2017.1402860>
- Center for Educational Research and Development. (2023). النشرة الإحصائية للعام الدراسي ٢٠٢٣-٢٠٢٢ [Statistical Bulletin 2022-2023]. Retrieved from <https://www.crdp.org/sites/default/files/2023-12/Statistical%20Bulletin%202022-2023%20DEC01.pdf>
- Cognia. (2022). *Performance Accreditation Overview*. <https://www.cognia.org/wp-content/uploads/2020/10/Performance-Accreditation-Overview.pdf>
- Conn, C. A., Bohan, K. J., Bies-Hernandez, N. J., Powell, P. J., Sweeny, S. P., Persinger, L. L., & Persinger, J. D. (2022). Expected data literacy knowledge and skills for early career teachers: Perspectives from school and district personnel. *Teaching and Teacher Education*, 111. <https://doi.org/10.1016/j.tate.2021.103607>
- Conn, C., Bohan, K., Bies-Hernandez, N., Powell, P., Luzader, J., Scholz, C., & Frederking, D. (2020). *Teaching and Assessing Data Literacy: Resource Guide for Supporting Pre-Service and In-Service Teachers*.
- Cowie, B., & Cooper, B. (2017). Exploring the challenge of developing student teacher data literacy. *Assessment in Education: Principles, Policy and Practice*, 24(2), 147–163. <https://doi.org/10.1080/0969594X.2016.1225668>
- Cui, Y., Chen, F., Lutsyk, A., Leighton, J. P., & Cutumisu, M. (2023). Data literacy assessments: a systematic literature review. *Assessment in Education: Principles, Policy and Practice*, 30(1), 76–96. <https://doi.org/10.1080/0969594X.2023.2182737>

- Danley, A. J. (2020). Providing Teacher Candidates Experience in Data Teams: Analyzing Literacy Data. *SRATE Journal*, 29(1).
- Data Quality Campaign. (2014). *Teacher Data Literacy: It's About Time A Brief for State Policymakers*. <https://dataqualitycampaign.org/wp-content/uploads/2016/03/DQC-Data-Literacy-Brief.pdf>
- Data Quality Campaign. (2016). *Roadmap for Early Childhood and K-12 Data Linkages: Key Focus Areas to Ensure Quality Implementation Where are we going?*. <https://dataqualitycampaign.org/wp-content/uploads/2016/03/Roadmap-for-Early-Childhood-and-K12-Data-Linkages.pdf>
- Data Quality Campaign. (2018). *Administrator Data Literacy Fosters Student Success*. <https://dataqualitycampaign.org/wp-content/uploads/2018/08/DQC-Admin-Data-Literacy-08102018.pdf>
- D'Ignazio, C. (2017). Creative data literacy: Bridging the gap between the data-haves and data-have nots. *Information Design Journal*, 23(1), 6–18. <https://doi.org/10.1075/idj.23.1.03dig>
- Doğan, E., & Demirbolat, A. O. (2021). Data-driven Decision-Making in Schools Scale: A Study of Validity and Reliability. *International Journal of Curriculum and Instruction*, 13(1), 507–523.
- Drake, T. A. (2022). Principals Using Data: An Integrative Review. *Leadership and Policy in Schools*. <https://doi.org/10.1080/15700763.2022.2036349>
- Dunlap, K., & Piro, J. S. (2016). Diving into data: Developing the capacity for data literacy in teacher education. *Cogent Education*, 3(1). <https://doi.org/10.1080/2331186X.2015.1132526>

- Ebbeler, J., Poortman, C. L., Schildkamp, K., & Pieters, J. M. (2017). The effects of a data use intervention on educators' satisfaction and data literacy. *Educational Assessment, Evaluation and Accountability*, 29(1), 83–105.
<https://doi.org/10.1007/s11092-016-9251-z>
- Filderman, M. J., Toste, J. R., Didion, L., & Peng, P. (2021). Data Literacy Training for K–12 Teachers: A Meta-Analysis of the Effects on Teacher Outcomes. *Remedial and Special Education*. <https://doi.org/10.1177/07419325211054208>
- Fontichiaro, K., & Johnston, M. P. (2020). Rapid shifts in educators' perceptions of data literacy priorities. *Journal of Media Literacy Education*, 12(3), 75–87.
<https://doi.org/10.23860/JMLE-2020-12-3-7>
- Gebre, E. (2022). Conceptions and perspectives of data literacy in secondary education. *British Journal of Educational Technology*, 53(5), 1080–1095.
<https://doi.org/10.1111/bjet.13246>
- Gerzon, N. (2015). Structuring Professional Learning to Develop a Culture of Data Use: Aligning Knowledge From the Field and Research Findings. *Teachers College Record*, 117(4), 1–28.
<https://doi.org/https://doi.org/10.1177/016146811511700407>
- Goffin, E., Janssen, R., & Vanhoof, J. (2022). Teachers' and school leaders' sensemaking of formal achievement data: A conceptual review. *Review of Education*, 10, e334. <https://doi.org/10.1002/rev3.3334>
- Gonzales, M. M., Bickmore, D. L., & Roberts, M. B. (2022). Implementing School Improvement Plans: Perceptions and Implications of Aspiring Principals for Educational Leadership Programs. *Journal of Research on Leadership Education*, 17(2), 160–180. <https://doi.org/10.1177/1942775120964821>

- Gould, R. (2017). Data Literacy is Statistical Literacy. *Statistics Education Research Journal*, 16(1), 22–25. <http://iase-web.org/Publications.php?p=SERJ>
- Grabarek, J., & Kallemeyn, L. M. (2020). Does Teacher Data Use Lead to Improved Student Achievement? A Review of the Empirical Evidence. *Teachers College Record*, 122(12), 1–42.
<https://doi.org/https://doi.org/10.1177/016146812012201201>
- Gummer, E. S., & Mandinach, E. B. (2015). Building a Conceptual Framework for Data Literacy. *Teachers College Record*, 117(4), 1–22.
<https://doi.org/https://doi.org/10.1177/016146811511700401>
- Hamilton, V., Onder, Y., Andzik, N. R., & Reeves, T. D. (2022). Do Data-Driven Decision-Making Efficacy and Anxiety Inventory Scores Mean the Same Thing for Pre-Service and In-Service Teachers? *Journal of Psychoeducational Assessment*, 40(4), 482–498. <https://doi.org/10.1177/07342829211069220>
- Hase, A., Kahnbach, L., Kuhl, P., & Lehr, D. (2022). To use or not to use learning data: A survey study to explain German primary school teachers' usage of data from digital learning platforms for purposes of individualization. *Frontiers in Education*, 7. <https://doi.org/10.3389/educ.2022.920498>
- Hegestedt, R., Nouri, J., Rundquist, R., & Fors, U. (2023). Data-Driven School Improvement and Data-Literacy in K-12: Findings from a Swedish National Program. *International Journal of Emerging Technologies in Learning*, 18(15), 189–208. <https://doi.org/10.3991/ijet.v18i15.37241>
- Ho, J. E. (2022). What counts? The critical role of qualitative data in teachers' decision making. *Evaluation and Program Planning*, 91.
<https://doi.org/10.1016/j.evalprogplan.2021.102046>

- Hoogland, I., Schildkamp, K., van der Kleij, F., Heitink, M., Kippers, W., Veldkamp, B., & Dijkstra, A. M. (2016). Prerequisites for data-based decision making in the classroom: Research evidence and practical illustrations. *Teaching and Teacher Education, 60*, 377–386. <https://doi.org/10.1016/j.tate.2016.07.012>
- Hubers, M. D., Schildkamp, K., Poortman, C. L., & Pieters, J. M. (2017). The quest for sustained data use: Developing organizational routines. *Teaching and Teacher Education, 67*, 509–521. <https://doi.org/10.1016/j.tate.2017.07.007>
- Ifenthaler, D. (2022). A systems perspective on data and analytics for distance education. *Distance Education, 43*(2), 333–341. <https://doi.org/10.1080/01587919.2022.2064828>
- Ifenthaler, D., Gibson, D., Prasse, D., Shimada, A., & Yamada, M. (2021). Putting learning back into learning analytics: actions for policy makers, researchers, and practitioners. *Educational Technology Research and Development, 69*(4), 2131–2150. <https://doi.org/10.1007/s11423-020-09909-8>
- International Baccalaureate Organization. (2018). *Programme standards and practices*. <https://www.ibo.org/globalassets/new-structure/become-an-ib-school/pdfs/programme-standards-and-practices-2020-en.pdf>
- Jennings, A. S. (2023). Uncovering Preservice Teachers’ Conceptions of Achievement and Accountability: Evidence from a Framed Field Experiment. *Action in Teacher Education, 45*(1), 37–51. <https://doi.org/10.1080/01626620.2022.2057372>
- Jimerson, J. B., & Wayman, J. C. (2015). Professional Learning for Using Data: Examining Teacher Needs & Supports. *Teachers College Record, 117*(4), 1–36.
- Kennedy-Clark, S., Galstaun, V., Reimann, P., Martyn, T., Williamson, K., & Weight, J. (2020). Voices on Data Literacy and Initial Teacher Education: Pre-service

- teachers' reflections and recommendations. *Australian Journal of Teacher Education*, 45(7), 60–76. Retrieved from <https://ro.ecu.edu.au/ajte/vol45/iss7/4>
- Kennedy-Clark, S., & Reimann, P. (2022). Knowledge types in initial teacher education: a multi-dimensional approach to developing data literacy and data fluency. *Learning: Research and Practice*, 8(1), 42–58.
<https://doi.org/10.1080/23735082.2021.1957140>
- Kim, M. S., & Yu, F. (2023). 'Teacher data literacies practice' meets 'pedagogical documentation': A scoping review. *Review of Education*, 11(2).
<https://doi.org/10.1002/rev3.3414>
- Kippers, W. B., Poortman, C. L., Schildkamp, K., & Visscher, A. J. (2018). Data literacy: What do educators learn and struggle with during a data use intervention? *Studies in Educational Evaluation*, 56, 21–31.
<https://doi.org/10.1016/j.stueduc.2017.11.001>
- Lasater, K., Bengtson, E., & Albiladi, W. S. (2021). Data use for equity?: How data practices incite deficit thinking in schools. *Studies in Educational Evaluation*, 69.
<https://doi.org/10.1016/j.stueduc.2020.100845>
- Luo, J., Wang, M., & Yu, S. (2022). Exploring the factors influencing teachers' instructional data use with electronic data systems. *Computers and Education*, 191.
<https://doi.org/10.1016/j.compedu.2022.104631>
- Mahmud, M. M., & Wong, S. F. (2022). Stakeholder's Perspectives of the Twenty-First Century Skills. *Frontiers in Education*, 7.
<https://doi.org/10.3389/educ.2022.931488>

- Mandinach, E. B., & Gummer, E. S. (2016a). Every teacher should succeed with data literacy. *Phi Delta Kappan*, 97(8), 43–46.
<https://doi.org/https://doi.org/10.1177/0031721716647018>
- Mandinach, E. B., & Gummer, E. S. (2016b). What does it mean for teachers to be data literate: Laying out the skills, knowledge, and dispositions. *Teaching and Teacher Education*, 60, 366–376. <https://doi.org/10.1016/j.tate.2016.07.011>
- Mandinach, E. B., & Jimerson, J. B. (2021). Data ethics in education: a theoretical, practical, and policy issue. *Studia Paedagogica*, 26(4), 9–26.
<https://doi.org/10.5817/SP2021-4-1>
- Mandinach, E. B., & Schildkamp, K. (2021a). Misconceptions about data-based decision making in education: An exploration of the literature. *Studies in Educational Evaluation*, 69. <https://doi.org/10.1016/j.stueduc.2020.100842>
- Mandinach, E. B., & Schildkamp, K. (2021b). The complexity of data-based decision making: An introduction to the special issue. *Studies in Educational Evaluation*, 69. <https://doi.org/10.1016/j.stueduc.2020.100906>
- McDowall, A., Mills, C., Cawte, K., & Miller, J. (2021). Data use as the heart of data literacy: An exploration of pre-service teachers' data literacy practices in a teaching performance assessment. *Asia-Pacific Journal of Teacher Education*, 49(5), 487–502. <https://doi.org/10.1080/1359866X.2020.1777529>
- Mekhitarian, S. (2022). *Harnessing Formative Data for K-12 Leaders; Real-time Approaches to School Improvement* (1st ed.). Routledge. <https://doi.org/https://doi-org.ezproxy.aub.edu.lb/10.4324/9781003245247>
- Mense, E. G., & Crain-Dorough, M. (Eds). (2018). *Data leadership for K-12 schools in a time of accountability*. IGI Global.

- Mertala, P. (2020). Data (il)literacy education as a hidden curriculum of the datafication of education. *Journal of Media Literacy Education, 12*(3), 30–42.
<https://doi.org/10.23860/JMLE-2020-12-3-4>
- Michos, K., Schmitz, M. L., & Petko, D. (2023). Teachers' data literacy for learning analytics: a central predictor for digital data use in upper secondary schools. *Education and Information Technologies, 28*, 14453–14471.
<https://doi.org/10.1007/s10639-023-11772-y>
- National Center for Systemic Improvement. (2021a). *Essential Elements of Comprehensive Data Literacy*. <https://files.eric.ed.gov/fulltext/ED620527.pdf>
- National Center for Systemic Improvement. (2021b). *NCSI Data Literacy with an Equity Mindset*. <https://files.eric.ed.gov/fulltext/ED613032.pdf>
- Ndukwe, I. G., & Daniel, B. K. (2020). Teaching analytics, value and tools for teacher data literacy: a systematic and tripartite approach. *Ndukwe and Daniel International Journal of Educational Technology in Higher Education, 17*, 22.
<https://doi.org/10.1186/s41239-020-00201-6>
- Papamitsiou, Z., Filippakis, M. E., Poulou, M., Sampson, D., Ifenthaler, D., & Giannakos, M. (2021). Towards an educational data literacy framework: enhancing the profiles of instructional designers and e-tutors of online and blended courses with new competences. *Smart Learning Environments, 8*(1).
<https://doi.org/10.1186/s40561-021-00163-w>
- Poortman, C. L., & Schildkamp, K. (2016). Solving student achievement problems with a data use intervention for teachers. *Teaching and Teacher Education, 60*, 425–433. <https://doi.org/10.1016/j.tate.2016.06.010>

- Prenger, R., & Schildkamp, K. (2018). Data-based decision making for teacher and student learning: a psychological perspective on the role of the teacher. *Educational Psychology, 38*(6), 734–752.
<https://doi.org/10.1080/01443410.2018.1426834>
- Prestigiacomio, R., Hunter, J., Knight, S., Maldonado, R. M., & Lockyer, L. (2020). Data in practice: A participatory approach to understanding pre-service teachers' perspectives. *Australasian Journal of Educational Technology, 36*(6), 107–119.
<https://doi.org/https://doi.org/10.14742/ajet.6388>
- Rääk, K., Eisenschmidt, E., & Tammets, K. (2021). Exploring the Perceptions of Estonian Teachers' Data Use in School Development. *Education Sciences, 11*(6), 262. <https://doi.org/10.3390/educsci11060262>
- Raffaghelli, J. E. (2020). Is Data Literacy a Catalyst of Social Justice? A Response from Nine Data Literacy Initiatives in Higher Education. *Education Sciences, 10*(9), 233. <https://doi.org/10.3390/educsci10090233>
- Reynolds, K. A., Triant, J. H., & Reeves, T. D. (2019). Patterns in how pre-service elementary teachers formulate evidence-based claims about student cognition. *Journal of Education for Teaching, 45*(2), 140–154.
<https://doi.org/10.1080/02607476.2018.1548170>
- Riddle, D. R., Beck, J. S., Morgan, J. J., Brown, N., & Whitesides, H. (2017). Making a case for case-based teaching in data literacy. *Kappa Delta Pi Record, 53*(3), 131–133. <https://doi.org/10.1080/00228958.2017.1334479>
- Roegman, R., Perkins-Williams, R., Budzyn, M., Killian-Tarr, O., & Allen, D. (2022). How Conceptions of Equity Inform Principal Data Use: A Purposeful Examination

- of Principals From Four School Districts. *Educational Administration Quarterly*, 58(2), 183–222. <https://doi.org/10.1177/0013161X211056084>
- Schildkamp, K. (2019). Data-based decision-making for school improvement: Research insights and gaps. *Educational Research*, 61(3), 257–273. <https://doi.org/10.1080/00131881.2019.1625716>
- Schildkamp, K., & Datnow, A. (2022). When Data Teams Struggle: Learning from Less Successful Data Use Efforts. *Leadership and Policy in Schools*, 21(2), 147–166. <https://doi.org/10.1080/15700763.2020.1734630>
- Schildkamp, K., Handelzalts, A., Poortman, C. L., Leusink, H., Meerdink, M., Smit, M., Ebbeler, J., & Hubers, M. D. (2018). *The Data TeamTM Procedure: A Systematic Approach to School Improvement*. Springer International Publishing. <http://www.springer.com/series/13812>
- Schildkamp, K., & Poortman, C. (2015). Factors Influencing the Functioning of Data Teams. *Teachers College Record*, 117(4), 1–42. <https://doi.org/https://doi.org/10.1177/016146811511700403>
- Schildkamp, K., Poortman, C. L., Ebbeler, J., & Pieters, J. M. (2019). How school leaders can build effective data teams: Five building blocks for a new wave of data-informed decision making. *Journal of Educational Change*, 20(3), 283–325. <https://doi.org/10.1007/s10833-019-09345-3>
- Schildkamp, K., Poortman, C. L., & Handelzalts, A. (2016). Data teams for school improvement. *School Effectiveness and School Improvement*, 27(2), 228–254. <https://doi.org/10.1080/09243453.2015.1056192>

- Schildkamp, K., Poortman, C., Luyten, H., & Ebbeler, J. (2017). Factors promoting and hindering data-based decision making in schools. *School Effectiveness and School Improvement, 28*(2), 242–258. <https://doi.org/10.1080/09243453.2016.1256901>
- Schildkamp, K., Smit, M., & Blossing, U. (2019). Professional Development in the Use of Data: From Data to Knowledge in Data Teams. *Scandinavian Journal of Educational Research, 63*(3), 393–411. <https://doi.org/10.1080/00313831.2017.1376350>
- Schramm-Possinger, M., & Harris, L. (2021). Investigating Teacher’s Practices and Beliefs of Data Literacy to Enhance Pre-service Teacher Education. *SRATE Journal, 30*(1), 1–11.
- Trantham, P. S., Sikorski, J., de Ayala, R. J., & Doll, B. (2022). An item response theory and Rasch analysis of the NUDKS: a data literacy scale. *Educational Assessment, Evaluation and Accountability, 34*(1), 113–135. <https://doi.org/10.1007/s11092-021-09372-w>
- Usova, T., & Laws, R. (2021). Teaching a one-credit course on data literacy and data visualisation. *Journal of Information Literacy, 15*(1), 84–95. <https://doi.org/10.11645/15.1.2840>
- Vanlommel, K., & Schildkamp, K. (2019). How Do Teachers Make Sense of Data in the Context of High-Stakes Decision Making? *American Educational Research Journal, 56*(3), 792–821. <https://doi.org/10.3102/0002831218803891>
- Visscher, A. J. (2021). On the value of data-based decision making in education: The evidence from six intervention studies. *Studies in Educational Evaluation, 69*. <https://doi.org/10.1016/j.stueduc.2020.100899>

- Washburn, E. K., Bailey Broome, K., Pierce, A., Stewart Broome, C., Hawley Broome, J., Blackman Broome, J., & Fenty, N. (2022). Collaborative professional development on data-based decision making for primary teachers of struggling readers: Responding and refining. *Journal of Research in Reading, 45*(3), 425–446. <https://doi.org/10.1111/1467-9817.12396>
- Wayman, J. C., Cho, S. B., Mandinach, V., Supovitz, E. B., & Wilkerson, J. C. (2016). *Guide to using the Teacher Data Use Survey*. U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Appalachia. <https://ies.ed.gov/ncee/>
- Whitesides, H., & Beck, J. S. (2020). “There is Subjectivity, There is Bias”: Teacher Candidates’ Perceptions of Equity in Data Literacy for Teaching. *Teacher Educator, 55*(3), 283–299. <https://doi.org/10.1080/08878730.2020.1725792>
- Education in Lebanon. (2024, January 2). In *Wikipedia*. https://en.wikipedia.org/wiki/Education_in_Lebanon
- Wurster, S., Bez, S., & Merk, S. (2023). Does learning how to use data mean being motivated to use it? Effects of a data use intervention on data literacy and motivational beliefs of pre-service teachers. *Learning and Instruction, 88*. <https://doi.org/10.1016/j.learninstruc.2023.101806>
- Yang, N., & Li, T. (2020). How stakeholders’ data literacy contributes to student success in higher education: a goal-oriented analysis. *International Journal of Educational Technology in Higher Education, 17*(Article 41). <https://doi.org/10.1186/s41239-020-00220-3>

