

Education Leadership Data Analytics (ELDA): *A White Paper Report on the 2018 ELDA Summit*

Report Number: ELDA-TC-2019-01

Published February 15, 2019

Teachers College, Columbia University

Authors:

Alex J. Bowers

April Bang

Yilin Pan

Kenneth E. Graves

Note: This work was jointly supported with funding from:

- *Teachers College, Columbia University, Office of the Provost: Provost Investment Fund*
- *National Science Foundation Northeast Big Data Hub – Big Data for Education Spoke*
- *The Robertson Foundation*

Any opinions, findings, and conclusions or recommendations are those of the authors and do not necessarily reflect the views of funding agencies.

Copyright 2019 © the Authors

Acknowledgements:

The authors wish to thank the funders for their generous support of the ELDA Summit 2018 at Teachers College, Columbia University in June of 2018, including the

- Teachers College, Columbia University, Office of the Provost: Provost Investment Fund
- National Science Foundation Northeast Big Data Hub – Big Data for Education Spoke
- The Robertson Foundation

Any opinions, findings, and conclusions or recommendations are those of the authors and do not necessarily reflect the views of funding agencies.

The authors wish to thank the attendees of the ELDA Summit 2018 for their participation, attendance and suggestions.

The authors also wish to thank the Teachers College, Columbia University Smith Learning Theater staff for all of their hard work and logistics support throughout the summit event.

Correspondence concerning this report should be addressed to:

Alex J. Bowers, Ph.D.
Teachers College, Columbia University
Department of Organization and Leadership
525 West 120th, Box 67
New York, New York 10027
Email: Bowers@tc.edu

Education Leadership Data Analytics Research Group: <https://www.tc.columbia.edu/elda/>
Teachers College, Columbia University: <https://www.tc.columbia.edu/>

How to cite this report:

Bowers, A.J., Bang, A., Pan, Y., Graves, K.E. (2019) Education Leadership Data Analytics (ELDA): A White Paper Report on the 2018 ELDA Summit. Teachers College, Columbia University: New York, NY. USA

Education Leadership Data Analytics (ELDA): *A White Paper Report on the 2018 ELDA Summit*

Abstract:

Education Leadership Data Analytics (ELDA) is an emerging domain that is centered at the intersection of education leadership, the use of evidence-based improvement cycles in schools to promote instructional improvement, and education data science. ELDA practitioners work collaboratively with school and district leaders and teachers to analyze, pattern, and visualize previously unknown patterns and information from the vast sets of data collected by schooling organizations, and then integrate findings in easy to understand language and digital tools into collaborative and community-building evidence-based improvement cycles with stakeholders. In June of 2018, over 100 participants gathered for the Education Leadership Data Analytics Summit at Teachers College, Columbia University in New York City, including researchers, practitioners, policymakers, and funders. This report provides a summary of the central issues, themes, and recommendations for the future of the field that emerged from the discussions at the ELDA Summit event. These issues include building capacity in the field through incentivizing researcher practitioner partnerships, and providing conference and networking opportunities, professional development, certification, and ultimately degree programs to train ELDA researchers and practitioners. Additionally, a central focus of the ELDA field is equity, data security and privacy, in concert with open and FAIR data standards to develop and share de-identified data and tools across contexts. We conclude the report with a blueprint of possible skills and competencies needed for ELDA practitioner training and professional development and provide recommendations for next steps to help grow the field.

Keywords: education leadership, evidence-based improvement cycles, education data science, big data, data analytics, data driven decision-making, evidence use.

Purpose and Executive Summary:

The purpose of this report is to provide a summary white paper report on the outcomes from the Education Leadership Data Analytics Summit 2018 at Teachers College, Columbia University. Education Leadership Data Analytics (ELDA) is an emerging domain that intersects the three areas of education leadership, data and evidence use in schools, and data analytics and data science. To learn more about the current conversation and needs in ELDA nationally and globally, and help to build capacity throughout the current and emerging research and practice networks in ELDA, we brought together over one hundred participants for the Education Leadership Data Analytics Summit 2018 at Teachers College, Columbia University in New York City on June 7 and 8, 2018. Through this event, researchers, practitioners, and policymakers came together to discuss and learn more about ELDA, and we gathered their interactions and responses as participants attended poster sessions, panel talks, and an interactive event at the Smith Learning Theater at Teachers College (TC).

In this document, we report on this effort. The gathering yielded multiple exciting areas for the future of the field of ELDA.

First, the domain and market is ripe for more capacity building offerings for teachers, leaders, central office staff, and researchers throughout education. Current offerings do not address all three sectors of ELDA of Education Leadership, Evidence-based improvement cycles, and Data Science. Additionally, offerings that do exist in the market are not accessible and do not address the needs of the market, such as providing professional development and continuing education credit (CEU) style non-credit courses to current school and district leaders on ELDA in an accessible format. Currently, no institutions offer a masters degree in ELDA. However, there is a central job in education of people in schools, districts, states, and nations who “do data” through processing and analyzing school data and then visualizing and working with the educators in their system to leverage that data for instructional improvement. These education data practitioners currently come to their jobs through completely idiosyncratic means, as there is currently no formalized degree or certification path for this career. Yet, every district, state, and nation has someone doing this job, without a network of support and capacity building.

Second, the researchers and practitioners in the nascent field of ELDA recognize that there are strong opportunities to build more capacity at the overlaps of each of the three domains of ELDA. Current work is mostly siloed in the individual domains of education leadership, evidence-based improvement cycles, and education data science. While there is a strong literature and practice base at the intersection of education leadership and evidence-based improvement cycles, there is a strong need for more research, training, and capacity building at the intersections of education leadership and education data science as well as evidence-based improvement cycles and education data science. Indeed, a central need identified in the ELDA domain is a priority on work at the intersection of all three domains, in which the new methods and techniques to visualize, pattern, understand, and communicate data and evidence to leaders and stakeholders from the data science domains is brought together with the current research and practice of education leadership and evidence-based improvement cycles.

Third, participants throughout the gathering identified equity in education as a central priority for ELDA. As the techniques continue to improve around patterning and understanding the large amounts of data collected in schools, teachers and school and district leaders have the opportunity to leverage this data to focus on instructional and system improvement for students and communities that have historically been underserved. The opportunity to understand individualized and personalized educational trajectories and interventions for students provides a unique opportunity to address the individual needs of students through applying the limited resources of schools and districts to those specific needs in a timely manner. Through evidence-based improvement cycles, teachers and leaders can work together to build capacity throughout their organization to leverage these new types of data and analytics as a means to build collaboration, trust, and capacity to improve instruction for each student, and across the organization.

Fourth, issues of data privacy as well as the FAIR and open data and algorithm standards were a central concern for ELDA. Throughout the work of ELDA, student data must be kept secure and private. Protecting data confidentiality and privacy is a core competency within ELDA. Yet, for the field to develop, de-identified and anonymized datasets, case studies, and research sites must be developed and published. To aid in the development of the field, these types of data should follow the FAIR data standards of Findable, Accessible, Interoperable, and Reusable.

Additionally, as algorithms are further developed around this data that can either make recommendations on students, or decisions on students, these algorithms must be open and accessible. As the bulk of this work is paid for by the taxpayer, open source algorithms are the only ethical means to allow school stakeholders to audit and understand how the data are being used, and why a school may select specific recommendations and decisions for students and teachers.

Fifth, evidence from the ELDA summit points to a central need to build capacity, tools, datasets, and networks of researchers and practitioners. A central priority identified for the ELDA field is to build training programs in ELDA, along with digital tools that can first be tested and validated and then shared across the field to help provide the infrastructure needed for ELDA to serve the field and positively impact schooling organizations and ultimately instructional improvement.

In this report we first detail the landscape and domain background for Education Leadership Data Analytics. We then overview and summarize the outcomes from the ELDA Summit. We conclude with an overview of the skills and competencies identified as needed in ELDA for four main roles in schools and districts, and provide additional details around these five main recommendations of this report.

The Domain Landscape of Education Leadership Data Analytics (ELDA)

Contextual Overview and Rationale

Across school districts in the US and globally, schools are inundated with increasing amounts of data (Bowers, Shoho, & Barnett, 2014; Halverson, 2014; Mandinach, Friedman, & Gummer, 2015; Wayman, Shaw, & Cho, 2017). Ever more data flows into schools from accountability systems and testing, to more traditional data such as teacher-assigned grades (Bowers, 2011; Brookhart et al., 2016), discipline reports, and more recently teacher and principal performance evaluation systems (Brocato, Willis, & Dechert, 2014), as well as the growing domain of personalized learning (Agasisti & Bowers, 2017; Bowers, 2016; Halverson et al., 2015; Krumm, Means, & Bienkowski, 2018; Piety, Hickey, & Bishop, 2014). Educators, and especially school and district leaders as well as district central offices and state departments of education, are urged to take advantage of these vast sets of data to help drive decisions to allocate the limited resources of schools to specific student needs with greater accuracy, efficiency and effectiveness (Bowers, 2008, 2017; Coburn & Turner, 2011; Farley-Ripple & Buttram, 2015; Honig & Venkateswaran, 2012; Jimerson & Childs, 2015; Marsh & Farrell, 2015; Schildkamp, Karbautzki, & Vanhoof, 2014; Schildkamp, Poortman, Luyten, & Ebbeler, 2017; Schildkamp, Poortman, & Handelzalts, 2016; Spillane, 2012; Supovitz & Morrison, 2015). Yet, currently for school district and state-level personnel who primarily work with data (“data strategists”), their daily work consists primarily of data reporting for policy compliance (Echeverria et al., 2018; Piety, 2013; Piety et al., 2014; Piety & Pea, 2018). One reason for this compliance focus around data is that nationally, district data strategists have few to no options to acquire training and certification around data use, data integration and management, “e-administration”, data mining, coding, statistics, and most importantly, how to work with management to help leaders build capacity within organizations for evidence-based improvement cycles through conversations using data and evidence (Agasisti & Bowers, 2017; Bowers, 2017). This is despite the strong growth in the last decade in industry, technology and the sciences in big data analytics and the emerging domain of data science (Cope & Kalantzis, 2016; Gandomi & Haider, 2015; Schutt & O’Neil, 2013).

Almost 50 years ago, in 1970, in talking about the use of data for educational leadership, Farmer predicted that “the greatest impact of the quantitative approach” will not be on problem solving, but rather on “problem formulation: the way managers think about their problems—how they size them up, bring new insights to bear on them, relate them to other problems, communicate with other people about them, and gather information for analyzing them” (p. 21). Since then, quantitative methods have become integral to school leadership and management practices as well as in management education (Agasisti & Bowers, 2017; Bowers, 2017). This work draws from the work of Bruno and Fox (1973) in an extensive report commissioned by the University Council for Educational Administration (UCEA) on “Quantitative Analysis in Educational Administrator Preparation Programs.” In their report, the authors reviewed and synthesized the literature and analyzed the “current thought and practice” of their time that was “relevant to the inclusion of quantitative analysis in preparation programs for educational administrators” (p. 2, 1973). The authors also examined how training in these methods could help school administrators address the rising dual demands of accountability and instructional improvement and provided overview summaries on the content of multiple university programs (Bruno & Fox, 1973). Their report provided useful evidence in their time, but the findings of Bruno and Fox (1973) have not been updated over the 40 years following their efforts (Bowers, 2017). Through the present report we

provide an overview of the emerging literature around this topic and work to illuminate new and strengthened evidence as well as learning to further our on-going efforts to enhance leadership and school performance with data and new ways of using data.

Emergence of Data Analytics in Education Leadership

The use of data for decision-making in education is “neither a new topic nor an unknown practice” with “growing awareness dating back to the 1990s [when] school principals, teachers, parents, stakeholders and policymakers started looking at quantitative data as an indispensable source for making decisions, formulating diagnoses about strengths and weaknesses of institutions and assessing the effects of initiatives and policies” (Agasisti & Bowers, 2017). Over the past several decades, quantitative research methods courses in colleges of education have thus become essential in preparing school district administrators and leaders to effectively manage school systems (Agasisti & Bowers, 2017; Bowers, 2017; Bruno & Fox, 1973; Kowalski, McCord, Peterson, Young, & Ellerson, 2011). Brunto and Fox (1973) attribute earlier growing demand for quantitative methods to the accountability movement and the development of new tools and techniques of their time that allowed for “the quantification of information for decision making,” which is otherwise known as “quantitative analysis” (p. 2). Since then, there has been a long tradition of education leadership graduate programs that include at least one quantitative research course alongside other courses deemed necessary for effective leadership in education (Anderson & Reynolds, 2015; Bowers, 2017; Hess & Kelly, 2005; Militello, Gajda, & Bowers, 2009; Thornton & Perreault, 2002). In addition, doctoral PhD or Ed.D. programs in education leadership have been on the rise with increasing numbers of programs and graduates of these programs in the United States (B. D. Baker, Orr, & Young, 2007; Goldring & Schuermann, 2009; Hackmann & McCarthy, 2011). With this rise, quantitative methods courses have continued to be offered and many times taken for granted in university degree programs (Bowers, 2017). Nevertheless, in the last 50 years, and especially so in the last 15 years, the field has seen an increasing trend of growing high-quality education research across domains (Bowers, 2017; Wang & Bowers, 2016; Wang, Bowers, & Fikis, 2016) along with a growing diversity of quantitative methods (Bowers, 2017; Goff & Finch, 2015; Hallinger & Heck, 2011), and the emergence of learning analytics (R. S. Baker & Inventado, 2014; Bienkowski, Feng, & Means, 2012; Piety & Pea, 2018). With the plethora of research published and increasing sophistication of research methods, a central purpose of leadership training has been “to train future school system leaders to become consumers of this work and apply critical thinking and evaluation of analytics to their decisions in their schools on a daily basis” (Bowers, 2017, p. 78).

Bowers (2017) examines the current state of quantitative research methods courses in education leadership and offers useful suggestions for curricula and instructional techniques that can help prepare graduates of education leadership programs use data and research regularly to foster improvement in instruction in schools, while strengthening collaboration between universities and districts. In addition to teaching basic statistics and empirical reasoning, he states that “quantitative methods courses provide an opportunity to build the capacity of school leaders as practitioner-scholars in assessment literacy, data literacy, and how to facilitate and lead building professional capacity through evidence-based improvement cycles” (2017, p. 74). Moreover, he discusses findings from the literature review on the different data and analysis needs of teachers, principals, and superintendents and asserts the need to provide differentiated recommendations for encouraging data use that reflects differing perspectives. Yet, ever more data continues to become

available in schools, while data strategists in districts and states must focus on compliance rather than analysis, understanding, application, and working with school and district leaders to communicate to stakeholders.

In the last decade, we have witnessed strong growth in industry, technology and the sciences in big data, data analytics, and the emerging domain of data science (Cope & Kalantzis, 2016; Donoho, 2015; Gandomi & Haider, 2015; Schutt & O'Neil, 2013). As noted recently by Krumm et al. (2018) “The daily activities of schools and universities— from taking attendance to assessing students— can leave a trail of data that, under the right conditions, can be used to explore teaching and learning like never before.” (p.1). Nevertheless, compliance focus around data persists, while schools and districts remain limited in their capacities to meet the increasing demands to leverage their now abundant data to drive decisions. One reason for this is that nationally, district data strategists have had few to no options to acquire training and certification around data use, data integration and management, “e-administration”, data mining, coding, statistics, and most importantly, how to collaborate and work with management in a way that would help leaders build capacity within organizations for evidence-based improvement cycles that involve conversations using data and evidence (Agasisti & Bowers, 2017; Bowers, 2017; Bowers, Krumm, Feng, & Podkul, 2016). To meet this need, “Organization-Level Data Analytics” or “Education Leadership Data Analytics” (ELDA) has been proposed (Agasisti & Bowers, 2017; Bowers, 2017) as a new domain that would help build the capacity of school and district data strategists as well as school administrators, educational quantitative analysts, research specialists, and data scientists to effectively understand and use data to inform decisions and strengthen collaboration to improve school systems across the United States as well as internationally.

Professional and Academic Rationale for ELDA

Education Leadership Data Analytics (ELDA) is the emerging domain of research, practice, and policy in education that focuses on bringing together three broad domains at the intersection of 1) Education Leadership, 2) Evidence Based Improvement Cycles, and 3) Data Science (see Figure 1).

Education Leadership Data Analytics (ELDA) Definition:

Education Leadership Data Analytics (ELDA) practitioners work collaboratively with schooling system leaders and teachers to analyze, pattern, and visualize previously unknown patterns and information from the vast sets of data collected by schooling organizations, and then integrate findings in easy to understand language and digital tools into collaborative and community-building evidence-based improvement cycles with stakeholders.

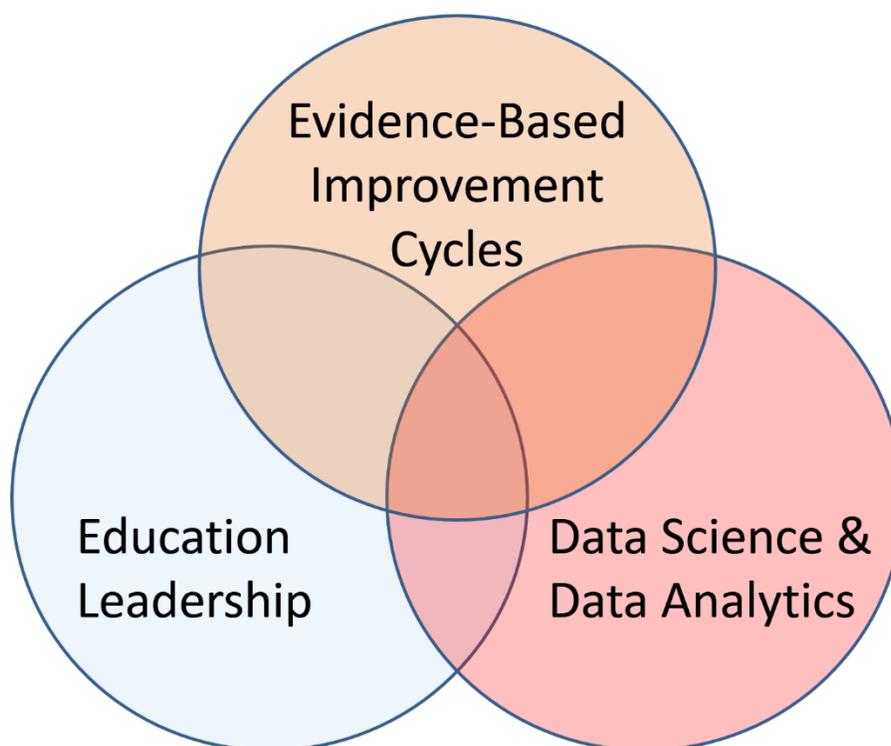


Figure 1: Education Leadership Data Analytics (ELDA) Venn Diagram

Current research in data-driven decision-making and leadership in education has called attention to a significant need for education leaders to develop capacities in these three main areas. On June 8, 2018, the first Education Leadership Data Analytics Summit was held at Teachers College, Columbia University. The Summit was designed to bring together education and research leaders and innovators working at the intersections of individual overlaps of two or three of these three circles in the Venn diagram. The ELDA Summit brought participants together across a wide variety of fields in education. ELDA practitioners work collaboratively with or within schools and districts, know how to facilitate and lead capacity-building conversations with educators using evidence and data to build trust and collaboration, and work with data through code, analytics, data mining and machine learning, and statistics to visualize and pattern data in new and informative ways.

Increased capacity building and training in education preparation programs in data literacy pertain to the training of educators in issues of assessment, measurement, and data use in practice (Mandinach et al., 2015; Mandinach & Gummer, 2013). From the perspective of leadership and evidence-based improvement cycles, the research literature has recently started to shift away from emphasizing data-driven decision making (Bambrick-Santoyo, 2010), where leaders infuse data into their decision-making process, towards more holistic approaches of evidenced-based improvement cycles where school leaders are encouraged to use evidence to develop capacity of teachers within their organization and build a trusting culture in which teachers collaborate and use evidence to help each other improve their instruction (Boudett, City, & Murnane, 2013; Bowers, 2017; Datnow & Hubbard, 2015; Hoogland et al., 2016; Marsh, 2012; Marsh & Farrell, 2015; Schildkamp et al., 2017; Supovitz & Morrison, 2015). These processes have worked to help

organizations move from traditional high inference, low evidence conversations to high evidence, low inference conversations that strengthen capacity for instructional improvement (Agasisti & Bowers, 2017; Bowers et al., 2014).

Recently, we seen the rise of big data analytics to potentially inform education and education decision making (Agasisti & Bowers, 2017; Cope & Kalantzis, 2016; Halverson et al., 2015; Krumm et al., 2018; Piety et al., 2014; Singh et al., 2017). The application of data science to organizational improvement in education (Bowers et al., 2016; Krumm et al., 2018; Piety et al., 2014; Piety & Pea, 2018) refers to the work of analysts who “translate data into knowledge and action through data mining and visualization, but also through interfacing with organizational leaders and stakeholders to inform evidence-based decisions” (Agasisti & Bowers, 2017) (p.187). Through the use of data science, education data mining (EDM), learning analytics (LA), and visual data analytics, the goal of this work with education data is to “make visible data that have heretofore gone unseen, unnoticed, and therefore unactionable” (Bienkowski et al., 2012) (p.ix).

Agasisti and Bowers (2017) identify and suggest concrete steps to further the development of data analytics in education that move beyond data use to the diffusion of analytics in supporting processes of educational decision-making that require strengthened collaboration among actors who make decisions and those who work with data in school systems. In their view:

Despite the rapid growth of attention towards the role of data and quantitative information for exploring and analyzing educational patterns and results, there is still a relevant separation between decision makers (principals and middle managers at the institution level, politicians at the governmental level) and data analysts and researchers (2017) (p.190).

In many ways, research to date indicates that school decision makers are aware of the importance and potential of data, yet do not consider their technical expertise as adequate to use data, while data analysts are satisfied with their technical expertise and work with data without connecting to the practical aspects of managing and improving schools (Agasisti & Bowers, 2017; Krumm et al., 2018). To bridge this disconnect, researchers in this domain have proposed a new role, namely that of the “education data scientist” (Agasisti & Bowers, 2017; Bowers et al., 2016; Cope & Kalantzis, 2016; Krumm et al., 2018; Piety et al., 2014; Piety & Pea, 2018).

Potential Challenges

Integrating data analytics in education leadership, with its incredible potential, will also come with a set of challenges. Researchers have identified and discussed many barriers and impediments to the use of analytics in education (Agasisti & Bowers, 2017; Cope & Kalantzis, 2016; Krumm et al., 2018; Piety et al., 2014; Piety & Pea, 2018). These challenges pertain to the area of ethics, complexity, cost, and school capacity. The problem around ethics is rooted in privacy issues and the potentially intrusive use of data and access to personal information (Agasisti & Bowers, 2017; Cope & Kalantzis, 2016; Ifenthaler & Tracey, 2016; Spector, 2016). The second challenge around complexity is more technical in nature and pertains to the complexity of data and data integration and the need for adequate systems of data storing and organization as well as robust data that is accurate and reliable (Agasisti & Bowers, 2017; Cope & Kalantzis, 2016; Piety et al., 2014). Bruno and Fox (1973) also discuss problems arising from the nature of quantitative analysis for which its

“complexity leads to confusion” (p. 19). Third, introducing and integrating data analytics for decision making in schools is a costly investment that requires building new infrastructure and sufficient resources both human and material (Agasisti & Bowers, 2017; Piety et al., 2014; Wayman, 2005; Wayman, Cho, & Johnston, 2007; Williamson, 2016). Finally, the challenge around school capacity pertains to “whether the various institutions that are interested in developing sophisticated analyses actually have the necessary competences, in terms of technical (analytical) skills of the personnel or, at least, they create conditions for developing them” (Agasisti & Bowers, 2017) (p.203). To address these potential barriers and impediments, Agasisti and Bowers (2017) suggest the use of ethical guidelines, processes and systems to manage increasingly complex data and ensure accuracy, utilization of open access code, and the development and provision of training.

Four domains for Training in ELDA:

As mentioned above, a central concern of the ELDA field is developing training and certification programs in Education Leadership Data Analytics (ELDA) that would build the capacities of various educational actors to effectively use data to inform decisions and strengthen collaboration to improve school systems across the United States as well as internationally. Here we would like to identify who these actors are and how this work in ELDA seeks to address their capacity needs and points of systemic collaboration. Bowers (2017) builds from the work of Bruno and Fox (1973) and identifies at least four different roles in the domain of education leadership and data analytics in schools. These differentiated roles— the first three discussed by Bruno and Fox (1973) and the fourth identified by Bowers (2017)—point to the need for current graduate programs to go beyond training for general school administration to build capacity for effective data-driven decision-making in schools. These roles are further described below and in Figure 2.

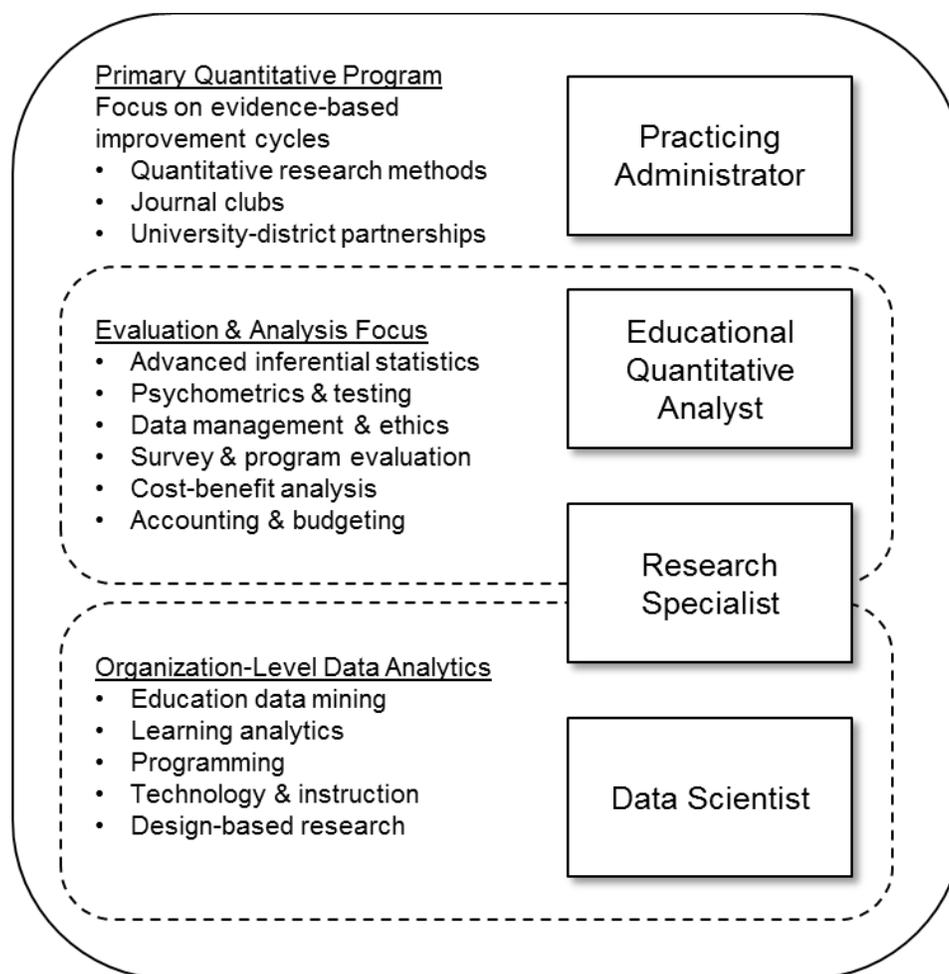


Figure 2. A model for quantitative research methods training in education leadership graduate programs. (from Bowers 2017)

The Practicing Administrator

The “Practicing Administrator,” are current or aspiring superintendents and school administrators for whom traditional quantitative methods courses have been focused on training (Bowers, 2017; Bruno & Fox, 1973). They are the decision-makers who will manage school systems and oversee efforts to improve organizational performance. With respect to efforts in ELDA, this person may already understand the importance of data, even using descriptive data to monitor their school performance, and would need to be trained in how to use data and analytics to make decisions, address problems, and inform evidence-based improvement cycles. This work should be focused on helping the practicing administrator know what types of questions can be asked and adequately answered using advanced data analytics, but also how to integrate those findings into evidence-based improvement cycles. These evidence-based improvement cycles should focus almost exclusively on the practicing administrator having the capacity and skills to facilitate positive collaborative conversations between and among teachers in their organizations in which the evidence is used to build trust, collaboration, and capacity through teachers coming together in evidence-based improvement cycles to improve their specific instruction around issues they identify with their students.

The Educational Quantitative Analyst

The “Educational Quantitative Analyst” is the person who is responsible for using and managing the day-to-day operational management data for the organization (Bowers, 2017; Bruno & Fox, 1973). These include assessment and test reporting to policy makers, enrollment trends and projections, addressing issues of accounting and cost–benefit analysis, searching for efficiencies in the system, analyzing data for bus routes and curriculum scheduling, and collecting data for personnel evaluations. This person focuses on “efficient service management analytics” and may benefit from learning more about how their work fits with the work of other actors in the system and how to strengthen collaboration through data analytics.

The Research Specialist

The “Research Specialist” conducts research on and with the organization, which includes analyzing effectiveness, efficiency, and instructional improvement (Bowers, 2016; Bruno & Fox, 1973). A contemporary example of this type of position could be researchers in organizations such as the University of Chicago Consortium on Chicago School Research (CCSR), a university-district partnership in which core research questions that are of interest to the Chicago Public Schools are addressed by researchers at CCSR through a mutually beneficial collaborative cooperation agreement (Bowers, 2017; Roderick, Easton, & Sebring, 2009). This person “focuses on assessment construction and validation, surveys and program evaluation with an eye towards psychometrics, testing and inferential statistics” (Agasisti & Bowers, 2017) (p.204). Similar to the educational quantitative analyst, this person may benefit from seeing how their work aligns with the work of other actors in the system and how they may strengthen their collaboration through the use of analytics.

The Education Data Scientist

There is a fourth type of quantitative education leadership practitioner-scholar position that has emerged over the last 40 years, the Education Data Scientist. Bowers (2017) uses the following definition of a data scientist from Schutt and O’Neil (2013):

A data scientist is someone who knows how to extract meaning from and interpret data, which requires both tools and methods from statistics and machine learning, as well as being human . . . Once she gets the data into shape, a crucial part is exploratory data analysis, which combines visualization and data sense . . . She’ll find patterns, build models, and algorithms . . . She may design experiments and is a critical part of data-driven decision making. She’ll communicate with team members, engineers, and leadership in clear language and with data visualizations so that even if her colleagues are not immersed in the data themselves, they will understand the implications. (Schutt & O’Neil, 2013, p. 16)

This definition fits with the description from Agasisti and Bowers (2017) and echoes the recommendations of both Cope and Kalantzis (2016) and Piety et al. (2014) to understand the educational data scientist as one who “owns the technical skills to collect, analyze and use quantitative data, and at the same time the managerial and communication skills to interact with decision makers and managers at the school level to individuate good ways of using the

information in the practical way of improving practices and initiatives” (Agasisti & Bowers, 2017) p.190.

Summary:

Together, these four roles of the practicing administrator, education quantitative analyst, research specialist, and education data scientist, make up four different facets of the work of Education Leadership Data Analytics (ELDA) practitioners. Current ELDA practitioners are the people in districts, states, and nations who help to lead their organizations using data and analytics. Put simply, these are the people in each schooling system who everyone knows as the person who “does data”. As noted above, doing this work is a complex task of human interaction and people skills, leadership skills, as well as psychometrics, statistics, evaluation, machine learning, coding, database management, data visualization, and with all education leadership roles, politics. A daunting job to say the least. In sum, while there is an emerging set of research on education data science as well as the ELDA intersection of education leadership, evidence-based improvement cycles, and data science/data analytics, there appears to be an opportunity to provide professional development and capacity training in this field, as the research currently indicates that the field is underserved.

An Example: The Harvard Strategic Data Project

While the research to date discussed above has noted the dearth of training, networking, and professional development activities for these types of education professionals, the Harvard University Strategic Data Project (SDP), is one of the few exceptions and an excellent example of an organized intention to build networking and training capacity in the field. Originally funded through a grant from the Bill and Melinda Gates Foundation, Harvard SDP annually recruits district data strategists who either join as fellows in the program or are already currently working in a state or local education agency (Center for Education Policy Research, n.d.; Hallgren, Pickens Jewell, Kamler, Hartog, & Gothro, 2013). These participants then meet regularly as a cohort during the year long program, are paired with national faculty (not necessarily at Harvard), and work on a data analytics and evidence-use project in their schooling organization that is designed to address a specific data issue or problem. Along with providing data analysis tools, code, and protocols for using data to inform decisions in schooling organizations, Harvard SDP is one of the few national and global opportunities for data strategists to build their skills in their career, as well as network and share practices, code, analytics, and professional development with other likeminded data strategists.

Structure of this Report:

We turn next in this report to an overview of the ELDA Summit 2018 event. We then discuss the outcomes from the summit, provide a blueprint of possible skills and competencies for training ELDA practitioners, and then conclude with recommendations for the field.

Education Leadership Data Analytics Summit 2018

ELDA Summit Overview and Description of the Speakers, Topics, and Event Structure:

On June 7 and 8 of 2018, 130 researchers and practitioners gathered at Teachers College, Columbia University in New York City to network and collaborate around the topic of Education Leadership Data Analytics (ELDA) at the ELDA Summit 2018. As described above, ELDA is an emerging domain that brings together Education Leadership, Evidence-Based Improvement Cycles, and Data Science to help schools, districts, states, and nations put the data they already collect to better use to inform decisions and capacity building of educators through applying big data and data science techniques to education data. The event started with a networking and poster session the evening of June 7 with 25 posters presented on a range of research and practice topics. Then on June 8, participants gathered first in the morning sessions for a keynote address by Andrew Krumm from Digital Promise, discussing his work in personalized learning and evidence use. This was followed by an engaging panel discussion that included representatives from Harvard, IBM Watson, University of Delaware, and the Learning Analytics, Education Quality Assurance, and Education Leadership Data Analytics groups at Teachers College, Columbia University. In the afternoon, participants gathered in the Smith Learning Theater at Teachers College, Columbia University, to network and collaborate in interactive teams where they heard from representatives from MIT, Digital Promise, Rochester City School District, and Fresno Unified School District on current data practices, data visualization, and open and FAIR data practices.

The event brought together researchers, practitioners, funders, and policymakers with nationally-recognized researchers to discuss the challenges and opportunities in this emerging field.

The Twitter event hashtag was #ELDASummit18

<https://twitter.com/search?f=tweets&vertical=default&q=%23ELDASummit18&src=typd>

The agenda for the two-day event was:

Thursday, June 7: Horace Mann 138 & 140

5:00pm - 7:00pm Pre-summit Networking Reception and Poster Presentations

Friday morning, June 8: Milbank Chapel

8:30am - 9:00am Registration

9:00am - 9:15am Welcome Remarks

Mark Anthony Gooden, Christian A. Johnson Endeavor Professor in Education Leadership, Teachers College, Columbia University

9:15am-9:30am Introduction to Education Leadership Data Analytics

Alex J. Bowers, Associate Professor of Education Leadership, Teachers College, Columbia University

9:30am - 10:15am

Keynote: Learning Analytics Goes to School: A Collaborative Approach to Improving Education
Andrew Krumm, Director of Learning Analytics Research at Digital Promise

10:30am-12:00pm

Panel: The Multiple Facets of Education Leadership, Evidence Use, and Data Analytics

- Madhabi Chatterji, Professor of Measurement, Evaluation and Education, Teachers College, Columbia University
- Elizabeth Farley- Ripple, Associate Professor of education and public policy, University of Delaware
- Gary Natriello, Ruth L. Gottesman Professor in Education Research & Professor of Sociology and Education, Department of Human Development at Teachers College, Columbia University
- Miriam Greenberg, Director of Education and Communications, Center for Education Policy Research, Strategic Data Project, Harvard University
- Alex Kaplan, Global Leader, Large Deals, IBM Watson Education
- Kenny Graves, Doctoral Candidate in Education Leadership, Teachers College, Columbia University

Friday noon, June 8: Grace Dodge 177 & 179

12:00pm - 1:30pm Lunch

Friday afternoon, June 8: Smith Learning Theater

1:30pm - 4:45pm Education Leadership Data Analytics Collaborative Workshop

- Alex J. Bowers, Associate Professor of Education Leadership, Teachers College, Columbia University
- Kenny Graves, Doctoral Candidate in Education Leadership, Teachers College, Columbia University
- Quick-Talk visualization and collaborative exemplars
- Andrew Krumm, Director of Learning Analytics Research at Digital Promise
- Amy Nurnberger, Program Head, Data Management Services, Massachusetts Institute of Technology & Adjunct Assistant Professor, Learning Analytics Program, Teachers College, Columbia University
- Jing Che, Senior Research Analyst at Rochester City School District (NY)
- David Jansen, Executive Director, Data Science and Software Systems at Fresno Unified School District

4:45pm – 5:00pm Closing

Alex J. Bowers, Associate Professor of Education Leadership, Teachers College, Columbia University

Poster of Presenters for the ELDA Summit 2018:

EDUCATION LEADERSHIP DATA ANALYTICS SUMMIT 2018



Dr. Mark Anthony Gooden
@gooden_mark
Teachers College,
Columbia University



Dr. Alex J. Bowers
@Alex_J_Bowers
Teachers College,
Columbia University



Dr. Andrew Krumm
@aekrumm
Digital Promise



Dr. Madhabi Chatterji
Teachers College, Columbia
University



Dr. Elizabeth Farley-Ripple
@FarleyRipple
University of Delaware



Dr. Gary Natriello
Teachers College,
Columbia University



Miriam Greenberg
@mirigreenberg
Harvard University



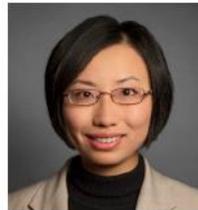
Alex Kaplan
IBM Watson Education



Kenneth E. Graves
@kegice
Teachers College, Columbia
University



Amy Nurnberger
@ANurnberger
MIT



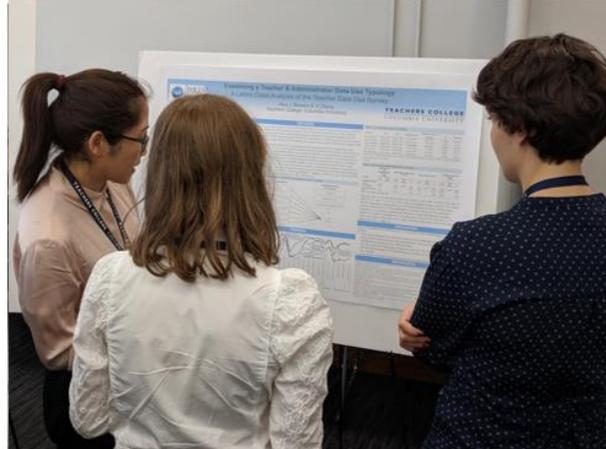
Dr. Jing Che
@genieche
Rochester City School
District



David Jansen
@davidejansen
Fresno Unified School
District

Overall Organization:

The meeting was organized into three parts. First, on the Thursday night, participants were invited to present posters on their work in the ELDA space. For the poster session, we had 25 posters presented with over 60 attendees. For the Friday morning introduction, keynote, and panel discussion, and lunch, we had 120 attendees. The Friday afternoon interactive event in the Smith Learning Theater had 100 attendees (maximum capacity).



Thursday night June 7 poster session



Friday morning opening, introduction, keynote, and panel discussion



Friday afternoon: Smith Learning Theater interactive event

Summit Meeting Intention and Goals:

The workshop/conference kicked off with a pre-reception and poster session for attendees on the night of Thursday June 7 to welcome folks and give all attendees an opportunity to showcase their work and network with other attendees. Then on June 8, we invited speakers from across the country for talks and panels in the morning and afternoon on what ELDA is, and how data analytics, data science, and big data practices that are drawn from "big data for the social good" domains can help inform decision making, leadership, and school evidence-based improvement cycles. In the afternoon, we gathered 100 attendees together for an interactive collaborative session in the Smith Learning Theater, and had them work in 20 teams of 5 to uncover the big issues in the ELDA domain, both in doing the work and in building a pipeline of people to inform the work, with the outcome as research questions, areas of focus, and networking across the teams to build capacity in the domain. The intention of the summit was to have the attendees build their capacity and ideas around ELDA through the poster session and morning keynote and panel discussions, and then mine that information in the collaborative teams in the afternoon in an interactive session where we would network the participants together, and then build the ideas together for what ELDA is and where the field could go.

Topics for the morning session included:

- Mark Gooden, Teachers College, Columbia University – Opening welcome as the Director of the Education Leadership Program at Teachers College, Columbia University, with a focus on how data analytics and data use can help focus schooling organizations on addressing the needs of all children. [https://www.tc.columbia.edu/organization-and-leadership/leadership/](https://www.tc.columbia.edu/organization-and-leadership/education-leadership/)
- Alex Bowers, Teachers College, Columbia University – Opening introduction to ELDA, outlining the Venn diagram of Education Leadership, Evidence-based Improvement Cycles, and Data Analytics/Data Science (Agasisti & Bowers, 2017; Bowers, 2017; Bowers et al., 2016).
- Andrew Krumm, Digital Promise – Keynote address discussing the application of ELDA to personalized learning through discussing his new co-authored book, *Learning Analytics Goes to School: A Collaborative Approach to Improving Education* (Krumm et al., 2018), which details the work through an NSF grant with charter schools in Silicon Valley in California and personalized learning.
- Madhabi Chatterji, Teachers College, Columbia University – Panel discussion on her work on quality assurance in education and her work on the Assessment and Evaluation Research Initiative at Teachers College, Columbia University. <https://www.tc.columbia.edu/aeri/>
- Elizabeth Farley- Ripple, University of Delaware – Panel discussion on her work as co-principal investigator for the Center for Research Use in Education. <http://www.research4schools.org/>

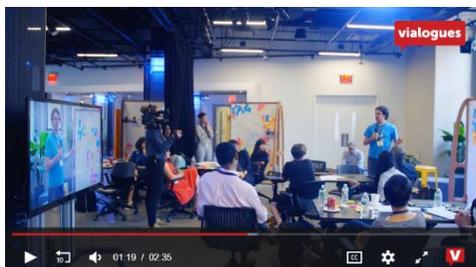
- Gary Natriello, Teachers College, Columbia University – Panel discussion on his work directing the Learning Analytics program at Teachers College, Columbia University. <https://www.tc.columbia.edu/human-development/learning-analytics/>
- Miriam Greenberg, Harvard University – Panel discussion on her work helping to direct the Strategic Data Project at the Center for Education Policy Research. <https://sdp.cepr.harvard.edu/>
- Alex Kaplan - IBM Watson Education – Panel discussion on his work on the role IBM and AI plays in education data science. <https://www.ibm.com/watson/education>
- Kenny Graves, Teachers College, Columbia University – Panel discussion on his work on the intersection of school technology, school leadership, and social justice (Graves & DeLyser, 2017).

Afternoon session in the Teachers College, Columbia University Smith Learning Theater



For the afternoon Learning Theater session, we built upon our experience from previous research and examples using design-based action-oriented interactive events (Finkel, Graves, & DeLyser, 2017), in which first participants were placed into teams of 5 based on their responses to a pre-event registration survey that asked open-ended response items as to their interest in ELDA and their expectations of the event. We had an icebreaker followed by four rounds of quick talks from work “from the field” in which a quick talk speaker gave a 10 minute presentation, and then teams were asked to digest that information together by creating post-it notes that broke down the issues for research and practice around ELDA from what they had just heard.





As an overview of the afternoon Learning Theater session, the following link leads to a two-minute video overview of the event, providing an opportunity to see the collaborative nature of the event.

<http://go.tc.edu/DataAnalyticsSpotlight>

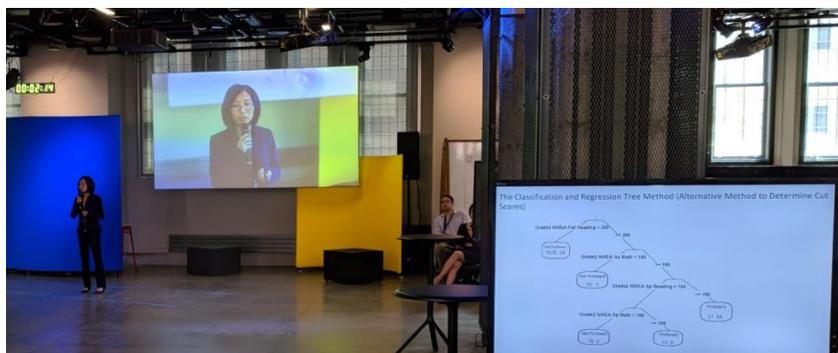
Overview of the Quick Talks:



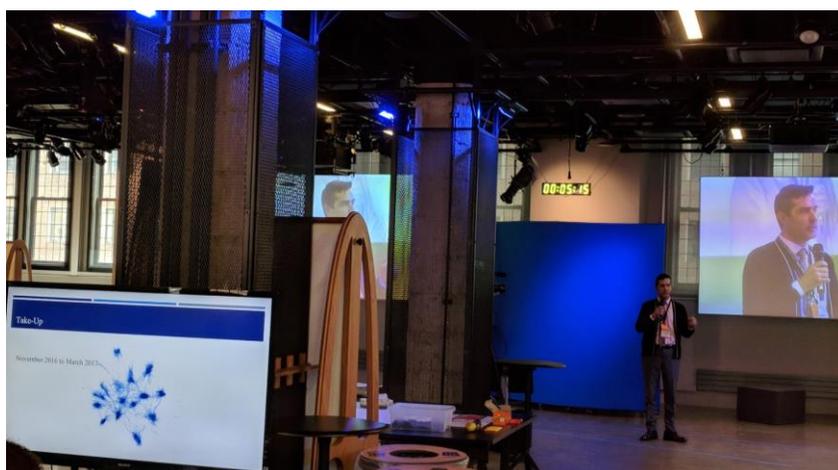
Andrew Krumm, Digital Promise – Providing additional “deep dive” information on how the work was done for his new book in collaboration with personalized learning charter schools, in which he detailed cluster analysis heatmap data dashboard creation and use by school leaders to make decisions (Krumm et al., 2018).



Amy Nurnberger, Massachusetts Institute of Technology – Provided a deep dive on FAIR data standards in education research, that data are Findable, Accessible, Interoperable, and Reuseable. This is the opposite of FOUL data that are Frustrating, Obfuscated, Unmanaged, and Lost (Austin et al., 2017).



Jing Che, Rochester City School District (NY) – Provided a deep dive on using ELDA in practice in Rochester to inform leadership decisions around student at-risk indicators (Che, 2016).



David Jansen, Fresno Unified School District – Provided a deep dive on the student interaction app and system in Fresno that has allowed them to make more informed decisions on student attendance (Garcia Mathewson, 2017).

Once participants had generated multiple post-it notes with ideas for research and practice in ELDA based on the content of each quick-talk, teams then clustered Post-it notes together, labeled clusters, and created topics, questions, and issues in ELDA that were most relevant to them. Teams then placed these topics and questions in two dimensions, priority and possibility, rating each one from 1 to 5, and then graphing them, to understand which issues had the highest possibility and priority.





During this activity, camera crews roamed the room, and displayed the work of individual teams on the big screens as well as multiple large LCD monitors throughout the Learning Theater. In this way, individual teams could see what the other teams were working on, and some information from other teams could make its way across teams through the video displays.



Teams then entered their #1 choice into Polleverywhere so that all teams could see the 20 top priority versus possibility choices. These were then put into a Qualtrics survey in real time, and a Qualtrics online survey was posted for participants to fill out. All participants then completed the survey where they rated each of the 20 ideas/issues/concerns around ELDA on a scale from 1-5 on priority versus possibility. The overall average ratings were displayed in two dimensions on the screens. Teams were given time to discuss what they saw. Then, each table had a location tracking device, called a Quppa device, one for each participant. Participants picked these up, and walked around the room, doing a gallery walk and dropping their device on a table for a team that they wanted to hear more from. The location of each device was displayed on a map of the Learning Theater so that participants could see where the devices piled up. We then did a selective share-out from teams and ended the day with a brief summary and thank-you to the participants, staff, and volunteers.



From this event, participants filled out three different surveys as a means to collect the collective knowledge of the participants in the summit. Participants filled out a registration survey, the Learning Theater real-time possibility versus priority survey, and a post-event survey.

Data Analysis of Participant Summary Survey Responses:

Registration Summary Survey Data Analysis:

Prior to the meeting, attendees filled out a brief registration survey, identifying their job role and industry sector, the coding tools that they use to do their work, as well as writing a few words on open response items about what they thought about ELDA as a field, and their goals for attending the meeting. We analyzed this data in two ways. First, we created counts of registrants and provide the bar graphs below of the percentage of registrants from each job role, field, as well as preferred data analysis tools. Second, we generated a wordcloud to visualize the most frequent words used in the open-ended response items.

In Figures 3 and 4, the percentages of registrants show that the majority of participants were from higher education and were researchers and analysts, mostly studying K-12 and higher education issues. While there were some practitioners, such as teachers and school leaders, practitioners were a group that had low representation at the summit. This issue was noted by a few participants in the post-event survey as well. Interpretation of outcomes from the summit should take this issue into account.

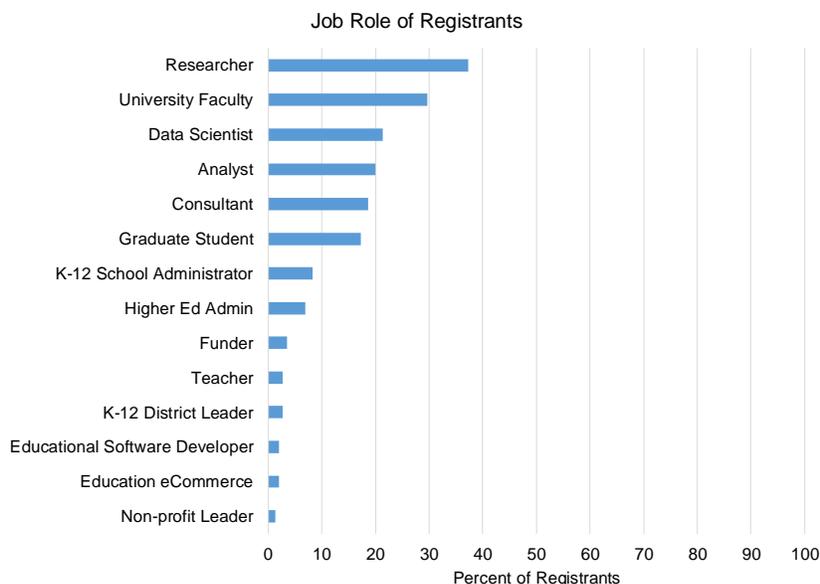


Figure 3: Job role of registrants. In Figure 3, of the 130 registrants, the largest percentage responded that their primary job role was as a researcher or university faculty. This accounted for over 2/3rd of the registrants. Less than 5% of registrants for the summit were teachers or district leaders.

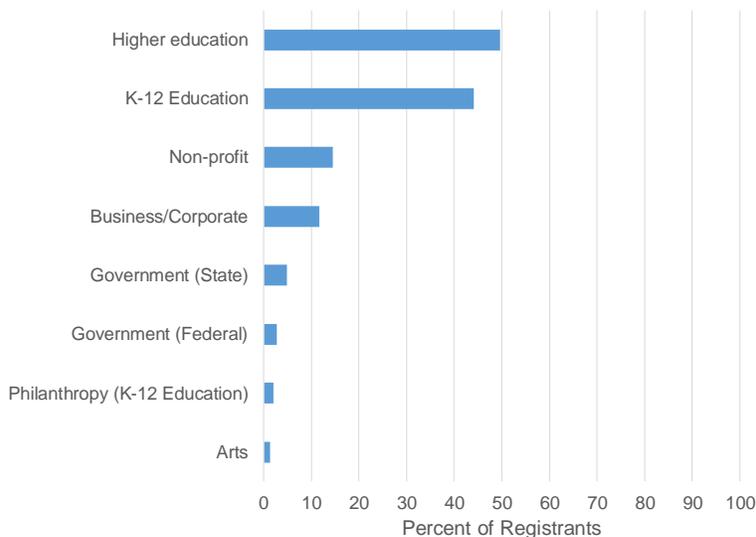


Figure 4: Industry sector of registrants. Figure 4 shows that of the 130 registrants, almost half were in higher education, while over 40% were K-12 education focused.

In Figure 5, we asked what statistical or data analytics software registrants were most proficient using. The results help to understand what people interested in ELDA know as far as software, with the top programs being the open source R statistical software, SPSS, Excel, STATA, and Python. To our knowledge, this is one of the first surveys of software usage in the ELDA or education data sciences field.

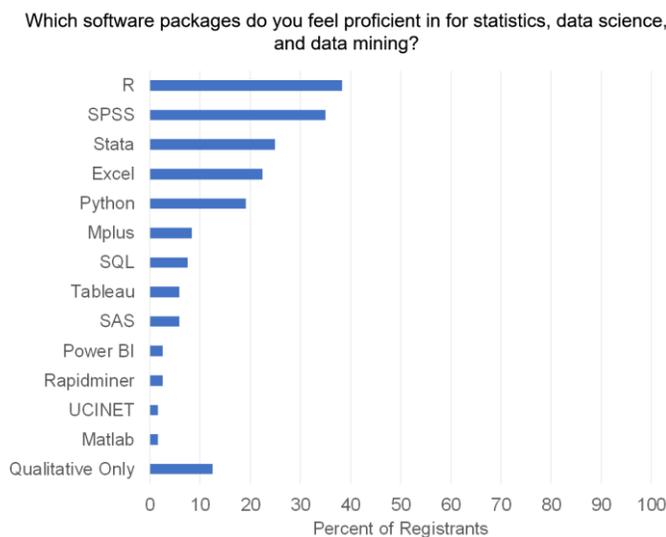


Figure 5: Software packages used by registrants. Of the 130 registrants, the most popular software package used was the open source R statistical software package, followed by SPSS, STATA, and then Excel and Python. Additionally, more than 10% of registrants noted that qualitative research methods were their primary proficiency.

Learning Theater Survey Data Analysis:

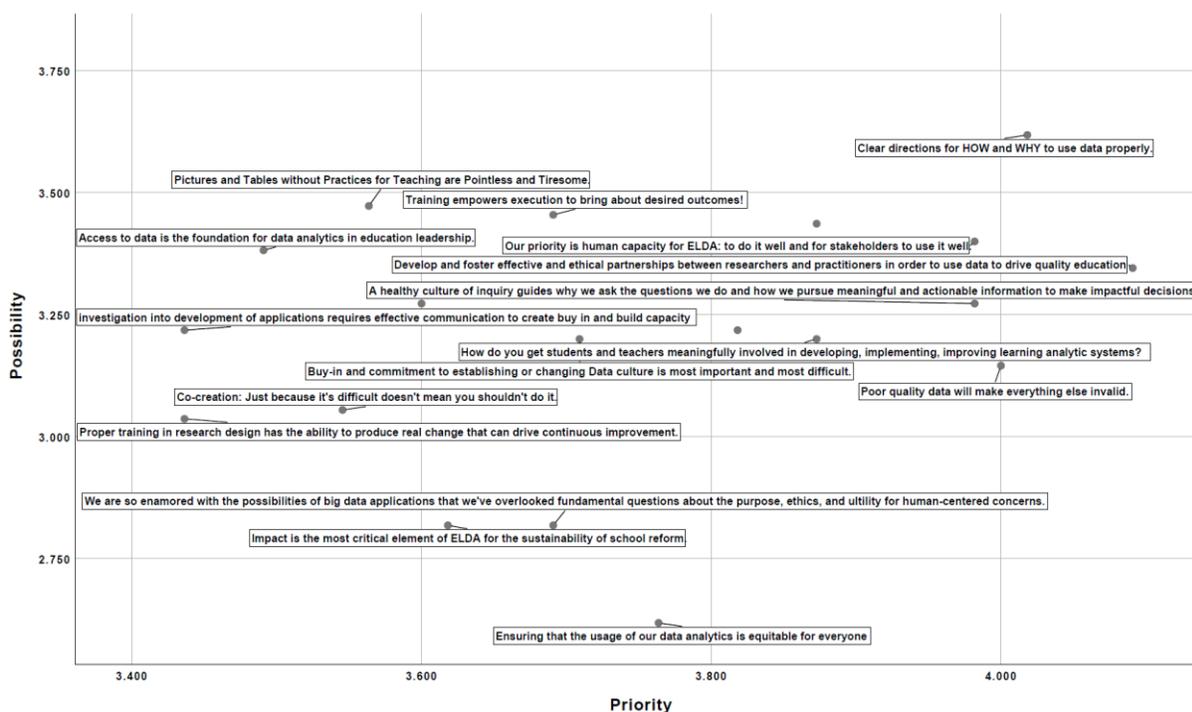


Figure 7: Priority versus Possibility plot from Learning Theater event

As noted above, as part of the Smith Learning Theater interactive afternoon event, each participant rated the ideas/issues/topics that the 20 teams generated from the event from 1-5 (5 being highest) in both priority and possibility dimensions. Figure 7 is the figure that was displayed to the participants during the event. The axis in both the x and y dimensions is shortened to display the topics in a way that makes them readable, as all of the issues cluster into a fairly tight cluster in the upper right of the overall plot, as the cluster is above 2.5 in each dimension. This figure represents the summary averages across all 100 participants for the 20 top identified topics in ELDA.

The goal of this process was to visualize the distribution of what are the highest priority and highest possibility topics, issues, and ideas that surfaced for the participants for the field of ELDA, and capture this information. The top issues in the upper right corner with the highest priority and possibility were:

1. Our priority is human capacity for ELDA: to do it well and for stakeholders to use it well.
2. Data quality and management matter most because without those, nothing good can come from learning analytics.
3. A healthy culture of inquiry guides why we ask the questions we do and how we pursue meaningful and actionable information to make impactful decisions.

The highest priorities regardless of possibility:

1. Develop and foster effective and ethical partnerships between researchers and practitioners in order to use data to drive quality education
2. Clear directions for HOW and WHY to use data properly.
3. Poor quality data will make everything else invalid.

Additionally, the below table provides the average priority and possibility data for each topic ordered by highest to lowest average priority rating.

<i>Description</i>	<i>Priority</i>	<i>Possibility</i>
Develop and foster effective and ethical partnerships between researchers and practitioners in order to use data to drive quality education	4.09	3.35
Clear directions for HOW and WHY to use data properly.	4.02	3.62
Poor quality data will make everything else invalid.	4.00	3.15
Our priority is human capacity for ELDA: to do it well and for stakeholders to use it well.	3.98	3.4
A healthy culture of inquiry guides why we ask the questions we do and how we pursue meaningful and actionable information to make impactful decisions.	3.98	3.27
How do you get students and teachers meaningfully involved in developing, implementing, improving learning analytic systems?	3.87	3.2
Data quality and management matter most because without those, nothing good can come from learning analytics.	3.87	3.44
Without the skills to collect, analyze, interpret, and communicate data, educational improvement is random or uncertain.	3.82	3.22
Ensuring that the usage of our data analytics is equitable for everyone	3.76	2.62
Buy-in and commitment to establishing or changing Data culture is most important and most difficult.	3.71	3.2
Training empowers execution to bring about desired outcomes!	3.69	3.45
We are so enamored with the possibilities of big data applications that we've overlooked fundamental questions about the purpose, ethics, and utility for human-centered concerns.	3.69	2.82
Impact is the most critical element of ELDA for the sustainability of school reform.	3.62	2.82
Sharing (fair) data/ research/thought process/ results is caring for your community of learners.	3.60	3.27
Pictures and Tables without Practices for Teaching are Pointless and Tiresome.	3.56	3.47
Co-creation: Just because it's difficult doesn't mean you shouldn't do it.	3.55	3.05
Access to data is the foundation for data analytics in education leadership.	3.49	3.38
investigation into development of applications requires effective communication to create buy in and build capacity	3.44	3.22
Proper training in research design has the ability to produce real change that can drive continuous improvement.	3.44	3.04

Overall, attendees for the Learning Theater event appear to want ELDA as a field to focus on building capacity in the field, focusing on data quality and data management, and building a culture of inquiry in schools, with additional areas of focus that include ethical and useful researcher practitioner partnerships, clear directions on data use, and a focus on ensuring data quality. These are central issues to consider in any professional development offerings to the ELDA field.

Post-Event Summary Survey Data Analysis:

A few days after the conclusion of the event, participants were sent a Qualtrics post-event survey by email. There were 47 respondents from 130 participants for a 36% response rate. Across the survey, participants responded that they were very satisfied by the overall event, and found others to network with in the field throughout the event.

In Figure 8 below, participants rated the central issues for the ELDA field from not important to very important. The top five most important areas were “hearing from practitioners”, “capacity building and training for practitioners”, “evidence-based improvement cycles/data use”, “data science/data analytics”, and “hearing about research practice partnerships”.

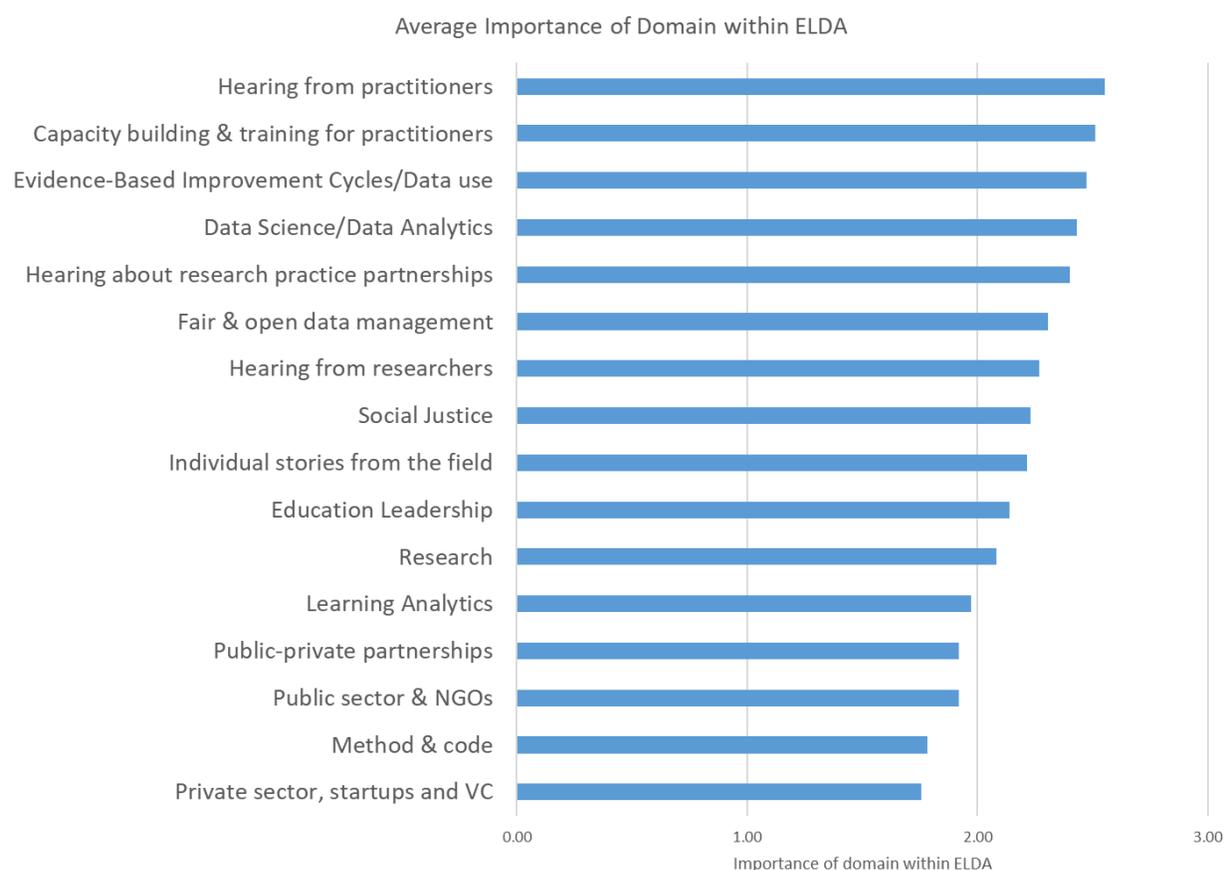


Figure 8: Average post-event survey responses (0: not important to 3: very important) for each domain discussed during the ELDA Summit.

To collect the conceptions around defining the field for ELDA from the participants in the post-event survey, respondents were asked the following open-ended question:

Given the sessions you attended at the ELDA Summit as well as your own experiences, to you, what are the central ideas, issues, and challenges in the domain of Education Leadership Data Analytics?

Seventeen of the post-event survey respondents provided a response to this question.

In reading the responses, five main themes emerged from across the provided responses:

1. Developing, growing, refining, and incentivizing feedback loops between researchers and practitioners in the use of data analytics for instructional improvement.
2. A crucial area is to build capacity in data analytics with building leaders, teachers, and researchers. Multiple respondents noted the central role of building capacity especially at the State Education Agency (SEA) level as well as the Local Education Agency level (LEA).
3. A focus on data privacy, quality, interoperability across data silos, and availability across contexts both for data sets and data tools, including FAIR and equitable uses of data.
4. A central issue of how to find faculty to train future administrators in ELDA.
5. A focus on the human element in education, approaching data and analytics use with humility and a collaborative stance to help educators address the issues they have, rather than an exclusive focus on questions from researchers.

SUMMARY & CONCLUSION

In conclusion, this report on the Education Leadership Data Analytics (ELDA) Summit 2018 lays an initial foundation for future efforts in research, policy, and practice at the intersection of education leadership, evidence-based improvement cycles, and education data science. First, the review of the literature around ELDA shows that the field is emerging, yet researchers and practitioners call for a strong need for training, capacity building, networking, and certification structures in ELDA, as both practitioners and researchers have few areas to call on for help with their work in this domain. Second, the findings from this report indicate that there are some professional development offerings at specific overlaps of the ELDA Venn diagram, such as the Harvard Strategic Data Project. However, there currently are no strong offerings for practitioners or researchers that address the central intersection of ELDA, such as a masters degree or advanced certification in ELDA. Currently, practitioners in schools, districts, states, and nations who work in ELDA come to the job through very idiosyncratic means, and lack a strong program of certification as well as a professional network to help support their work. Third, the results from the ELDA Summit 2018 reinforces the current near-term central issues of ELDA, to focus on capacity building and practice through integrating research with practical applications to train current practitioners in fair and ethical data analysis and data use in an effort to positively inform evidence-based improvement cycles.

In Figure 10 below, we summarize the central skills and competencies for the ELDA field, as an integration of the information from the review of the literature, and the responses from the ELDA Summit 2018. Here, we use the Bowers (2017) framework for different types of roles in districts for ELDA on the left including the Practicing Administrator, Quantitative Analyst, Research Specialist, and Education Data Scientist to frame the different facets of the domain. For each area within the dashed regions, core skills and competencies could be integrated for each of the four job roles. However, the level of integration and depth of required skills and knowledge varies for each job role in ELDA. Nevertheless, these main areas in Education Leadership, Evidence-based

Improvement Cycles, and Data Science/Data Analytics helps to frame future program, certification, and professional development planning in the ELDA domain.

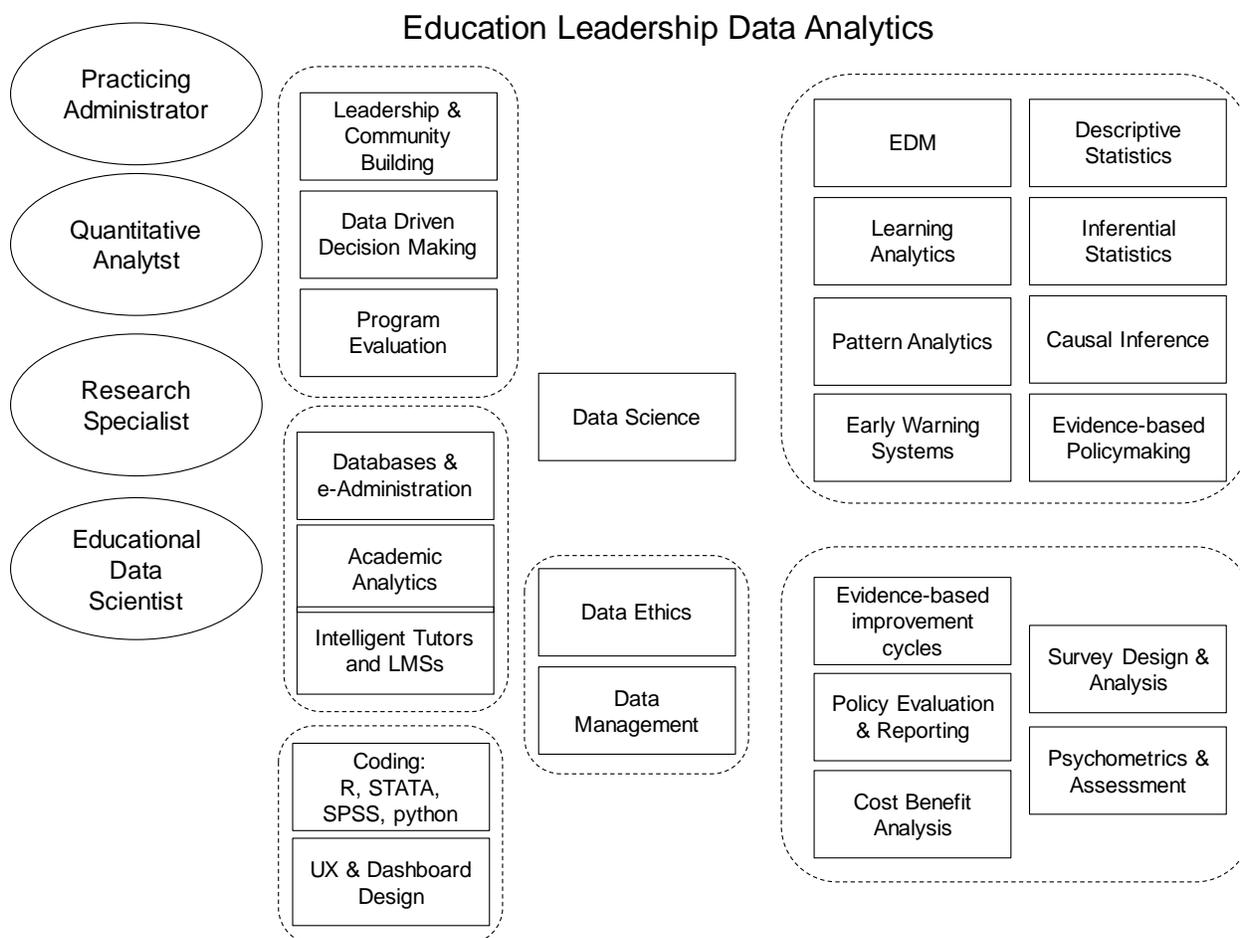


Figure 10: Core competencies and skills for Education Leadership Data Analytics (ELDA)

Our summary of the literature in the ELDA domain provides a means to highlight seven potential core competency and skill domains for professional development and training for practitioners and researchers in the field. First, these include school building and school system leadership as well as community building, such as shared instructional leadership, leadership for learning, and culturally responsive leadership (Bowers, Blitz, Modest, Salisbury, & Halverson, 2017; Boyce & Bowers, 2018; Khalifa, Gooden, & Davis, 2016; Marks & Printy, 2003; Murphy, Elliott, Goldring, & Porter, 2007; Urick & Bowers, 2014). These leadership competencies also include the data driven decision-making and program evaluation literature noted above. Second, there is a strong need for training in “e-Administration” and database management, as the number and size of education datasets in schooling organizations continues to grow (Krumm et al., 2018; Piety et al., 2014). This is especially important as schooling organizations add additional streams of data, such as recommender systems, personalized learning systems, and educational games and apps (Krumm et al., 2018; Piety et al., 2014; Piety & Pea, 2018), as well as tracking long-term student outcomes and organizational interactions, such as through academic analytics (Agasisti & Bowers, 2017;

Siemens, 2013), and intelligent tutors and learning management systems (R. S. Baker & Koedinger, 2018; Koedinger, D'Mello, McLaughlin, Pardos, & Rosé, 2015). Third, as demonstrated in the responses of the participants in the summit, multiple platforms for coding and analytics are the standard. ELDA practitioners should be versed in multiple statistical and data science programming languages, such as R, Python, SATA, and SPSS. Additionally, as across the data science literature discussed above, data dashboards and user interface design (UX) is a central competency, as visualization and interactivity of data analytics and data tools is key for bridging the divide between analytics and understanding of stakeholders.

Fourth, we list data science as a single box, as the field of data science is rapidly developing. Nevertheless, given the literature to date on education data science and the intersection with big data analytics (Agasisti & Bowers, 2017; Bowers et al., 2016; Krumm et al., 2018; Piety et al., 2014; Piety & Pea, 2018), inclusion of data science within ELDA is crucial to provide an avenue for the innovations from the data sciences to help inform education practice.

Fifth, data ethics and management of data with a focus on ethical, confidential, and private use of data is a core competency. As noted above, to help build the field, FAIR data standards that work to provide open and accessible data and tools (Austin et al., 2017), will create part of the infrastructure needed for the field to develop. At the same time, ethical use of the data will provide safeguards and training on the protection of data privacy, while ensuring that decision algorithms in education are open and accessible to understand how machine-informed decisions are being made, and the extent that they may be biased or not (Agasisti & Bowers, 2017).

Sixth, a core competency area is in statistical and machine learning methods to help inform predictions, and early warning systems, to understand the data patterns available, and positively influence policy and decisions in schools to help support student learning and instruction in classrooms. Skills within this domain include education data mining and learning analytics as well as inferential statistics (R. S. Baker & Inventado, 2014; R. S. Baker & Yacef, 2009; Krumm et al., 2018; Piety & Pea, 2018; Siemens, 2013). These skills also include the use of education data to make long-term predictions and inform actionable early warning systems and indicators (Allensworth, 2013; Allensworth, Nagaoka, & Johnson, 2018; Bowers, Sprott, & Taff, 2013; Bowers & Zhou, in press; Davis, Herzog, & Legters, 2013; Mac Iver, 2013).

Seventh, the final core competency area includes skills on surveying stakeholders as well as psychometrics and assessments (Bowers, 2017), while also considering how to evaluate and test interventions, such as through evidence-based improvement cycles, as well as cost-benefit analysis.

Overall, while it may not be possible nor even advisable to provide a deep experience in each of these core competencies for all four facets of the Practicing Administrator, Quantitative Analyst, Research Specialist, and Education Data Scientist, we argue that ELDA researchers and practitioners should strive to build these skills over an entire career. It may be the case that initial training in ELDA would give entrée into each of the areas, with the profession structuring learning opportunities for career professionals at conferences and networking events to help continue to build their skills, share their practices, and work in collaboration with partners and stakeholders throughout each schooling system.

Near-term Recommendations:

The information collected from this process indicates a strong need for certification and degree programs as well as capacity building and professional development offerings in Education Leadership Data Analytics, as there appears to be a strong market that is currently underserved in this area nationally and globally. Building on the literature review as well as feedback from the ELDA Summit 2018, we provide the following near-term recommendations:

1. *Annual or semi-annual ELDA research and practice meetings or conferences.* Capacity building, training, and networking for current researchers and practitioners is a central identified concern in the ELDA field. There is a strong need for conferences and professional development opportunities to meet, share practices, and build networks and capacity. Additionally, a central recommendation and focus from the field that emerged from the summit is the critical role of feedback loops and researcher-practitioner partnerships between researchers, practitioners, universities, and schooling systems. We encourage future conferences to provide multiple tracks to serve the various needs, including conferences with simultaneous research, training, and industry development tracks, bringing each together to help bridge between different areas of interest. A useful example of such meetings is the KDD annual meeting sponsored by the Association for Computing Machinery's Special Interest Group on Knowledge Discovery and Data Mining (ACM SIGKDD), which includes multiple tracks that brings together researchers and practitioners of machine learning and data science (<https://www.kdd.org/>).
2. *Funding for networking and visiting researchers and practitioners.* There is a strong need for sharing of experiences, research ideas, practical applications, and capacity across the field. We recommend that funders work to focus on helping researchers and ELDA practitioners share their experiences and data tools by funding teams to be resident in different locations. This could take the form of long-term internships and fellowships, as well as more short-term week long, or month long training and capacity building. For example, university researchers could host three to five people for one or two weeks and focus on a specific topic, and the same could take place for school districts where they host a small team to help focus on a specific research or practice topic, with both the host and the guests learning and exchanging ideas and tools with each other.
3. *A consortium of like-minded institutions around ELDA.* To help continue to build capacity in the field, we recommend that like-minded institutions form a consortium to share resources, information, and training. This consortium could take many forms, from including universities, to also including school districts, as well as NGOs, research groups, and vendors and technology companies. Such a consortium could help provide a currently needed central resource and deliberative body, as many different data, data management, and data use architectures are being deployed to schools. A body that could provide some standardization across the industry would benefit the entire ELDA field, as this could help standardize data systems, which in turn would make analysis, tool building, and testing easier.

4. *A national dialogue on curriculum, skills, and core competencies in ELDA*. While we provide an initial proposed set of core competencies and skills in this report, we encourage more work in this area and recommend that ELDA researchers and practitioners work to create a shared set of expectations around needed skills and core competencies that would make up a curriculum for potential training and certification programs in ELDA. Ensuring an open and inclusive dialogue around the core competencies would benefit the ELDA field to ensure that training and professional development addresses the needs of schools and the people doing the work on the ground to best serve education communities.

References:

- Agasisti, T., & Bowers, A. J. (2017). Data Analytics and Decision-Making in Education: Towards the Educational Data Scientist as a Key Actor in Schools and Higher Education Institutions. In G. Johnes, J. Johnes, T. Agasisti, & L. López-Torres (Eds.), *Handbook on the Economics of Education* (pp. 184-210). Cheltenham, UK: Edward Elgar Publishing.
- Allensworth, E. M. (2013). The Use of Ninth-Grade Early Warning Indicators to Improve Chicago Schools. *Journal of Education for Students Placed at Risk (JESPAR)*, 18(1), 68-83. doi:10.1080/10824669.2013.745181
- Allensworth, E. M., Nagaoka, J., & Johnson, D. W. (2018). *High School Graduation and College Readiness Indicator Systems: What We Know, What We Need to Know*. Retrieved from Chicago, IL: <https://consortium.uchicago.edu/sites/default/files/publications/High%20School%20Graduation%20and%20College-April2018-Consortium.pdf>
- Anderson, E., & Reynolds, A. (2015). The State of State Policies for Principal Preparation Program Approval and Candidate Licensure. *Journal of Research on Leadership Education*, 10(3), 193-221. doi:10.1177/1942775115614292
- Austin, C. C., Bloom, T., Dallmeier-Tiessen, S., Khodiyar, V. K., Murphy, F., Nurnberger, A., . . . Whyte, A. (2017). Key components of data publishing: using current best practices to develop a reference model for data publishing. *International Journal on Digital Libraries*, 18(2), 77-92. doi:10.1007/s00799-016-0178-2
- Baker, B. D., Orr, M. T., & Young, M. D. (2007). Academic Drift, Institutional Production, and Professional Distribution of Graduate Degrees in Educational Leadership. *Educational Administration Quarterly*, 43(3), 279-318. doi:10.1177/0013161x07303320
- Baker, R. S., & Inventado, P. S. (2014). Educational data mining and learning analytics. In J. A. Larusson & B. White (Eds.), *Learning Analytics* (pp. 61-75). New York: Springer. Retrieved from http://link.springer.com/chapter/10.1007%2F978-1-4614-3305-7_4.
- Baker, R. S., & Koedinger, K. R. (2018). Towards Demonstrating Value of Learning Analytics for K-12 Education. In D. Niemi, R. D. Pea, & B. Saxberg (Eds.), *Learning Analytics in Education* (pp. 49-62). Charlotte, NC: Information Age Publishing.
- Baker, R. S., & Yacef, K. (2009). The State of Educational Data Mining in 2009: A Review and Future Visions. *Journal of Educational Data Mining*, 1(1), 3-16.
- Bambrick-Santoyo, P. (2010). *Driven by Data: A Practical Guide to Improve Instruction*. San Francisco, CA: Jossey-Bass.
- Bienkowski, M., Feng, M., & Means, B. (2012). *Enhancing Teaching and Learning Through Educational Data Mining and Learning Analytics: An Issue Brief*. Retrieved from Washington, DC: <http://www.ed.gov/edblogs/technology/files/2012/03/edm-la-brief.pdf>

- Boudett, K. P., City, E. A., & Murnane, R. J. (2013). *Data Wise: Revised and Expanded Edition: A Step-by-Step Guide to Using Assessment Results to Improve Teaching and Learning. Revised and Expanded Edition*. Cambridge, MA: Harvard Education Press.
- Bowers, A. J. (2008). Promoting Excellence: Good to great, NYC's district 2, and the case of a high performing school district. *Leadership and Policy in Schools*, 7(2), 154-177.
- Bowers, A. J. (2011). What's in a grade? The multidimensional nature of what teacher-assigned grades assess in high school. *Educational Research and Evaluation*, 17(3), 141-159. doi:10.1080/13803611.2011.597112
- Bowers, A. J. (2016). Building Community and Capacity for Data-Intensive Evidence-Based Decision Making in Schools and Districts (NSF DGE-1560720) (Vol. \$499,623). Nassau County New York: National Science Foundation (NSF), Directorate for Education and Human Resources (EHR), Division of Graduate Education (DGE).
- 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. doi:10.1177/1942775116659462
- Bowers, A. J., Blitz, M., Modest, M., Salisbury, J., & Halverson, R. (2017). Is There a Typology of Teacher and Leader Responders to CALL, and Do They Cluster in Different Types of Schools? A Two-Level Latent Class Analysis of CALL Survey Data. *Teachers College Record*(119), 4.
- Bowers, A. J., Krumm, A. E., Feng, M., & Podkul, T. (2016). *Building a Data Analytics Partnership to Inform School Leadership Evidence-Based Improvement Cycles*. Paper presented at the Annual meeting of the American Educational Research Association, Washington, DC.
- Bowers, A. J., Shoho, A. R., & Barnett, B. G. (2014). Considering the Use of Data by School Leaders for Decision Making. In A. J. Bowers, A. R. Shoho, & B. G. Barnett (Eds.), *Using Data in Schools to Inform Leadership and Decision Making* (pp. 1-16). Charlotte, NC: Information Age Publishing.
- Bowers, A. J., Sprott, R., & Taff, S. (2013). Do we know who will drop out? A review of the predictors of dropping out of high school: Precision, sensitivity and specificity. *The High School Journal*, 96(2), 77-100.
- Bowers, A. J., & Zhou, X. (in press). Receiver Operating Characteristic (ROC) Area Under the Curve (AUC): A Diagnostic Measure for Evaluating the Accuracy of Predictors of Education Outcomes. *Journal of Education for Students Placed at Risk*.
- Boyce, J., & Bowers, A. J. (2018). Toward an evolving conceptualization of instructional leadership as leadership for learning: Meta-narrative review of 109 quantitative studies across 25 years. *Journal of Educational Administration*, 56(2), 161-182. doi:doi:10.1108/JEA-06-2016-0064
- Brocato, K., Willis, C., & Dechert, K. (2014). Longitudinal Data Use: Ideas for District, Building, and Classroom Leaders In A. J. Bowers, A. R. Shoho, & B. G. Barnett (Eds.), *Using Data in Schools to Inform Leadership and Decision Making* (pp. 97-120). Charlotte, NC: Information Age Publishing.
- Brookhart, S. M., Guskey, T. R., Bowers, A. J., McMillan, J. H., Smith, J. K., Smith, L. F., . . . Welsh, M. E. (2016). A Century of Grading Research: Meaning and Value in the Most Common Educational Measure. *Review of Educational Research*, 86(4), 803-848. doi:10.3102/0034654316672069

- Bruno, J. E., & Fox, J. N. (1973). *Quantitative Analysis in Educational Administrator Preparation Programs*. Columbus, Ohio: The ERIC Clearinghouse on Educational Management, University Council for Educational Administration.
- Center for Education Policy Research. (n.d.). Harvard University Strategic Data Project. Retrieved from <https://sdp.cepr.harvard.edu/>
- Che, J. (2016). *When Rigor Meets Relevance: Determining Cut Scores for Early Indicators for Third-Grade Reading Proficiency Innovatively*. Paper presented at the Annual meeting of the American Educational Research Association (AERA), Washington, DC. https://convention2.allacademic.com/one/aera/aera16/index.php?cmd=Online+Program+View+Paper&selected_paper_id=1061554&PHPSESSID=0seui8dievjtebm4dmvdfnl0n5
- Coburn, C. E., & Turner, E. O. (2011). Research on Data Use: A Framework and Analysis. *Measurement: Interdisciplinary Research and Perspectives*, 9(4), 173-206. doi:10.1080/15366367.2011.626729
- Cope, B., & Kalantzis, M. (2016). Big Data Comes to School: Implications for Learning, Assessment, and Research. *AERA Open*, 2(2), 2332858416641907. doi:10.1177/2332858416641907
- Datnow, A., & Hubbard, L. (2015). Teachers' Use of Assessment Data to Inform Instruction: Lessons From the Past and Prospects for the Future. *Teachers College Record*, 117(4), 1-26.
- Davis, M., Herzog, L., & Legters, N. (2013). Organizing Schools to Address Early Warning Indicators (EWIs): Common Practices and Challenges. *Journal of Education for Students Placed at Risk (JESPAR)*, 18(1), 84-100. doi:10.1080/10824669.2013.745210
- Donoho, D. (2015). *50 years of Data Science*. Paper presented at the Princeton NJ, Tukey Centennial Workshop.
- Echeverria, V., Martinez-Maldonado, R., Granda, R., Chiluiza, K., Conati, C., & Shum, S. B. (2018). *Driving data storytelling from learning design*. Paper presented at the Proceedings of the 8th International Conference on Learning Analytics and Knowledge, Sydney, New South Wales, Australia. <https://dl.acm.org/citation.cfm?id=3170380>
- Farley-Ripple, E. N., & Buttram, J. L. (2015). The Development of Capacity for Data Use: The Role of Teacher Networks in an Elementary School. *Teachers College Record*, 117(4), 1-34.
- Finkel, K., Graves, K. E., & DeLyser, L. A. (2017). *Special Session: CS Education Research Knowledge Forum*. Paper presented at the Proceedings of the 2017 ACM SIGCSE Technical Symposium on Computer Science Education, Seattle, Washington, USA. <https://dl.acm.org/citation.cfm?id=3017809>
- Gandomi, A., & Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics. *International Journal of Information Management*, 35(2), 137-144. doi:<http://dx.doi.org/10.1016/j.ijinfomgt.2014.10.007>
- Garcia Mathewson, T. (2017). Can this game-like app help students do better in school. Retrieved from <https://www.wired.com/story/can-this-game-like-app-help-students-do-better-in-school/>
- Goff, P., & Finch, M. (2015). Challenges and Opportunities for Education Leadership Scholarship: A Methodological Critique. In A. J. Bowers, A. R. Shoho, & B. G. Barnett (Eds.), *Challenges and Opportunities of Educational Leadership Research and Practice: The State of the Field and Its Multiple Futures* (Vol. 6, pp. 119-146). Charlotte, NC: Information Age Publishing.

- Goldring, E., & Schuermann, P. (2009). The changing context of K-12 education administration: Consequences for Ed.D. program design and delivery. *Peabody Journal of Education*, 84(1), 9-43.
- Graves, K. E., & DeLyser, L. A. (2017). *Interested In Class, But Not In The Hallway: A Latent Class Analysis (LCA) of CS4All Student Surveys*. Paper presented at the Proceedings of the 2017 ACM SIGCSE Technical Symposium on Computer Science Education, Seattle, Washington, USA. <https://dl.acm.org/citation.cfm?id=3017722>
- Hackmann, D. G., & McCarthy, M. M. (2011). *At a Crossroads: The Educational Leadership Professoriate in the 21st Century*. Charlotte, NC: Information Age Publishing.
- Hallgren, K., Pickens Jewell, C., Kamler, C., Hartog, J., & Gothro, A. (2013). *Strategic data project and education pioneers year 1 report: Laying the groundwork for data-driven decision making*. Retrieved from Princeton, NJ: http://www.mathematica-mpr.com/publications/pdfs/education/strategic_data_project_year1.pdf
- Hallinger, P., & Heck, R. H. (2011). Conceptual and methodological issues in studying school leadership effects as a reciprocal process. *School Effectiveness and School Improvement*, 22(2), 149-173. doi:10.1080/09243453.2011.565777
- Halverson, R. (2014). Data-Driven Leadership for Learning in the Age of Accountability. In A. J. Bowers, A. R. Shoho, & B. G. Barnett (Eds.), *Using Data in Schools to Inform Leadership and Decision Making* (pp. 255-267). Charlotte, NC: Information Age Publishing.
- Halverson, R., Barnicle, A., Hackett, S., Rawat, T., Rutledge, J., Kallio, J., . . . Mertes, J. (2015). *Personalization in Practice: Observations from the Field (WCER Working Paper 2015-8)* (WCER Working Paper 2015-8). Retrieved from Madison, WI:
- Hess, F. M., & Kelly, A. P. (2005). *Learning to lead? What gets taught in principal preparation programs*. Retrieved from Cambridge, MA: <http://www.ksg.harvard.edu/pepg/research.htm>
- Honig, M. I., & Venkateswaran, N. (2012). School–Central Office Relationships in Evidence Use: Understanding Evidence Use as a Systems Problem. *American Journal of Education*, 118(2), 199-222. doi:10.1086/663282
- 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. doi:<https://doi.org/10.1016/j.tate.2016.07.012>
- Ifenthaler, D., & Tracey, M. W. (2016). Exploring the relationship of ethics and privacy in learning analytics and design: implications for the field of educational technology. *Educational Technology Research and Development*, 64(5), 877-880. doi:10.1007/s11423-016-9480-3
- Jimerson, J. B., & Childs, J. (2015). Signal and Symbol: How State and Local Policies Address Data-Informed Practice. *Educational Policy*, 31(5), 584-614. doi:10.1177/0895904815613444
- Khalifa, M. A., Gooden, M. A., & Davis, J. E. (2016). Culturally Responsive School Leadership: A Synthesis of the Literature. *Review of Educational Research*. doi:10.3102/0034654316630383
- Koedinger, K. R., D'Mello, S., McLaughlin, E. A., Pardos, Z. A., & Rosé, C. P. (2015). Data mining and education. *Wiley Interdisciplinary Reviews: Cognitive Science*, 6(4), 333-353. doi:10.1002/wcs.1350

- Kowalski, T. J., McCord, R. S., Peterson, G. J., Young, P. I., & Ellerson, N. M. (2011). *The American School Superintendent : 2010 Decennial Study*. Lanham, Md: R&L Education.
- Krumm, A. E., Means, B., & Bienkowski, M. (2018). *Learning Analytics Goes to School: A Collaborative Approach to Improving Education*. New York: Routledge.
- Mac Iver, M. A. (2013). Early Warning Indicators of High School Outcomes. *Journal of Education for Students Placed at Risk (JESPAR)*, 18(1), 1-6.
doi:10.1080/10824669.2013.745375
- Mandinach, E. B., Friedman, J. M., & Gummer, E. S. (2015). How Can Schools of Education Help to Build Educators' Capacity to Use Data? A Systemic View of the Issue. *Teachers College Record*, 117(4), 1-50.
- Mandinach, E. B., & Gummer, E. S. (2013). A Systemic View of Implementing Data Literacy in Educator Preparation. *Educational Researcher*, 42(1), 30-37.
doi:10.3102/0013189x12459803
- Marks, H. M., & Printy, S. M. (2003). Principal Leadership and School Performance: An Integration of Transformational and Instructional Leadership. *Educational Administration Quarterly*, 39(3), 370-397. doi:10.1177/0013161X03253412
- Marsh, J. A. (2012). Interventions Promoting Educators' Use of Data: Research Insights and Gaps. *Teachers College Record*, 114(11), 1-48.
- Marsh, J. A., & Farrell, C. C. (2015). How leaders can support teachers with data-driven decision making: A framework for understanding capacity building. *Educational Management Administration & Leadership*, 43(2), 269-289. doi:10.1177/1741143214537229
- Militello, M., Gajda, R., & Bowers, A. J. (2009). The Role of Accountability Policies and Alternative Certification on Principals' Perceptions of Leadership Preparation. *Journal of Research on Leadership Education*, 4(3), 30-66. doi:10.1177/194277510900400301
- Murphy, J., Elliott, S. N., Goldring, E., & Porter, A. C. (2007). Leadership for learning: a research-based model and taxonomy of behaviors. *School Leadership & Management*, 27(2), 179-201. doi:10.1080/13632430701237420
- Piety, P. J. (2013). *Assessing the educational data movement*. New York, NY: Teachers College Press.
- Piety, P. J., Hickey, D. T., & Bishop, M. (2014). *Educational data sciences: Framing emergent practices for analytics of learning, organizations, and systems*. Paper presented at the Proceedings of the Fourth International Conference on Learning Analytics and Knowledge.
- Piety, P. J., & Pea, R. D. (2018). Understanding Learning Analytics Across Practices. In D. Niemi, R. D. Pea, & B. Saxberg (Eds.), *Learning Analytics in Education* (Vol. 215-232). Charlotte, NC: Information Age Publishing.
- Roderick, M., Easton, J. Q., & Sebring, P. B. (2009). *The Consortium on Chicago School Research (CCSR): A new model for the role of research in supporting urban school reform*. Retrieved from Chicago: <https://ccsr.uchicago.edu/publications/ccsr-new-model-role-research-supporting-urban-school-reform>
- Schildkamp, K., Karbautzki, L., & Vanhoof, J. (2014). Exploring data use practices around Europe: Identifying enablers and barriers. *Studies in Educational Evaluation*, 42, 15-24.
doi:10.1016/j.stueduc.2013.10.007
- 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. doi:10.1080/09243453.2016.1256901

- Schildkamp, K., Poortman, C. L., & Handelzalts, A. (2016). Data teams for school improvement. *School Effectiveness and School Improvement*, 27(2), 228-254. doi:10.1080/09243453.2015.1056192
- Schutt, R., & O'Neil, C. (2013). *Doing Data Science: Straight Talk from the Frontline*. Cambridge, MA: O'Reilly.
- Siemens, G. (2013). Learning Analytics: The Emergence of a Discipline. *American Behavioral Scientist*, 57(10), 1380-1400. doi:10.1177/0002764213498851
- Singh, L., Deshpande, A., Wenchao Zhou, Banerjee, A., Bowers, A. J., Friedler, S., . . . Zuo, W. (2017). *NSF BIGDATA PI Meeting – Domain Specific Research Directions and Data Sets*. Retrieved from Washington, D.C.:
- Spector, J. M. (2016). Ethics in educational technology: towards a framework for ethical decision making in and for the discipline. *Educational Technology Research and Development*, 64(5), 1003-1011. doi:10.1007/s11423-016-9483-0
- Spillane, J. P. (2012). Data in Practice: Conceptualizing the Data-Based Decision-Making Phenomena. *American Journal of Education*, 118(2), 113-141. doi:10.1086/663283
- Supovitz, J., & Morrison, K. (2015). Does Collaboration Facilitate Data Use in Schools? *Journal of Studies in Education*, 5(2), 136-156. doi:10.5296/jse.v5i2.7379
- Thornton, B., & Perreault, G. (2002). Becoming a Data-Based Leader: An Introduction. *NASSP Bulletin*, 86(630), 86-96. doi:10.1177/019263650208663009
- Urick, A., & Bowers, A. J. (2014). What Are the Different Types of Principals Across the United States? A Latent Class Analysis of Principal Perception of Leadership. *Educational Administration Quarterly*, 50(1), 96-134. doi:10.1177/0013161x13489019
- Wang, Y., & Bowers, A. J. (2016). Mapping the Field of Educational Administration Research: A Journal Citation Network Analysis of the Discipline. *Journal of Educational Administration*, 54(3), 242-269. doi:10.1108/JEA-02-2015-0013
- Wang, Y., Bowers, A. J., & Fikis, D. J. (2016). Automated Text Data Mining Analysis of Five Decades of Educational Leadership Research Literature: Probabilistic Topic Modeling of EAQ Articles From 1965 to 2014. *Educational Administration Quarterly*. doi:10.1177/0013161x16660585
- Wayman, J. C. (2005). Involving teachers in data-driven decision making: Using computer data systems to support teacher inquiry and reflection. *Journal of Education for Students Placed at Risk*, 10(3), 295-308.
- Wayman, J. C., Cho, V., & Johnston, M. T. (2007). *The data-informed district: A district-wide evaluation of data use in the Natrona county school district*. Retrieved from Austin: http://edadmin.edb.utexas.edu/datause/Wayman_data_use_evaluation.pdf
- Wayman, J. C., Shaw, S., & Cho, V. (2017). Longitudinal Effects of Teacher Use of a Computer Data System on Student Achievement. *AERA Open*, 3(1), 2332858416685534. doi:doi:10.1177/2332858416685534
- Williamson, B. (2016). Digital education governance: data visualization, predictive analytics, and 'real-time' policy instruments. *Journal of Education Policy*, 31(2), 123-141. doi:10.1080/02680939.2015.1035758

About the authors:

Alex J. Bowers



Alex J. Bowers is an Associate Professor of Education Leadership at Teachers College, Columbia University, where he works to help school leaders use the data that they already collect in schools in more effective ways to help direct the limited resources of schools and districts to specific student needs. His research focuses on the intersection of effective school and district leadership, data driven decision making, student grades and test scores, student persistence and dropouts. His work also considers the influence of school finance, facilities, and technology on student achievement. Dr. Bowers studies these domains through the application of

Intensive Longitudinal Data analysis (ILD), such as data visualization analytics, multilevel and growth mixture modeling, and cluster analysis heatmap data dashboards. He earned his Ph.D. in K12 Educational Administration from Michigan State University, and previous to teaching and education research, spent a decade as a cancer researcher in the biotechnology industry, with an M.S. in Biochemistry, Microbiology and Molecular Biology, and a B.S. in Biochemistry. ORCID: 0000-0002-5140-6428

April Bang



April H. Bang is a leadership educator, researcher, and practitioner specializing in adaptive leadership, transformative learning and adult development, systemic change, and collaborative capacity building. She is an advanced doctoral student in the Adult Learning and Leadership program of the Organization and Leadership Department at Teachers College, Columbia University. Her current research integrates her specialized interests and adult learning concentration with leadership and data analytics. Prior to her doctoral studies, she taught leadership to undergraduate students at Yonsei University in Seoul, Korea and has

diverse and extensive experience as a practitioner working across the fields of human rights, criminal justice reform, international rule of law development, and economic policy, including work at the Vera Institute of Justice, International Justice Mission, Harvard Kennedy School's Executive Session on Human Rights Commissions and Criminal Justice, and the Federal Reserve Bank of New York. April is also developing as an artist. With an on-going curiosity to examine and demonstrate how art could foster individual and collective transformation, she has started to exhibit her visual artwork in galleries and has co-curated a community art installation in Harlem.

Yilin Pan



Yilin Pan, Ph.D. is currently a post-doctoral researcher jointly hired by the Department of Educational Policy and Social Analysis and the Department of Organization Leadership at Teachers College, Columbia University. She specializes in cost-effectiveness and cost-benefit analysis, decision-making in resource allocation and Bayesian statistics. Dr. Pan's research aims to facilitate the utilization of research evidence to better guide policymakers and practitioners' decision-making about resource allocation. She has been working on applying Bayesian statistics to improve the methodologies that generate research evidence. Her attempts focus on localizing evidence of program effectiveness and cost obtained from evaluation settings to reflect the student and teacher characteristics of a specific decision-making setting, the subjective judgments of the local decision makers and the values of the local stakeholders. Yilin Pan earned a B.A. in English Literature and Linguistics and a M.A. in Higher Education at Tsinghua University, P. R. China, and a Ph.D. in Economics and Education at Teachers College, Columbia University. Prior to her current job, she worked as a consultant at the World Bank's education sector.

Kenneth E. Graves



Kenneth E. Graves, Ph.D. is a recent graduate of the Education Leadership program at Teachers College, Columbia University and currently works as the Upper School (9-12) Ethics & Technology Coordinator at the Ethical Culture Fieldston School in the Bronx, NY. Dr. Graves' research broadly focuses on examining the intersection of educational technology, school leadership, and social justice education in order to help school and districts lead instructional technology interventions that address specific issues in historically underserved populations. His work also considers ethical and legal issues in technology leadership, leadership for computer science (CS) education, data-driven decision making for school improvement, and quantitative methodologies. Furthermore, his teaching interests lie in preparing future principals and technology leaders for instructional leadership in the digital age in topics such as designing innovative professional learning experiences for teachers, evaluating new technology initiatives, CS teaching methods and pedagogy, as well as using data visualizations for school reporting. Prior to research, Dr. Graves was an award-winning teacher and school leader in several schools. Kenny holds a B.A. in English, Secondary Education, and Latin American/Iberian Studies from the University of Richmond, a M.A. in Instructional Technology and Media, as well as a M.Phil and Ph.D. in Education Leadership from Teachers College, Columbia University.

The authors also wish to thank the hard work of the Education Leadership Data Analytics (ELDA) Research group at Teachers College, Columbia University for all of their work in managing the logistics of the ELDA 2018 Summit.



ELDA Research Group. Pictured from left to right: April Bang, Xiaoliang Zhou, Alex Bowers, Sen Zhang, Luronne Vaval, Kenneth Graves, Yilin Pan, Aaron Hawn.

Education Leadership Data Analytics Research Group: <https://www.tc.columbia.edu/elda/>
Teachers College, Columbia University: <https://www.tc.columbia.edu/>