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FACTORS RELATED TO DATA USE IN INSTRUCTIONAL LEADERSHIP: THE IMPORTANCE OF DATA LITERACY IN LEADERSHIP EDUCATION

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Abstract:

Using the theoretical framework of information use environments, this study examined 183 principals' use of data in instructional leadership in a Midwest state in the US and identified the factors related to data use. Survey results indicate that data were frequently used by the principals for instructional leadership. Principals' data literacy including perceptions of data quality and data analysis skills significantly predicted their frequency of data use in instructional leadership. School district's requirement of data-driven decision making, data accessibility, and school team of data analyses did not seem to serve as the significant predictors. Results provide insights and implications guiding data literacy education in school leader preparation.

Keywords:

Principal; data use, factor, instructional leadership, data literacy

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Introduction

Data-driven decision making (DDDM) originating from business management models such as Total Quality Management (Deming, 1986) and Knowledge Management (Davenport & Prusak, 1998) constitutes the evidence-based foundation for the new era of educational accountability and school improvement in the US (Means, Padilla, & Gallagher, 2010). It has been influencing principals who are facing ever-increasing public and policy pressure to improve schools and provide educational equity. Accountability and improvement demands have been forcing school leaders to explore much more the granular data and to do analyses that are more sophisticated. Data-driven decision making has been the central focus of education policy (Mandinach, Honey, & Light, 2006) and an emerging important field of school leadership (Mandinach & Gummer, 2013).

Over the past decade, we have witnessed that the ultimate purpose of reinforcing data use for decision making in education is the continuous improvement of student academic performance (Data Quality Campaign, 2009). This driving force has heightened the importance of instructional leadership and its relevant use of data in the building level. School administrators use high stakes test data to understand general patterns of performance, identifying their schools' strengths and weaknesses so that they can effectively allocate resources and plan professional development and other kinds of targeted intervention activities. Principals need to think very differently about instructional leadership, and to use data to inform instructional practice (Mandinach et al., 2006).

In conjunction with the trend of school administrators' data use in instructional leadership, various discussions and studies on data-driven decision making have been conducted. The majority of studies as reviewed in the following section have been focused on inductive research in developing structure models (e.g., American Association of School Administrators, 2002; Ikemoto & Marsh, 2007), working framework (e.g., Mandinach et al., 2006; Knapp, Copland, & Swinnerton, 2007; Wohlstetter, Datnow, & Park, 2008) and technical tools (e.g., Brunner, et al., 2005; Stringfield, Wayman, & Yakimowski-Srebnick, 2005). These studies have constructed the theoretical foundation that is deemed effective for data-driven decision making practices. Since data-driven decision making has been practiced for over a decade, there is a need to use more quantitative research to better understand the general situations of data-driven decision making at schools and to determine the effectiveness of the various models that have been developed and implemented.

There is yet little empirical deductive research from the principal's perspective to evaluate, test, or prove the models or framework of data-driven decision making. This study aims to fill this void using survey research to determine the extent of principals' data use for instructional leadership and examine the environmental factors that influence the use of data. With the results of this study, school leadership educators and

district authorities can better understand the extent of principals' data-driven decision making and the factors affecting these practices in order to effectively assist and support data use for instructional leadership. We also hope that this study can help school leadership educators recognize the importance of educating data literacy in school leader preparation, which was highlighted in reports informing the formation of the Educational Leadership Program Standards developed by Educational Leadership Constituent Council (ELCC) (2011), which is adopted by the Council for the Accreditation of Educator Preparation (CAEP). This will contribute to the rethinking and reframing of the current educational leadership preparation (English, Papa, Mullen, & Creighton, 2012) that is "At the Crossroads" (Hackmann & McCarthy, 2011).

Theoretical Framework and Literature Review

This study was designed based on two theoretical perspectives, O'Reilly's (1983) model for use of information in organizational decision making and Taylor's (1991) model of Information Use Environments (IUE). O'Reilly proposes that information is a commodity used for a variety of purposes. Under some circumstances, it may be used as a basis for decision making, in others as a corroborative for decisions already made, and in still others for symbolic reasons. Information is not a fixed substance, but one which may be selectively perceived and processed. Therefore, O'Reilly proposes that information is more likely to be used for decision making when (1) it is readily accessible, (2) it is summarized, selectively interpreted and organized, (3) it is perceived to be valid and reliable, and (4) it is fed into an operating control system, which includes an effective set of incentives.

IUE (Taylor, 1991) suggests that the information behaviors of the decision making process are the products of the elements of the information use environments. IUE is defined as the set of elements that affect the flow and use of information into, within, and out of an organization, and determine the criteria by which the value of information will be judged. Information behaviors such as principals' data use in instructional leadership is influenced by (1) the sets of people such as principals who share assumptions about the nature of their work and the role of information unit; (2) the problems which are characterized by dimensions that are applied to judge the usefulness of information; and (3) the work settings that influence principals' attitude towards information as well as the availability and value of information.

Taylor's (1991) model is based on the notion that a person's information behavior is the result of an interaction between who the person is and the work environment. Taylor asserted that IUE could serve as a generalized model, a useful means for organizing, describing, and predicting the information behaviors of any given population in a variety of contexts. The IUE model has been widely applied to various research efforts in determining and predicting the factors influencing the information behaviors in

different professions and entrepreneurs and provides a useful structure for research on information behaviors of a group or an organization (Choo, 2002).

In this study, the "sets of people" of IUE (Taylor, 1991) was high school principals, from which the variable included for this study was the principals' data analysis skills. The "problem" of IUE was the administrative problems in instructional leadership. The "work settings" of IUE in this study were presented by the school demographic characteristics and organization operational variables including the school district requirement of data-driven decision-making, school data analysis team, and accessibility of data. The variable in this study that fell into the category of the value of information in IUE was the principals' perception of data quality.

Data Analysis Skills. Data analysis skills related to principals' educational background and training experiences seem to be a critical element affecting principals' information behaviors of data-driven decision making (Mandinach & Gummer, 2013). High school principals with higher levels of training in research methods generally rely more on both formal and informal sources of information than those with fewer data analysis skills (McCloskey, Altschuld & Lawton, 1985). It is the priority of data-driven decision making for principals to have basic understanding of applied statistics, data analysis skills, and other necessary computer skills (Means. et al*.,* 2010; Thornton & Perreault, 2002) because the response of principals' data-driven decision making depends on their comfort and proficiency in the use of data (Mathews, 2002).

Some scholars believed that data analysis at school is not mysterious work. The most important school improvement processes do not require sophisticated data analysis or special expertise (Schmoker, 2003). Most of statistical analyses useful to administrators are not complex. They do not require complex calculations and can be completed with a basic understanding of mathematics. It is generally simple counts, averages, percentages and rates (Creighton, 2001). However, lack of these skills contributes to one of the key reasons why little data are used and why it is so difficult to generate enough commitment to link data with decisions (Mandinach & Gummer, 2013).

Policy Requirement. The organizational context in which the decision occurs may affect the seeking and use of information in decision making (O'Reilly, 1983). Taylor (1991) emphasized that the physical and social context in which a principal works affects the way they seek and make use of information. Work setting features such as organizational hierarchical characteristics may influence individual attitudes toward information which finally affects information behaviors of data-driven decision making. Improving the capacity of schools to provide high-quality instruction and supporting their efforts to effectively use data through policies are critical to success (Ikemoto & Marsh, 2007). Therefore, a majority of school districts required all or some of their schools to follow specific data-driven decision making practices in formulating their school improvement plans (Means et al., 2010). Armstrong and Anthes (2001) found that schools successful in using data to support decision making creates a school structure

where data use is embedded in the daily schedule, and staff continue to develop data analysis skills. Case studies concluded that a supportive administrative organization structure plays a key role in the practice of data-driven decision making (Means et al., 2010; Rudy & Conrad, 2004).

Reichardt's (2000) study examined the role of state policies and programs in facilitating and encouraging the use of data in decision making at the school level. The study identified that creating a policy structure to support and encourage data-driven decision making increased and improved the use of data-driven decision making in schools. One the other hand, state policy requirements heighten principals' awareness of issues in delving deeper into the data for problem solutions (Mathews, 2002). As principals bear ultimate responsibility for effective data-driven decision making, the district mandates that they receive data training and the district has the appropriate policies in place to guarantee the implementation of data-driven improvement (Means et al., 2010).

Data Analysis Team. As information is more likely to be used by decision makers if it is summarized, selectively interpreted and organized (O'Reilly, 1983), principals' successful integration of data-driven decision making into educational strategy requires a team approach (Long, Rivas, Light, & Mandinach, 2008). A number of research studies have demonstrated evidence that the establishment of an action team responsible for collecting and analyzing data contributes an essential element in the effectiveness of data use in schools (e.g., Bernhardt, 2008; Parsons, 2003).

A team created for gathering and organizing data use at schools can make principals' data-driven analysis more efficient (Baker & Richards, 2004; Halverson, Pritchett, & Watson, 2007). Principals who emphasize the use of data in their decision making incorporate the knowledge and expertise of other professionals to guide the process rather than embark on their projects alone. They use key individuals to guide their data-driven decision making and to implement the plans that they devised. The shared data and the cooperative analysis of those data have become the norm (Knapp, et al., 2007; Mathews, 2002). A team approach could avoid or reduce conflicts and fears that may be caused by using data for decision making (Thornton & Perreault, 2002). An artful principal who effectively conducts data-driven decision making develops a small group of teachers to serve as the initial core for implementation of the data-driven programs. With the establishment of the group, issues of fear are greatly reduced and a stronger support is developed.

Accessibility of Data. Information must be easily accessible by the relevant decision makers before it can have an impact on decision making. Information is more likely to be used by decision makers if it is readily accessible (O'Reilly, 1983). Efficient and timely processing and disseminating of data in school systems and states provide the necessary capacity for principals to make data-driven instructional decisions (Thorn, 2002). Principals should be able to gain access to the data at schools and in the

classroom so that they can efficiently conduct data-driven decision making. It should be a top priority to bring all educational data together for easy access and analysis (Bernhardt, 2008; Means et al., 2010).

Principals had an abundance of data available to guide them in their data-driven decision making (Bernhardt, 2008; Mathews, 2002). However, inaccessibility of proper data or information remains a key block on the road of data-driven decision making (McIntire, 2002; Means et al., 2010; Streifer, 2002). Although the primary criterion for data-driven decision making process is to have the right data available at the right time, it is difficult to find or access the data when they are needed for it usually requires too much time and effort to analyze (Bernhardt, 2008; Salpeter, 2004).

Data Credibility. The meaningfulness of the information generated by the school system varies in relation to the knowledge and skills of the users. The quality of any data is judged by the user in terms of credibility and usefulness. Information is more likely to be used by decision makers if it is from a source deemed as credible or trustworthy and central to the user's functioning (O'Reilly, 1983). A number of early laboratory studies demonstrated that better-quality information is generally associated with improved decision making performance (e.g., Porat & Haas, 1969; Streufert, 1973, as cited in O'Reilly, 1983). How data can be collected in a valid and reliable form is one of the key elements for school administrators in using data for school administrators' decision making (Bernhardt, 2008; LaFee, 2002; Means et al., 2010).

When data are perceived to be valid and reliable in collections and analysis, data not only confirm what is working well, but also reveal the gaps between the current reality and the shared vision in a way that inspires collective action (Zmuda, Kuklis, & Kline, 2004). Reliability of data remains a challenge for school leaders to conduct data-driven decision making. It is difficult but essential to develop validation processes, procedures and definitions to deliver reliable data that users trust. The need for data validity and their users' buy-in is critical for data-driven decision making (Bernhardt, 2008; Ediger, 2002; Wohlstetter, et al., 2008).

Methodology

This study used original survey instruments to examine high school principals' data use for instructional leadership and to identify factors within the principals' information use environments that are related to data use. This study conceptualized data-driven instructional leadership as that school principals seek data and use them with different frequency as they define problems, develop alternative responses, estimate probabilities, and order outcomes in their attempts to make choices that deliver satisficing benefits to the school instruction (O'Reilly, 1983). Within this study, data were operationally confined to (1) student test scores; (2) demographics including attendance and graduation rates; (3) teachers', students', administrators', and parents' perceptions

of the learning environment; and (4) data of school programs and instructional strategies (Bernhardt, 2008).

Survey Participants

The population of this study was all the 294 individuals with the title of principal in public high schools in a Midwest state in the US. One hundred and eighty three (62.2%) principals participated in this study. Babbie (2002) insisted that a response rate of 50% is adequate for analysis and reporting and a response rate of 60% is good in its representativeness of the population. Table 1 presents the description of the total 183 participants' demographic

information including their gender, age, ethnicity, educational attainment, length of total school administrative experience, and length of holding the principal position at the current school. The majority of the respondents were male (80.6%) and Caucasians (97.8%) high school principals. There were more principals in the age group of more than 50 to 62 (43.7%) than in any of the two younger groups. The lowest level of educational attainment for all principals was the master's degree. Half of the respondents had been holding the principal position for the range of one to six years. Only 13.1% of the respondents were novice principals (less than one year). The majority (64.3%) of the high schools were small-sized (less than 500 students).

Table 1

Demographic Information of the Survey Respondents and their Schools

		Frequency	*Percent of Total*
Gender	*(n = 180)*		
	Male	145	80.6%
	Female	35	19.4%
Age (n = 179)			
	29 to 40	34	19.0%
	More than 40 to 50	65	36.3%
	More than 50 to 62	80	44.7%
Ethnicity (n = 182)			
	African American	4	2.2%
	Caucasian	178	97.8%
Educational Attainment (n = 182)			
	Ph. D or Ed. D	22	12.1%
	Ed. S (educational specialist)	54	29.7%

	Master's degree	106	58.2%
School Size (Enrollment) (n = 168)			
	500 or less	108	64.3%
	More than 500 to 1000	24	14.3%
	More than 1000	36	21.4%
School Socioeconomic Status (Reduced or Free Lunch) (n = 179)			
	20% or less	46	25.7%
	More than 20% to 40%	85	47.5%
	More than 40%	48	26.8%
Schools Having a Team for Data Collection and Analysis (n = 181)			
	Yes	118	65.2%
	No	63	34.8%
Schools Required to Implement Data-Driven Decision making by District (n = 179)			
	Yes	131	73.2%
	No	48	26.8%

Data Collection

Data collection for this study combined on-line and mail surveys. All the survey participants were informed of the data definition (Bernhardt, 2008) before they responded to the survey items of 3DMIIL (Data-Driven Decision making Index for Instructional Leadership). One hundred and one principals successfully responded to the online survey. In order to increase the return rate, an appreciation and reminder email message was sent to all the survey participants two weeks following the initial email communication, thanking those who may had already participated and encouraging those that had not done so.

Mail surveys were sent to those high school principals whose email addresses were not included in the list or whose email addresses were not correct, and those who emailed the researcher and reported difficulties in doing the online surveys. Of the 163 mail surveys, 91 principals (55.8%) returned their survey responses to the researcher. The combination of online and mail survey generated a total of 183 usable surveys, which provided an overall return rate of 62.2% of the total population of 294 high school principals in the state.

Survey Instruments

The survey instruments used for data collection in this study were the Data-Driven Decision making Index for Instructional Leadership (3DMIIL) (see Appendix A),

the Data Quality Index (DQI) (see Appendix B), Data Accessibility Index (DAI) (see Appendix C), and Data Analysis Skills Index (DASI) (see Appendix D).

The development of the 3DMIIL was based on the framework of Educational Leadership Constituent Council (ELCC) (2011) standards of the building level leadership adopted by NCATE. The ELCC standards highlight the values of data-driven decision making in the dimension of instructional leadership. The 3DMILL included items developed to measure the principals' data use for decision making derived from the ELCC standards of instructional leadership. The items were designed to measure the frequency of the principals' data use for decision making practices in instructional leadership in their schools. The items were defined as "how frequently do you practice this?" with a corresponding 5-choice scale as follows: (1) rarely or never, (2) seldom, (3) sometimes, (4) often, and (5) usually or always.

The DQI was composed of six survey questions measuring principals' perceptions of data quality on accuracy, objectivity, believability, completeness, and applicability. The DAI included three items that were developed to measure principals' accessibility of data. All these nine items in the two scales were selected from the Information Quality Questionnaires (IQQ) (Wang & Strong, 1996), which has been proved reliable and valid in business. All the survey questions in these two scales had the following five response choices: (1) strongly disagree, (2) disagree, (3) neutral, (4) agree, and (5) strongly agree.

The DASI included three items measuring principals' data analysis skills and were developed based upon the suggestions of several high school principals and research (e.g., McIntire, 2002). School administrators needed to have the fundamental spreadsheet and database techniques such as filtering, sorting, and creating pivot tables and histograms, and also some fundamental data analysis. Principals were asked to rate their comfort level in the three tasks related to data analysis. There were five response choices: (1) very uncomfortable, (2) uncomfortable, (3) somewhat comfortable, (4) comfortable, and (5) very comfortable. In addition, two questions were developed by the researcher to ask whether school districts required data-driven decision making, and whether the high school established a team for data analysis. All these above five factors were believed to be related to the practices of data-driven decision making based on the above literature review.

The survey questions of 3DMIIL were developed by a panel of school administrators and derived directly from the ELCC (2011) instructional leadership program standards. The construction of the survey questions was also based on definitions of data (Bernhardt, 2008; Davenport & Prusak, 1998) and data-driven decision making (O'Reilly, 1983; Streifer, 2002) found in the literature. The survey items were reviewed by the researcher and then by four professors teaching data analysis for school leadership, two field experts on school data analysis, and five high school principals. These steps added values to the content validity of the survey instrument.

Variables and Statistical Analyses

Independent variables in this study included the following five variables: (a) a principal's self-evaluation of his or her data analysis skills, (b) a principal's self-evaluation of data quality, (c) school district requirement of data-driven decision making, (d) establishment of team for data analysis in the school, and (e) accessibility of data. The dependent variable was the frequency of principals' data use in decision making practices in instructional leadership.

Factor analysis was used to determine the underlying constructs for measures on the 3DMIIL. Cronbach's alphas were used to measure the internal consistency reliability of all the multi-itemed constructs for the data collected from all the respondents. As a preliminary analysis, mean scores and standard deviations for each the 3DMQIL items were calculated to investigate how often high school principals used data for their decision makings in instructional leadership. Multiple regression analyses were conducted to determine what factors were significantly related to principals' data use in instructional leadership. Specifically, it attempted to determine whether the five independent variables predicted principals' data-driven decision making practices in instructional leadership.

Results

Principal components analysis was conducted utilizing a varimax rotation, which indicated that the 3DMIIL accounted for 60.0% of the variance. The reliability coefficients of the Cronbach's alpha estimates for all the scales in the four instruments ranged from .84 to .88. Based on the results of these analyses, the survey instruments were deemed credible and reliable.

Table 2 presents the descriptive statistics of overall mean scores and standard deviations for data use for instructional leadership. Mean and standard deviations of the nine individual items in the 3DMIIL is also provided in Table 2. The overall mean scores revealed that high school principals often used data in addressing administrative problems in instructional leadership (M = 3.99, SD = 0.54). Over half of the principals (51.4%) reported their mean scores within the range of from four (often) to five (usually or always), indicating this group of surveyed principals used data for instructional leadership in a high frequency.

Standard multiple regression results indicated that the overall model significantly predicted principals' data-driven decision making practices in instructional leadership, *R Square* = .210, *Adjusted R Square*= .186, F (5, 166) = 8.818, p < .001. This model accounted for 21% of variance in principals' data use in instructional leadership. A summary of regression coefficients is presented in Table 3. Two of the five variables: (a) principals' perceptions of data quality (p <.01), and (b) their data analysis skills (p <.01), significantly contributed to the model. The other three variables: (a) principals' data accessibility (p >.05), (b) school data analysis team (p >.05), and (c) school district requirement for data-driven decision making (p >.05) were not significant predictors.

Table 2

Means and Standard Deviations of the 3DMIIL Constructs and Individual Items

Item No.	*Item*		*M*	*SD*
Leadership in School Instruction		3.99	0.54	
I use data to identify problems in student learning.			4.24	0.69
I use data to generate approaches to curriculum improvement.			4.23	0.71
I use data to make recommendations regarding learning programs.			4.20	0.73
I use data to determine whether specific programs lead to improved achievement.			4.16	0.70
I use data to plan professional development programs.			4.04	0.78
I use data to evaluate the instructional efficiency of the school.			3.84	0.86
I use data to assess learning equity for different populations.		3.77	0.96	
I use data to guide my decision making in budget formulation focus on student learning.		3.68	0.98	
I use data to predict the outcome of new instructional programs.			3.66	0.90

Table 3

Coefficients for Model Variables of the Leadership Construct of School Instruction

	B	β	*t*	*p*	*Bivariate r*	*Partial r*	*Tolerance*
(Constant)	2.408		9.200	.001			
Data analysis skills	0.136	0.226	3.012	.003	.314	.208	.843
Evaluation of Data	0.208	0.224	2.839	.005	.354	.215	.765
Data accessibility	0.045	0.069	0.848	.398	.293	.066	.711
School team	0.109	0.096	1.310	.192	.155	.101	.892
District requirement	0.132	0.107	1.434	.154	.225	.111	.849

The procedures of data screening and residual scatterplots were conducted to examine the assumptions for the multiple regression. Figure 1 indicates that the points clustered along the horizontal zero line in a well-distributed way, showing that the assumptions of normality, linearity, and homoscedasticity were tenable. All of the

tolerance statistics were greater than .1 (see Table 3), indicating that there was not a multicollinearity problem among the independent variables.

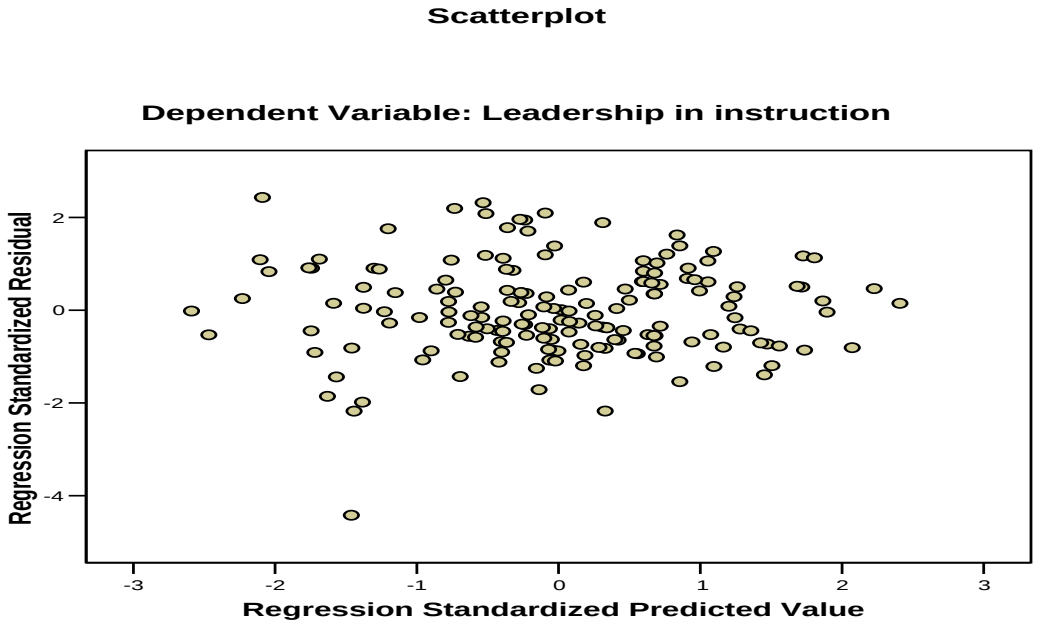

Figure 1. Residuals plots of standardized residuals versus predicted values for Leadership Construct of School Instruction

Discussion

Principals' Data Use for Instructional Leadership

The self-reported responses reveal an overall picture of the high school principals' data use in their instructional leadership. The results of this study indicate that the overall high school principals' frequency level of using data for decision making reached "often" with the mean scores of 3.99. These descriptive statistics not only provide the evidence that the high school principals practiced data-driven decision making in instructional leadership, but also in an encouragingly high degree. This factual evidence was also confirmed by looking at the percentage of principals who responded that their use of data for decision making between the high frequency from "sometimes" to "often" was close to and over 50% in the instructional leadership.

Although it may not be the case that data-driven decision making is widely practiced among the high school principals, this study reveals that a majority of the principals frequently used data to guide their administrative decisions in instruction leadership. The results of this study are consistent with the literature on principals' data-driven decision making practices (e.g., LaFee, 2002; Mathew, 2002; Means. et al., 2010; Salpeter, 2004; Schildkamp & Kuiper, 2010). Accountability acting as a driving force of data-driven decision making, has added new responsibilities for states, districts,

and schools to exercise more and more efforts in collecting, analyzing and reporting data to prove their bottom line of school improvement.

After years of reinforcement of data-driven decision making in various efforts such as the areas of policy, research, and practice, it seems that an increased interest in data-driven decision making is apparent and it is being more frequently utilized. Principals seem to commonly recognize the benefits and values of data-driven decision making, and respond to the call in using data as a guide for decision making during the course of a decade in framing how school would react to the accountability environment. Principals will continue to focus their efforts with regard to student achievement and quality teaching and learning, and to seriously evaluate and analyze the existing data in their schools (Means. et al*.,* 2010). Under the mechanism of educational accountability, principals as the top leader in high schools are held accountable for student achievement. Data-driven decision making as part of school instructional leadership is an effective strategy for their leadership career success.

Factors Influencing Data Use for Instructional Leadership

Data analysis skills were found to have a significantly positive relationship to their data-driven decision making practices in the instructional leadership. The higher level a principal's data analysis skills, the more frequently he/she would use data for their decision making. This finding supports the literature and the conceptual framework in the essential role of data analysis skills in data-driven decision making education (e.g., Bernhardt, 2008; Goldring & Berends, 2009; Mandinach & Gummer, 2013; O'Day, 2002). Individuals with higher data analysis skills tend to process a higher measure of cognitive complexity, and therefore, are likely to process more information in complex decision situations than those who had low ability of cognitive complexity. The skills of searching information, designing and creating spreadsheets, and basic statistical analysis equip the principals with more complex cognitive structures, which make them better able to integrate information acquired into the decision making process.

Principals might be limited in the amount of information they can handle in a decision situation. However, with the skills of data analysis, principals as decision makers can process large amounts of data without consuming a great deal of time and are able to use real-time information that is relevant and useful for decision making. From this perspective, it is natural and reasonable that data analysis skills as the tools for information processing are strongly related to the data-driven decision making practices.

Principals' perceptions about data quality were found to significantly predict their frequency in using data for instructional leadership. The significant relationship between principals' perceptions of data quality and their data use indicates that principals who perceived data to be high quality (accuracy, objectivity, believability, completeness, and applicability) used data for decision making more frequently. This finding supports

O'Reilly's (1983) research on examining whether the perceived quality of the source of information was the important factor in determining levels of use of information. Results of the regression analyses also reveal that data quality is even more important than data analysis skills in predicting data use for decision making in instructional leadership. An individual's attitudes towards information are among the most important elements influencing information use (Bernhardt, 2008; Choo, 2002; Means. et al., 2010; Wohlstetter, et al., 2008). Data are more likely to be used for decision making in instructional leadership when data are found to be accurate and understandable, appropriately collected, and correctly processed. Principals use data for decision making when the data are objective, reflecting the true face of the programs and organization, with high reliability and validity and from a source deemed as trustworthy.

Findings of this study show that frequency of principals' data use in instructional leadership did not have so much to do with school district requirement of data-driven decision making, data accessibility, and the school team of data analysis. District requirements are critical in pointing the way for principals' effective data-driven decision making in early stages of reinforcing the practice. Because principals practice data-driven decision making frequently in instructional leadership, and they may have commonly recognized the importance and benefits of data-driven decision making, their use of data may have been institutionalized. They do not need the organization's hierarchical requirement to enforce them to use data for decision making. Their data-driven decision making is not based on external mandates and compliance but relies instead on perceptions of data quality and the skills necessary for collecting and analyzing data. They did not even worry significantly about whether data accessibility was easy or not for them.

The existence of school team of data collection and analysis does not seem to affect principals' data use in instructional leadership. Since much research exists that a team approach for data collection and analysis contribute to principals' data-driven decision making (e.g., Halverson et al., 2007; Long et al., 2008; Parsons, 2003), the results of this study may indicate that the teamwork reported by the principals does not functions well or work effectively. For instance, team members of data collection and analysis in these schools might not understand the team's mission or their own roles and responsibilities or they might not know how to do their tasks or buy into the team's purpose and goals.

It is a challenging task for principals to organize a well-coordinated team to share the burden of information processing and to put it into the central functioning for principals' data-driven decision making. Teamwork requires leaders to develop delicate organizational skills including eliminating the feelings of fears, creating trust and intimacy among the team members, and setting appropriate goals. Team members should be knowledgeable and well trained in information management including coordinating, organizing, prioritizing, and limiting the information. Team members must

also act as communication specialists. Therefore, a team approach does not mean simply finding several teachers and hoping for them to work effectively. There is a significant difference in supporting data-driven decision making between a team that works effectively and a team only composed of several teachers.

Conclusions and Implication for Leadership Education

Organizational decision making, in essence, is information behavior. A person's information behavior is the result of an interaction between who the person is and the environment (Taylor, 1991). The organizational context in which a decision is taken may affect the acquisition and use of information in decision making (O'Reilly, 1983). Principals' perceptions of data quality and data analysis skills were significantly influential in predicting their frequency of data use in instructional leadership. Integrating this result with the descriptive finding of high frequency of data use in instructional leadership, we can possibly propose that person-related or internal factors such as perceptions of data quality and data analysis skills tend to particularly contribute to principals' data use in instructional leadership, in which data-driven decision making is extensively practiced, commonly well accepted, and reinforced earlier.

The findings of this study point to the emerging and re-emerging importance of implementing data literacy in leadership education (Mandinach & Gummer, 2013). There is no lack of information for principals' decision making in the school (Bernhardt, 2008). The skills needed to search, select, perceive, evaluate, and use data can vary from total lack of information skills to some level of literacy. How the principals solve this discrepancy depends on their ability to embrace the basic competency of data literacy. Data literacy is the ability to understand and use data validly and effectively to inform decisions (Mandinach & Gummer, 2012). This conceptualization covers the two significant predictors of data analysis skills and data quality perceptions in data-driven instructional leadership.

Data literacy is a set of data and information skills that enable principals to recognize how to locate, collect, analyze, evaluate, integrate, and communicate information. These skills are critical in dealing with daily information and in using the broad array of tools to search and organize information, to analyze results, and to communicate and integrate the results for decision making (Bennet, 2004; Mandinach & Gummer, 2012; Means. et al., 2010). Since there is lack of building administrator preparation on how to use data as well as lack of district leadership support for data-driven decision making (Means. et al., 2010), this study reveals the essential need of data literacy education for school administrators and their candidates. Its importance is even enhanced with the recent research by Means et al. (2010) indicating that teacher preparation and district leadership appear to re-emerge as perceived major barriers for districts that have been engaged in spreading data-driven decision making for six years or more.

Data quality was more important than data analysis skills in predicting data use for decision making in instructional leadership. Expertise and capacity at the school site for data-driven decision making is necessary but not a sufficient condition for success (Wohlstetter et al., 2008). Reliability of data remains a challenge for school leaders to conduct data-driven decision making (Salpeter, 2004). In addition to data analysis skills, data literacy education requires the more important component on how to evaluate and analyze data validly which leads to the perception of data quality. It is essential to learn how to develop validation processes and procedures and better understand the data definitions. The district also should know how to create an effective information use environment in delivering high quality and reliable data that principals trust (Means. et al*.,* 2010).

In addressing the question of what data analysis skills are specifically necessary so that school administrators will often link data with their decision making, Mandinach and Gummer (2013) suggested that school leaders require the integration of two sets of data literacy. One is how to involve others in decision making and the other is how to use data in appropriate ways to guide their decision making (Holcomb, 1999). Skills in collecting and organizing multiple sources data into databases or spreadsheets represent the proverbial elements in conducting data-driven decision making (Bernhardt, 2008; Goldring & Berends, 2009; Streifer, 2002). How to manipulate the data, readying them for analysis, and using graphing for better representations of the data are critical issues in data-driven decision making. Finally, if principals are to incorporate the information into their cognitive maps or repertoire of strategies, they must have sufficient knowledge and ability to interpret it (O'Day, 2002).

This study had several limitations. First, the survey data for this study were self-reported, which tend to be subjective and possibly to be overrated. Second, this study was limited to several of the important contextual variables of Taylor's (1991) IUE model. The limited number of variables investigated did not have the capacity to analyze other IUE factors such as people's social network, people's attitude toward technology, school district and school, organization structure, school history, and decision process. Third, the instrument of 3DMIIL did not differentiate specific types of data to be used, which could possibly influence its content validity.

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Appendix A: Survey Instrument: Data-Driven Decision making Index for Instructional Leadership

Please read each statement carefully. Circle one of the following five scales that best describes your frequency of use of data for each statement.

1= Rarely or never
2= Seldom
3= Sometimes
4= Often
5= Usually or always

I use data to:

(1) make recommendations regarding learning programs.	1	2	3	4	5
(2) generate approaches to curriculum improvement.	1	2	3	4	5
(3) plan professional development programs.	1	2	3	4	5
(4) assess learning equity for different populations.	1	2	3	4	5
(5) evaluate the instructional efficiency of the school.	1	2	3	4	5
(6) predict the outcome of new instructional programs.	1	2	3	4	5
(7) identify problems in student learning.	1	2	3	4	5
(8) guide my decision making in budget formulation focus on student learning.	1	2	3	4	5
(9) determine whether specific programs lead to improved achievement**.**	1	2	3	4	5

Appendix B: Survey Instrument: Data Quality Scale

Please indicate your level of agreement with each of the following statements using the response scale listed below.

1= Strongly disagree
2= Disagree
3= Neutral
4= Agree
5= Strongly agree

1) Data are believable.	1	2	3	4	5
2) Data are objective.	1	2	3	4	5
3) Data are reliable.	1	2	3	4	5
4) Data are accurate.	1	2	3	4	5
5) Data are applicable to my work.	1	2	3	4	5
6) Data come from good sources.	1	2	3	4	5

Appendix C: Survey Instrument: Data Accessibility Scale

Please indicate your level of agreement with each of the following statements using the response scale listed below.

1= Strongly disagree
2= Disagree
3= Neutral
4= Agree
5= Strongly agree

1) Data are easily obtainable.	1	2	3	4	5
2) Data are easily retrievable.	1	2	3	4	5
3) Data are quickly accessible when needed.	1	2	3	4	5

Appendix D: Survey Instrument: Data Analysis Skills Scale

Please rate your comfort level for the following tasks using the response scale listed below in the next page:

1= Very uncomfortable
2= Uncomfortable
3= Somewhat comfortable
4= Comfortable
5= Very comfortable

1) Search information from databases	1	2	3	4	5
2) Design and create spreadsheets	1	2	3	4	5
3) Do some basic statistical data analyses	1	2	3	4	5

