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Abstract

As school leaders, principals must seek, use, and make sense of data and information. This study presents the findings of a survey study of 182 high school principals' data use and examines the differences in the extent of principals' data use for decision making in solving various dimensions of administrative problems. Results show principals used data frequently for decision-making in instructional leadership, organization operational leadership and school vision leadership, among which data use in instructional leadership was most frequent. Principals' use of data was significantly less frequent in the leadership dimension of collaborative partnerships and larger-context politics. This article ends with implications with regard to improving school leadership programs in meeting the emergent need of preparing data driven decision makers and suggestions for research relevant to the central topic of data-driven decision making.

Keywords: principal, administrative problem, data use, data-driven decision-making

Introduction

From a cognitive science perspective, school administration is mostly the administrative behaviors that are problem-based and problem-driven. It is characterized by problem-related choices that principals make. By the nature of their jobs, principals are problem finders and problem solvers (Davis & Davis, 2003; Glasman, 1994; Leithwood & Steinbach, 1995; Mintzberg, 1980). A problem exists whenever there is a gap between where the solver is (current state) and where he/she wants to be (goal state). Problems at schools, in a broad sense, are synonymous with tasks (Leithwood & Steinbach). Principals deal with various aspects of administrative problems or tasks including pedagogical problems, instructional improvement issues, and organizational issues.

As problem solvers, principals must seek, use, and make sense of data and information. Data-driven decision-making originating from business management models (Deming, 1986) has contributed to the foundational activities that underlie No Child Left Behind. Data-driven decision making in schools is the purposeful process of selecting, gathering and analyzing relevant data to define school administrative problems, identifying or developing alternative solutions, estimating outcomes of the alternative solutions, and choosing the preferred alternative in addressing the administrative

problems (O'Reilly, 1983; Simon, 1997; Streifer, 2002). For data use to lead to school improvement, it is important to further research on the concept of data-driven decision making (Schildkamp & Kuiper, 2010) as it continues to impact building level administrators who face ever-increasing public and policy pressure to improve schools and provide education equity. The importance of knowing how to use data or evidence in decision making was also highlighted in reports informing the formation of the National Council for Accreditation of Teacher Education (NCATE) Educational Leadership Constituent Council (ELCC) (2011) Educational Leadership Program Standards.

A problem-solving perspective on school leadership focuses our attention on the thought processes underlying the administrative information behavior of data-driven decision making (Perez & Uline, 2003). Such a perspective poses the need to increase our understanding of the relationship between school leaders' data use and administrative problem solving. It is essential for us to investigate the relationship of these two important factors in the topic of data-driven decision making. This study presents the findings of a survey study of high school principals' data use relevant to different administrative problems and examines the differences in the frequency of principals' data use for decision making in various administrative problem solving dimensions.

Conceptual Framework and Literature Review

Administrative behavior theory (Simon, 1997) suggests that a major priority task in solving administrative problems in organization is to determine where the knowledge or information is located that can provide the various kinds of factual premises that decisions require. The function of knowledge in the decision-making process of solving administrative problems is to determine which consequences follow upon which of the alternative strategies. Since knowledge can be transformed and generated by administrators' use of data and information (Davenport & Prusak, 2000), data functions as a basis for comparative prediction in the problem solving process. If the predictions are accurate, then a correct decision can be made (Simon, 1997). Information behaviors such as principals' data use for decision-making are driven by the problems characterized by the dimensions that are applied to judge the usefulness of information, their perceptions about problem resolution that regulates the intensity of the principals' information search and their expectations about the kinds of information they need (Taylor, 1991; O'Reilly, 1983). It can be logically hypothesized that characteristics of different kinds of administrative problems and their solutions influence the use of data for decision making.

Drucker (1966) proposed two basic kinds of problems related to generic or unique decisions. Problems of generic decisions are routinely solved by formulaic rules and regulations established by the organization. Problems of unique decisions are problems that are not adequately answered by a general principle or rule. Similarly, Simon (1973) categorized problems into two groups: structured and ill-structured problems. Problems faced by principals tend to exist along a continuum that ranges from highly structured to ill-structured problems or even dilemmas (Leithwood & Steinbach, 1995; Smith & Piele, 1997; Ubben & Hughes, 1997). Most problems vary according to the extent to which they affect all functions of an organization, the number and layers of individuals within the

organization, and the degree to which they represent a particular class (Davis & Davis, 2003).

In examining the extent of data use for decision making, the most significant dimensions of problems are well structured and ill structured (Taylor, 1991). The terms of structured and ill-structured problems denote the amount of relevant knowledge and skills principals possess when encountering a problem and the degree of certainty they have for an effective solution. Structured problems stimulate well-developed responses that demand less conscious thought process while ill-structured problems require more thoughts and create a significant role for information collection skills (Leithwood & Steinbach, 1995). Well-structured problems can be solved by the application of logical and algorithmic process, and tend to require hard data. Ill-structured problems have variables that are not well understood and require more probabilistic information on how to proceed rather than data. Each of these dimensions would appear to have an effect on the kinds of information deemed useful (Taylor, 1991).

"Everyday problems encountered by school leaders are typically very complex in terms of the actual analyses needed to properly address the issue" (Streifer, 2002, p. 4). Streifer insisted that problems of equity, student achievement, school improvement, and systemic reform are more complex. They require multiple analyses covering various subcomponents of the problem and a consideration of sub-analysis in the light of the whole before a broad picture of the problem and potential solutions can be understood. One of the keys of data-driven decision making is the ability to effectively frame problems and develop a "concept map" that breaks the problem into more manageable components for data analysis. "When data become 'more dense' through use of as many pertinent variables as possible, our fundamental understanding of the problem will become enriched, leading us to make better decisions" (Streifer, p. 8). Based on the case study of two schools involving in data-driven decision-making, Streifer concluded that complex problems require comprehensive data and multiple analyses.

However, Davis and Davis (2003) argued that most of the toughest school administrative decisions made by principals are the ones where the computer and lots of quantitative data just are not useful. Instead, most of the difficult decisions are made with a considerable amount of intuitive or gut feelings. Findings of the survey study supported this argument that intuition, instead of data-based rational and analytical thinking, seems to emerge when problems are complex, nontransparent, and messy. The use of intuition depends upon one or more of the following factors: the complexity of the problem, the immediacy of the problem, the characteristics and needs of the participants of involved with the problem, the degree of knowledge about problem facts, and the impact of the decision outcomes (Agor, 1986; Davis & Davis, 2003; Hogarth, 2001).

Conceptual framework and review of limited literature presented suggests the logical reasoning that characteristics of administrative problems to be solved could impact an administrator's use of data for decision making. Results of research used small samples seem to somewhat support this notion. However, research reveals inconsistent results on the relationship between data use and types of administrative problems to be solved, which poses the question of whether principals are likely to use more or less data in solving complex or difficult administrative problems. More research, particularly using larger sample size, is needed not only to retest the conceptual framework, but also to specify the relationship between the frequency of data use and administrative problem

dimensions that are clearly defined. Therefore, the purpose of this study is to examine the differences in the extent of principals' data use for decision making in different administrative problem dimensions. This study also aimed to add to the limited body of the data-driven decision making research and provide evidences for leadership programs to enhance data-driven decision making skills in preparing school leaders in the age of education accountability.

Methodology

This study used a cross-sectional survey research approach to examine the differences in principals' data use in addressing different school administrative problems. A quantitative study requires collection of reliable, accurate and objective data, and systematic analysis of that data. The cross-sectional approach is utilized to develop a portrait and understanding of the particular phenomenon of principals' data-driven decision-making practices in addressing administrative problems. Surveys are useful tools for collecting information from people to describe and compare their behaviors and attitudes (Fink, 2003), and probably the best method for gathering original data from a large population (Babbie, 2002), such as the high school principals in this study.

The administrative problems of the different leadership dimensions are operationally framed based upon the standards of the Educational Leadership Constituent Council (ELCC) (2011). These standards are educational leadership program standards developed by ELCC and adopted by the National Council for Accreditation of Teacher Education (NCATE) (2011). In this study, administrative problems are confined to the specific areas that were stated as the items of the leadership dimensions of school vision, school instruction, school organization, collaborative partnerships (ELCC/NCATE). Data is defined as "a set of discrete, objective facts about events", which is the essential raw material for the creation of information (Davenport & Prusak, 1998, p. 2). In this study, data is 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.

Participants

A total of 182 high school principals in a Midwest state participated in this study. They are 63.0% of the population of the 289 individuals with the title of principal in public high schools. A response rate of 60% is good in its representativeness of the population (Babbie, 2002). 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 the younger groups. The lowest level of educational attainment for all principals was the master 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 presents the description of the total 182 participants' demographic information including their gender, age, ethnicity, and educational attainment.

Table 1
Demographic Information of the Survey Respondents and their Schools

	<i>Frequency</i>	<i>Percent of Total</i>
<i>Gender (n = 180)</i>		
Male	145	80.6%
Female	35	19.4%
<i>Age (n = 179)</i>		
29 to 40	34	19.0%
More than 40 to 50	65	36.3%
More than 50 to 62	80	44.7%
<i>Ethnicity (n = 182)</i>		
African American	4	2.2%
Caucasian	178	97.8%
<i>Educational Attainment (n = 182)</i>		
Ph. D or Ed. D	22	12.1%
Ed. S (educational specialist)	54	29.7%
Master's degree	106	58.2%
<i>Length of Total School Administrative Experience (n = 175)</i>		
Less than 1 to 5 years	34	19.4%
More than 5 to 10 years	44	25.1%
More than 10 to 15 years	28	16.0%
More than 15 to 20 years	28	16.0%
More than 20 years	41	23.4%
<i>Length of Holding the Principal Position at Current School (n = 175)</i>		
1 year or less	23	13.1%
More than 1 to 3 years	46	26.3%
More than 3 to 6 years	41	23.4%
More than 6 to 10 years	32	18.3%
More than 10 years	33	18.9%
<i>School Size (Enrollment) (n = 168)</i>		
500 or less	108	64.3%
More than 500 to 1000	24	14.3%
More than 1000	36	21.4%

Survey Instrument

The survey instrument used for data collection in this study was the Principal Data-Driven Decision-Making Index (P3DMI) (see Appendix A). The instrument served to collect data leading to quantitative or numerical descriptions of the targeted aspects of data used in addressing administrative problems for the study population of high school principals. The P3DMI included items developed to measure the principals' practices of data-driven decision-making based upon the framework of the ELCC/NCATE (2011) building level leadership program standards. The P3DMI survey questions included items derived mainly from the following four constructs of the ELCC standards of administrative problems: (a) school vision, (b) school instruction, (c) school organization, and (d) collaborative partnerships. The items were designed to measure the frequency of the principals' data-driven decision-making practices. 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 survey questions of P3DMI were developed by a panel of school administrators and derived directly from the ELCC (2011) leadership program standards. Each survey question was directly traceable to a specific ELCC leadership program standard. The construction of the survey questions was also based on definitions of data (Bernhardt, 1998; 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, and five high school principals. The survey instrument was also pilot-tested to help the researchers identify errors, readjust the design, and predict possible problems (Litwin, 2003). All these steps helped to build the content and construct validity of the instrument. The four constructs of data use in addressing administrative problems included (a) school vision, (b) school instruction, (c) school organization, and (d) collaborative partnerships. 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. The reliability coefficients estimates for all the scales in these instruments ranged from .84 to .88, which indicated that the survey instruments were deemed highly reliable.

Data Collection, Analysis, and Variables

The survey instrument of P3DMI was administered using both on-line and mail. All the survey participants were informed of the data definition before they responded to the survey items. In order to increase the return rate, an appreciation and reminder email messages were 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. The combination of online and mailed surveys generated a total of 183 usable surveys, providing an overall return rate of 63.3% of the total population of the 289 high school principals in the state.

As a preliminary analysis, mean scores and standard deviations for each of the P3DMI items were calculated to investigate how frequent high school principals used data for addressing the administrative problems. Descriptive statistics such as average mean scores and standard deviations in each of the four constructs of administrative problems: (a) school vision; (b) school instruction; (c) school organizational operation and (d) collaborative partnerships were used to examine the extent of principals' use of data to solve the administrative problems. The one-way within-subject analysis of variance (ANOVA) was conducted to evaluate the systematic differences among the mean scores of data use in solving these four constructs of administrative problems. The independent variable for ANOVA was the principals' administrative problems in the four different dimensions: (a) school vision, (b) school instruction, (c) school organization, and (d) collaborative partnerships. The dependent variable was the extent of data use in addressing these administrative problems.

Results

Table 2 presents the descriptive statistics of overall mean scores and standard deviations for each of the four constructs using data to address the administrative problem in (a) school vision, (b) school instruction (c) school organizational operation and (d) collaborative partnerships. Mean and standard deviations of the 30 individual items in the P3DMI are also provided in Table 2. The items of each construct were ranked in order from the highest to the lowest mean for the purpose of understanding the extent of the differences of principals' data-driven decision-making practices among the individual items.

Table 2
Means and Standard Deviations of the P3DMI Constructs and Individual Items

<i>Item No.</i>	<i>Item</i>	<i>M</i>	<i>SD</i>
<i>Extent of Data Use for Administrative Problems in School Vision</i>			
	I use data to develop a school vision of learning that promotes the success of all students.	4.01	0.92
	I use data to make decisions in aligning resources with the school vision.	3.98	0.87
	I use data to determine what strategies to use in achieving the goals of advocating for all students.	3.76	0.90
	I use data to generate potential elements of a vision statement.	3.56	1.01
	I use data to develop alternatives for implementing the vision.	3.49	0.87
	I use data to define possible problems in vision implementation.	3.36	0.96
<i>Extent of Data Use for Administrative Problems in School Instruction</i>			
	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 predict the outcome of new instructional programs.	3.66	0.90
<i>Extent of Data Use for Administrative Problems in School Organizational Operation</i>			
	I use data to promote an environment for improved student achievement.	4.28	0.72
	I use data to monitor instructional practices of the school organization.	4.18	0.75
	I use data to advocate for policies that promote success for all students.	4.10	0.87
	I use data to assign human resources in ways that promote student achievement.	3.93	0.82
	I use data to insure that staff members are treated fairly.	3.90	1.02
	I use data to identify safety issues.	3.83	0.92
	I use data to judge my performance in effective management.	3.68	0.86

(Table 2 continued)
Means and Standard Deviations of the P3DMI Constructs and Individual Items

<i>Item No.</i>	<i>Item</i>	<i>M</i>	<i>SD</i>
	<i>Extent of Data Use for Administrative Problems in Collaborative Partnerships</i>	3.29	0.77
	I use data to measure the effectiveness of outreach to the community.	4.16	0.70
	I use data to develop effective communication plans.	3.70	0.90
	I use data to understand the larger context of the community, which affects opportunities for students.	3.66	0.93
	I use data to determine what type of community input should be gained.	3.32	0.94
	I use data to mobilize community resources for the benefit of student learning.	3.28	1.01
	I use data to gauge the effectiveness of collaborative relationships with the community.	3.21	0.96
	I use data to develop effective approaches for school-family partnership.	3.20	0.94
	I use data to generate approaches with school stakeholders that reflect their concern.	3.20	1.02
	I use data to negotiate with political decision makers for the improvement of students' educational opportunities.	3.18	1.11

The overall mean scores revealed that high school principals sometimes and/or often used data in addressing administrative problems in all the four leadership constructs. The highest overall mean score among these four constructs was the administrative problems dimension of school instruction ($M = 3.99$, $SD = 0.54$). This indicated that the principals used data more frequently in addressing problems or making decisions in school instructional leadership rather than the other leadership dimensions. The frequency of principals' data use in the administrative problem areas of school organizational operation was also relatively high ($M = 3.88$, $SD = 0.67$). The overall mean scores of the frequency of principals' data use in the administrative problem dimension of school vision were at the third place ($M = 3.71$, $SD = 0.71$), but close to the overall means of the above two dimensions. With comparison to the above three dimensions, the principals' data use were frequently low in the administrative problem dimension of collaborative partnerships ($M = 3.29$, $SD = 0.77$).

The one-way within-subject analysis of variance (ANOVA) yielded results of significant differences among the mean scores of the frequency of principals' data use in the four administrative problem constructs, Wilks' $\lambda = 0.367$, $F(3, 167) = 95.85$, $p < .001$, $Partial \eta^2 = .633$. Follow-up paired t -tests for the six pairs of differences in the four leadership constructs evaluated at 0.01/6 or 0.002 level using Bonferroni procedure indicated that only one pair, school organizational operation versus school instruction, was non-significant, $t(177) = 2.509$, $p = .013$, $d = .189$. The data use frequency of the administrative problem construct of collaborative partnerships was significantly lower

than the other three constructs: (a) school organizational operation, $t(174) = -14.471, p < .001, d=1.097$; (b) school instruction, $t(175) = -16.112, p < .001, d=1.218$; and (c) school vision, $t(174) = -10.321, p < .001, d=.782$. All the values of the effect size (d) in these three tests represented large-sized effects, which indicated the differences were practically substantial. The data use frequency of the administrative problem construct of school vision was significantly lower than that of school organizational operation, $t(176) = -4.328, p < .001, d=.326$, and school instruction, $t(177) = -7.189, p < .001, d=.540$. The values of the effect size (d) in these two tests represented medium-sized effects.

Discussion

Taylor (1991) asserted that “each of the definable Information Use Environments has a discrete class of problems, spawned by its particular setting and by the exigencies of its profession, occupation, or life style” (p. 225). Accordingly, high school principals’ administrative problems can be divided into four categories based upon the factor analysis: (a) school vision, (b) school instruction (c) school organizational operation and (d) collaborative partnerships. The overall mean scores indicate that the principals used data in a high frequency in problems solving and decision-making in the three constructs of (a) school instruction ($M = 3.99$), (b) school organizational operation ($M = 3.88$), and (c) school vision ($M = 3.71$). Data were used the most frequently in school instruction dimension of administrative problems, which reached the high frequency level of “often” and “usually or always”. Data were used the least frequently in the administrative problem dimension of collaborative partnerships ($M = 3.29$), which was significantly lower than the other three constructs in overall mean scores.

There existed the significant systematic differences among the mean scores on the four leadership constructs. This finding supports the notion that a high school principal’s administrative problems emerging in the school context define the shape of his/her information seeking and use. Problem dimensions that are the characteristics and nature of the typical problems faced by the particular set of people (principal) can have an effect on their data use (Taylor, 1991). Data were most frequently used by principals in addressing problems in curriculum, teaching, and learning at school, which reflects the realities that data-driven decision-making was primarily and/or urgently demanded with the purposes of improving student achievement in the accountability movement, especially with the implementation of the No Child Left Behind. The use of data is focused in solving problems of school improvement (Bernhardt, 1998; Thornton & Perreault, 2002). Data-driven decision-making is mostly referred in a narrow sense to using data in solving problems and making decisions of school instruction and student learning, which can be shown in both practice and research. Principals who assume the role of instructional leaders should value information and can be more likely to gather and rely on information in making decisions (McColskey et al., 1985).

There is very little theoretical or practiced-based literature about data-driven decision-making in addressing administrative problems in school-community relations and collaborative partnerships. Therefore, this reasonably supports the finding that principals least frequently practiced data-drive decision-making in the administrative problem construct of collaborative partnerships. Problems act as surrogates of the information use environment, and because they encapsulate enough of the more salient

demands of the use of environment, problem dimensions contribute to the information needs and use in decision-making (MacMullin & Taylor, 1984).

Another aspect of problem dimension that Taylor (1991) proposed is to define information need and serve as criteria by which the relevance of information to a problem will be judged. MacMullin and Taylor (1984) identified 11 problem dimensions as lying on a continuum that would appear to have an effect on the kinds of information deemed useful. Among these dimensions, the most significant are well structured/ill structured, and complex/simple. Structured problems demand less conscious thought process while ill-structured problems require more thoughts and create a significant role for information collection skills (Leithwood & Steinbach, 1995). This proposition is supported by the results of this study that principals most frequently used data for decision-making in student achievement, school improvement, and equity, which were believed to be complex or ill-structured problems by Streifer (2002).

If administrative problems solved with less data are well-structured problems, the results of the study would suggest that the administrative problems in school-community relations and larger-context politics tend to be less ill-structured and less complex problems for the principals because principals used data the least frequently. This is not only demonstrated by the lowest overall mean scores, but also by the individual items with lower mean scores.

On the contrary, some research literature and propositions insisted that most of the difficult decisions posed by ill-structured problems are made with a considerable amount of intuitive or gut feelings instead of the rational/analytical approach based upon data analysis (Agor, 1986; Davis & Davis, 2003; Hogarth, 2001). If this proved to be true for the principals, the different results of data use in different leadership dimensions found by this study would indicate that the administrative problems in collaborative partnerships were more complex and ill-structured problems for the principals while other administrative problems tended to be less ill-structured and complex. This proposition seems to be consistent with Leithwood and Steinbach (1995) notion that parent problems, community problems, and Ministry of Education problems have a high incidence of ill-structured problem characteristics. The topic that which proposition is true for the majority of high school principals seems to be complicated, but obviously interesting, which needs more delicate and more in-depth studies in order to offer a persuasive answer.

Finally, it is interesting and noteworthy that the finding of this study was somewhat different from the Davis' and Davis' (2003) study on the areas of decisions that are made mostly upon the principals' intuition instead of data-based rational analyses. Results of their study in California indicated that secondary principals mostly use their intuition for making decisions in the areas of program, policy, school safety, staffing, and assignments. This study demonstrated that high school principals in the Midwest state used data more frequently for their decision-making in the above areas. The comparison of these two studies provides evidence that principals' use of data or intuition for decision making could be very complex, dynamics and situational (Choo, 1998; Francis, 2010; O'Reilly, 1983; Taylor, 1991).

Conclusions and Implications

In consistence with the conceptual framework (O'Reilly, 1983; Simon, 1997; Taylor, 1991), there were differences in principals' use of data for addressing administrative problems in the decision-making process. Principals used data frequently in addressing instructional, organization operational and school vision administrative problems, among which data use in solving instructional administrative problems was the most frequent. Principals' use of data was at a much lower level for problem solving in external leadership dimensions of collaborative partnerships and larger-context politics.

This study provides findings related to the attention-attracting topic of data-driven decision-making which connotes some important practical implications for improving data-driven decision-making in preparing school leaders in the age of education accountability. Data-driven decision-making skills in education leadership program can be targeted and focused on how to effectively use data to address administrative problems in the leadership dimensions of instruction, vision development and school organization, which were also supported by the results of this study. Efforts should also be made to promote data-driven decision-making in leadership dimension of collaborative partnerships.

School district strategies for improving data-driven decision-making should be used in an integrated approach based on the notion that information behaviors are situational and the factors of the information use environments interact with each other (Choo, 1998; O'Reilly, 1983; Taylor, 1991). This notion is strongly supported by the findings of this study. For improving data-driven decision-making in instructional leadership that has been practiced frequently and in a developed stage, school districts or policy makers should focus on their time, efforts, and financial supports on enhancing the internal or "higher-level" factors such as principals' data analysis and upgrade their attitudes towards data quality. For improving data-driven decision-making in the leadership areas such as collaborative partnership and school vision that have not been practiced so frequently or at the initial stage, the external or "lower-level" factors such as school district requirement and data accessibility should be strongly emphasized.

Limitations and Suggestions for Further Research

This study had several limitations. First, the survey data for this study were self-reported, which tended to be subjective and possibly were overrated. This suggests a need of using broadened study subjects, for instance, examining teachers and/or superintendents' perceptions on principals' use of data. Second, as this study did not differentiate data in investigating principals' data use, future studies might look at what types of data are mostly used or preferred by principals in different dimensions of administrative problem solving, if there are any differences, and how principals acquire and use data in the process of decision-making.

Finally, the relationship between data-driven decision-making and the effectiveness in addressing the administrative problems was beyond the scope of this study. However, a positive relationship was assumed, which is the premise of data-driven decision-making and represents the beliefs and values of most policy makers and educators under the

movement of accountability. It is another important area that needs comprehensive empirical research to support the premise of data-driven decision-making. Future studies may look at what level of data use for solving different administrative problems is effective and well accepted by principals and whether data-based rationality contradicts with “gut-feeling” in decision-making.

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