Structural Equation Modeling for High School Principals’ Data-Driven Decision Making: An Analysis of Information Use Environments

Mingchu Luo

**Background:** Accountability demands are increasingly pushing school leaders to explore more data and do more sophisticated analyses. Data-driven decision making (DDDM) has become an emerging field of practice for school leadership and a central focus of education policy and practice.

**Purpose:** This study examined principals’ DDDM practices and identified the factors influencing DDDM using the theoretical frame of information use environments.

**Participants:** Participants were 183 public high school principals in a Midwestern state.

**Research Design:** The research design was cross-sectional survey research.

**Data Collection and Analysis:** Survey instruments were developed and administered to principals. Structural equation modeling was conducted to determine what factors significantly affect principals’ DDDM practices in different leadership dimensions.

**Findings:** Principals used data more frequently in instructional and organization operational leadership than in the leadership dimensions of school vision and collaborative partnerships. Different contextual factors affected data use in different leadership dimensions. Human-related factors such as perceptions of data quality and data analysis skills seemed to have direct effects on data use in addressing administrative problems in instruction and organizational operation, in which data were used frequently. Organization-related factors such as school district requirement and accessibility of data tended to have more direct influence on data use in the leadership dimensions of school vision and collaborative partnerships, where data were used less often.

**Conclusions:** This study supports the proposition that as information behavior, DDDM is situational, multidimensional, and dynamic. Results provide insights into practice, research, and theoretical foundation for the emerging topic of DDDM.

**Keywords:** data; data-driven decision making; information use environment; leadership dimension; principal

The passage and implementation of the No Child Left Behind Act (NCLB, 2001) opened a new era of educational accountability and school improvement.
Schools are held accountable to meet the adequate yearly progress, which requires educators to closely monitor student performance on the high-stake assessments. NCLB significantly increases the pressure on states, districts, and schools to collect, analyze, and report data. “In God we trust; all others bring data” (Deming, 1986) captures the essence of NCLB. Accountability demands are increasingly forcing school leaders to explore much more the granular data and to do more sophisticated analyses. Data-driven decision making (DDDM) has become an emerging field of practice for school leadership (Streifer, 2002) and a central focus of education policy and practice (Mandinach, Honey, & Light, 2006). Nationwide standards-based control and outcome-based funding have brought DDDM to the top of every principal’s agenda (Leithwood, Aitken, & Jantzi, 2001; Thornton & Perreault, 2002).

The extensive use of DDDM in policy and practices at schools reveals a strong need for research on the current realities of DDDM practices and factors influencing those practices. These are the critical issues in both practice and research, yet surprisingly little empirical research has actually been conducted on these issues, especially from the principal’s perspective. This study directly addresses this need, by examining the extent to which high school principals apply DDDM and identify factors in the principals’ work environments that may affect their DDDM practices. Furthermore, this study aims to present a rather complete picture of high school principals’ DDDM practices and help policy makers understand, assist, and support principals in light of the factors that impact their practices. The results of this study provide insights into the conditions of information use environment necessary for achieving good practices of principals’ DDDM.

Theoretical Framework

Taylor’s (1986, 1991) model of Information Use Environments (IUE) about information behaviors provides a useful theoretical framework for this study. This model indicates that information use depends not only on the subject matter or how well the information content fits a topic but also on the situational characteristics that are contingent on the user’s work and organizational contexts. Information behaviors such as principals’ DDDM are influenced by (1) the sets of people who share assumptions about the nature of their work and the role of information unit, (2) the problems

Author’s Note: This paper is based in part on the author’s doctoral dissertation completed at the University of Nebraska. The author acknowledges the contributions of Dr. Leon Dappen, Dr. Gary Hartzell, Dr. Laura Schulte, and Dr. John Hill for their comments and suggestions on earlier drafts of this paper.
characterized by dimensions that are applied to judge the usefulness of information, (3) the work settings that influence an individual’s attitude toward information as well as the availability and value of information, (4) and the perceptions about problem resolution that regulate the intensity of an individual’s information search and his or her expectations about the kinds of information he or she needs. 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 (Rosenbaum, 1993).

IUE (Taylor, 1991) was developed to study how context determines information needs, seeking, and use. Taylor asserted that IUE can 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 determination and prediction of the factors influencing the information behaviors in different professions and entrepreneurs and has provided a useful structure for the research on the information behaviors of a group or an organization (Choo, 2002; Rosenbaum, 1993; Taylor, 1991).

In addressing the areas of principals’ DDDM practice, the Educational Leadership Constituent Council (ELCC, 2002) standards were used as the framework for this study, through which high school principals’ DDDM was examined in different leadership dimensions. The National Policy Board for Educational Administration published the revised Standards for Advanced Programs in Educational Leadership in 2002, which were developed and revised by the ELCC (2002) and adopted by the National Council for the Accreditation of Teacher Education (NCATE, 2002). The ELCC standards serve as school leadership preparation program standards and can be used as a cornerstone for the professional development of existing school administrators (Murphy & Shipman, 1998; Murphy, Yff, & Shipman, 2000). Compared to the old standards, the revised standards have more emphasis placed on school administrators’ ability and knowledge in using data. DDDM is integral to the key school administrators’ skills in all the area standards.

Literature Review

Decision making process was defined as “the conversion of information into action,” which suggests an important role for information in the process (McClure, 1978, p. 382). Processing of information is a vital aspect of human behavior and is a critical input to the decision process (Taylor, 1986). Therefore, organizational decision making, in essence, is information behavior, whereas a person’s information behavior is the result of an interaction between the person and the environment (Rosenbaum, 1993).
Principal characteristics. Taylor’s (1991) model suggested that sets of people like principals in the same occupation or profession share assumptions and attitudes about the nature of work that impact their information behaviors. An individual’s assumptions and attitudes about the nature of work are influenced by his or her education, professional training, occupation, and usual activities, which bring about the characteristics of his or her information behaviors. Taylor suggested that the demographics such as age, gender, and race within the set of people might have an effect on individual information behaviors.

There seems to be a difference between experienced and novice principals in structuring, acquiring, and processing information (Hoy & Miskel, 1996; Lord & Maher, 1991). Experienced principals are more organized, integrated, and structured with critical elements strongly related to the problems and are better able to recall information about recent and distant events related to current problems. They often rely on nonrational, intuitive processes to make decisions because their expertise and knowledge allow them to immediately recognize key aspects of situations and to move efficiently to solution formulation and implementation (Lord & Hall, 1992). Therefore, they minimize the effortful, analytic processing of information to solve problems (Hoy & Miskel, 1996).

However, experienced principals can be highly efficient processors of information in specific social or task-related areas. Experienced principals in general are not superior in processing information, but only in the domains for which they have richly elaborated knowledge structures (Hoy & Miskel, 1996). Experienced principals may also be oriented to using more information in some complex decision making. Marsh’s (1992) research found that school leaders with higher abilities integrate the information management functions with their school leadership activities and are reflective about the use of information in teaching and learning, especially student results.

Education appears to be the most significant factor affecting individual information behaviors (Taylor, 1991). This notion was supported by studies of principals’ data use in decision making. High school principals without background in research and measurement have difficulty in understanding and interpreting the data presented to them for their decision making (McColskey, Altschuld, & Lawton, 1985). Principals who major in mathematics at college have their advantages in using data for decision making effectively (Mathews, 2002).

Data analysis skills related to principals’ education background and training experience seem to be a critical element influencing principals’ information behaviors of DDDM (Choppin, 2002; Mason, 2002). If principals are to “incorporate the information into their cognitive maps or repertoire of strategies, they must attend to it and must have sufficient knowledge and ability to interpret it”
Thus, it is the priority of DDDM for principals to have basic understanding of applied statistics, data analysis skills, and other necessary computer skills (Thornton & Perreault, 2002). Mathews’ study (2002) revealed that adequate skill training for analyzing and using data is essential for principals to carry out DDDM. Furthermore, the meaningfulness of the information generated by the school system varies in relation to the knowledge and skills of the users. 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 et al., 1985). Successful school leaders are skillful at interpreting and conducting research, evaluating programs, and planning for the future (J. R. Hoyle, English, & Steffy, 1994).

*Problem dimensions.* Principals’ problems arise from the contexts they work in and the roles they play. High school principals generally have administrative problems that can be mainly divided into six categories: school vision, instruction, organization, collaborative partnership, moral perspective, and larger-context politics (ELCC, 2002), which define the shape of principals’ information seeking and using (Taylor, 1991).

The more significant dimensions of problems that shape information use are whether the problem is well structured or ill structured. Each of these two dimensions would appear to have an effect on the kinds of information deemed useful (Taylor, 1991). The terms of structured and ill-structured problems denote the amount of relevant knowledge and skill 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, whereas ill-structured problems require more thought 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.

In contrast to Leithwood and Steinbach (1995), Davis and Davis (2003) argued that most of the toughest school administrative decisions made by principals are the ones in which 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 Davis and Davis’s (2003) 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 (Agor, 1986; Davis & Davis, 2003; Hogarth, 2001). The use of intuition depends on one or more of the following factors: the complexity of the problem, the immediacy of the
problem, the characteristics and needs of the participants involved with the problem, the degree of knowledge about problem facts, and the impact of the decision outcomes.

Organizational factors. 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 he or she seeks and makes use of information. Work setting features such as organizational hierarchical characteristics and access to information may influence attitudes toward information, the types and structures of information required, and the flow of availability of information, which finally affects information behaviors of DDDM. A supportive administrative organization structure plays a key role in the practice of DDDM (Armstrong & Anthes, 2001; Rudy & Conrad, 2004).

Power, as the criteria used in decision making (Pfeffer, 1992), impacts the organizational contextual influences on information use for decision making (O’Reilly, 1983). Principals’ willingness to provide opportunities for information acquisition may be tempered by their competitive notions of power (Kirby & Bogotch, 1993). Goldstein, Marcus, and Rausch (1978) described how groups often desire evaluation research to satisfy external demands, but simultaneously are looking for the results to justify established policies and procedures. Decision makers are more receptive to research conclusions that fit nicely into established policies. Based on the research and development laboratories (Pelz & Andrew, as cited in Taylor 1991), Taylor suggested that what executives emphasize and reward has a great deal to say about the importance of different kinds of information. Information is more likely to be used by decision makers when it is fed into an operating control system, which includes an effective set of incentives (O’Reilly, 1983).

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 across the state of Wyoming. Creating a policy structure to support and encourage DDDM is the important role for states and districts to implement school-level DDDM. State policy requirements for using data in school improvement have pressured principals to base their decisions on data (Mathews, 2002). As principals bear ultimate responsibility for effective DDDM, the district should have the appropriate policies in place to guarantee the implementation of data-driven improvement (American Association of School Administrators [AASA], 2002).
Principals’ successful integration of DDDM into educational strategy requires a team approach (AASA, 2002). Several 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 at schools (e.g., Bernhardt, 1998; Noyce, Perda, & Traver, 2000; Parsons, 2003). Baker and Richards (2004) emphasized that a team assembled for gathering and organizing data use at schools can make principals’ data-driven analysis more efficient. Thornton and Perreault (2002) suggested that a team approach can avoid or reduce conflicts and fears that may be caused by using data for decision making. Information is more likely to be used by decision makers if it does not lead to conflict among the set of relevant actors (O’Reilly, 1983).

Information is more likely to be used by decision makers if it is readily accessible (O’Reilly, 1983). The perceived ease of access to information appears in studies to be the most important variable governing use of information (Gerstenberger & Allen, 1968; O’Reilly, 1979, as cited in Taylor, 1991). Principals should be able to gain access to the data at schools and in classrooms so that they can efficiently conduct DDDM. LaFee (2002) confirmed that difficult data accessibility resulting from nonsystematic and incompatible data storing and organizing is an important reason why evolution of DDDM and the paradigm shift is painful.

Although data accessibility remains a prerequisite for principals’ DDDM, it is not the sole element that influences the use of information for decision making. Even when information is abundant and clear, some school leaders may just “stare directly at the information available to them, and then blithely ignore it” (Reeves, 2002, p. 95). Accessibility of data and information does not limit its connotations just within the physical access. It seems to have something to do with the perceived validity and utility of information (Taylor, 1991).

Perceptions of information quality. The quality of any information is judged by the user in terms of its 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 laboratory studies demonstrated that better quality information is generally associated with improved decision making performance (e.g., Porat & Haas, 1969; Streufert, 1973, both 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 (Glickman, 1993; Jamentz, 2001; LaFee, 2002). 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). The need for data validity and their users’ buy-in is critical for DDDM. If data from tests are to be used in decision making, then valid and reliable tests need to be written (Ediger, 2002).

The literature review indicates that factors related to principals’ practices of DDDM are various and complex. Factors can be derived from people, work settings, problem nature, and perceptions of information quality (Taylor, 1991). Specifically, they can be any of the following factors: principals’ education, experiences, data analysis skills, problem dimension, school district requirement and support, school data analysis team, accessibility of data, and perceptions of data quality.

However, there are two important issues that the past studies do not address: (1) which factors are significant, and (2) how the factors interrelate with each other in influencing DDDM. Data-driven decision making is an interactive, multifaceted, and contextual practice within the school organization. Decision makers, the uses of data, and the context within which decision makers make choices are interrelated. The situational context of information acquisition and use through which decisions are made are critical in understanding organizational decision making (O’Reilly, 1983).

The review of the literature also reveals that there are two areas of limitations in the research of principals’ DDDM. First, because of the small samples, the results based on the qualitative studies (e.g., Glickman, 1993; Jamentz, 2001; LaFee, 2002; Mathews, 2002; Noyce et al., 2000; Parsons, 2003) do not have the capacity to address the issue regarding general situations of DDDM practices of principals as a set of professionals. Second, DDDM practices are confined to the principals’ instructional leadership role (e.g., Jamentz, 2001; LaFee, 2002; Mathews, 2002). DDDM in other leadership roles of school vision, organization, collaborative partnerships, moral perspective, and larger-context politics remain new areas for research.

By adding to the existing body of research on DDDM, this study sought to advance our understanding of the interactive factors in principals’ IUE that impact principals’ data use for their decision making. Specifically, this study addressed the following research questions: (1) To what extent do high school principals practice DDDM in addressing the administrative problems of the leadership dimensions developed by the ELCC/NCATE (2002)? (2) Are there any differences in the extent of principals’ DDDM practices among these leadership dimensions? and (3) What are the models of factors in principals’ IUE that influence their DDDM practices in the leadership dimensions?
METHOD

Survey Participants and Data Collection

The population of this study was the 289 individuals with the title of principal in public high schools in a Midwestern state. Data collection for this study combined online and mail surveys. A cover letter was e-mailed with an embedded link to the Web-based survey to 235 (81.3% of the total) high school principals. In order to increase the return rate, multiple contacts using appreciation and reminder e-mail messages were applied to all the survey participants following each e-mail communication, thanking those who may have already participated and encouraging those who had not done so.

The mail survey included two groups of high school principals. The first group was the 75 high school principals whose e-mail addresses were not included in the list or whose e-mail addresses were not correct. The second group was 25 principals who e-mailed the researcher and reported difficulties in doing online surveys. The combination of online and mail survey generated a total of 183 usable surveys, which provided an overall return rate of 63.3% of the total population of 289 high school principals in the state.

Instrumentation and Variables

Instrument components and variables. The survey instruments used for data collection in this study were the Principal Data-Driven Decision Making Index (P3DMI), the Scales of Data Quality, Accessibility, and Analysis Skills (SDQAAS), and demographic information questions. The P3DMI consisted of the items developed to measure the principals’ practices of DDDM based on the framework of the ELCC/NCATE (2002) leadership program standards. These P3DMI survey questions asked principals to rate their use of data, with data defined as from four sources: (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, 2003). The majority of data in these categories were quantitative in nature. It was assumed that principals defined data the same way when responding to the survey. The P3DMI items were designed to measure the frequency of the principals’ DDDM practices. Respondents rated the frequency of their use of data for purposes such as developing a school vision and making decisions using a corresponding 5-choice scale as follows: 1 = rarely or never, 2 = seldom, 3 = sometimes, 4 = often, and 5 = usually or always.
The 10-item SDQAAS included three subscales of data quality, data accessibility, and data analysis skills. The data quality subscale was composed of four survey questions measuring principals’ perceptions of the extent to which data were believable, accurate, reliable, and came from good sources. The data accessibility subscale included three items that were developed to measure principals’ accessibility of data. All of the seven items in the two subscales were selected from the Information Quality Questionnaires (Wang & Strong, 1996). The survey questions in these two subscales had the following five response choices: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

The subscale of data analysis skills included three items measuring principals’ data analysis skills and was developed based on the suggestions of several high school principals and on research (McIntire, 2002). Principals were asked to rate their comfort level in the three tasks related to data analysis in (1) searching information from databases, (2) designing and creating spreadsheets, and (3) doing basic statistical 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, from a policy perspective, required principals to use data for their decision making, and whether the high school has a team working for data collection and analysis.

The last section of the survey included eight items for collecting the demographic data level of education, length of holding the principal position at the current school, school size, and school socioeconomic status. For collecting the data of school size, principals were asked to provide the number of students in their schools. The data of school socioeconomic status were gathered by asking principals to estimate the percentage of their students receiving free or reduced lunch. For analyses in the models, these percentages were converted into that of students not receiving free or reduced lunch.

**Content validity.** Measurement of content validity of this study is important because research conclusions based on the structural analysis assume that the measurement is accurately measuring principal’s DDDM practices. Considerable efforts were made to ensure that the survey questions of P3DMI are valid, by using the following steps.

First, O’Reilly’s (1983) “simplified model of decision making process” guided item development for P3DMI. Survey questions developed cover the phases of defining a problem, developing alternatives, estimating probabilities and ordering outcomes in a balanced way. The construction of the
survey questions was also based on definitions of data (Bernhardt, 1998; Davenport & Prusak, 1998) and DDDM (O’Reilly, 1983; Streifer, 2002) found in the literature.

Second, the survey questions of P3DMI were derived from the ELCC (2002) leadership program standards. These standards were used as the content criteria for developing survey questions of principals’ DDDM practices in school vision, school instruction, school organization, collaborative partnerships, moral perspective and larger-context politics. These survey questions provided a representative sampling of the DDDM skills deemed necessary for principals as argued by the ELCC.

The third step in ensuring the content validity was the initial development of P3DMI. A group of 15 secondary school administrators with an average of 14 years of experience in education who were enrolled in the courses of a doctoral program in educational administration at a Midwest university were asked to help in developing survey questions for the P3DMI. After the researcher presented the research proposal and the contexts of the survey, including identifying the survey specific purposes and clarifying the relevant terms (Fink, 2003), the group of school administrators was divided into six panels. Each panel was assigned to develop survey questions for P3DMQ related to one of the following leadership dimensions: school vision, school instruction, school organization, collaborative partnerships, moral perspective, and larger-context politics.

Fourth, the researcher revised the survey questions initially developed based on ELCC (2002) standards and the literature of DDDM (e.g., Bernhardt, 1998; Creighton, 2001; Glasman, 1994; Holcomb, 1999; O’Reilly, 1983; Streifer, 2002; Taylor, 1991; Thornton & Perreault, 2002). Among the 42 survey questions that had been developed, 32 were adopted. The other items were deleted because of their lack of importance or use of unconventional language (Fink, 2003; Fowler, Jr., 1995). The wording of the adopted 32 questions was refined. Referring to the following two instruments: School Information Collection and Decision Making (Leithwood & Aitken, 1995) and Data Review Questions (Reeves, 2002), the researcher then developed 14 more items in accordance with the indicators of each of the ELCC standards.

The fifth step in survey instrument validation was the content validity assessment. Four professors teaching data analysis for school leadership, two field experts on school data analysis, and five high school principals were asked to review each of the total 46 survey questions of the leadership dimensions and those of the three independent constructs respectively measuring the principals’ data analysis skills, principals’ perceptions of data quality, and principals’ data accessibility. All these judges assessed “the
extent to which the items in each scale are relevant and representative examples” (Yukl, Lepsinger, & Lucia, 1992, p. 421) of principals’ DDDM measured by the P3DMI. Based on the mean scores of each survey questions, the comments, and suggestions, 10 survey questions were deleted.

The final step in survey instrument validation was pilot testing. Thirty-one high school principals participated in the pilot study and completed the P3DMI and the SDQAAS. The purpose of the pilot testing was to help the researcher identify errors, readjust the design, and predict possible problems (Litwin, 2003) with these two instruments. Based on the analysis of the pilot study results, the researcher made appropriate adjustments to the instruments to enhance validity and reliability.

Data Analysis Techniques

As preliminary analyses, factor analysis was conducted to determine the underlying constructs and Cronbach’s alpha was used to measure the constructs’ reliability. Mean scores and standard deviations for each the P3DMQ items were calculated to investigate how often high school principals’ practiced DDDM. Descriptive statistics such as average mean scores and standard deviations in each of the leadership constructs were used to examine the extent of principals’ DDDM practices. The one-way within-subject analysis of variance (ANOVA) was conducted to evaluate the systematic differences among the mean scores on the leadership constructs. Structural equation modeling (SEM) was conducted to determine what factors significantly affect principals’ DDDM practices in each of the leadership dimensions.

RESULTS

The Instrument Constructs and Their Reliabilities

Factor analysis was used to determine the underlying constructs for measures on the 36-item P3DMI. Principal components analysis was conducted utilizing a varimax rotation, which indicated that the retaining four constructs should be investigated in P3DMI, accounting for a total of 59.98% of the variance. Construct 1 included six items with positive loadings that covered the items in practicing DDDM in the leadership dimension of school vision (ELCC, 2002; Standard 1). Construct 2 included 8 items with positive loadings that covered the
items in practicing DDDM in the leadership dimension of school instruction (ELCC, 2002; Standard 2). Construct 3 included seven items in positive loadings that covered the items in practicing DDDM in the leadership dimensions of school organizational operation and moral perspective (ELCC, 2002; Standards 3 and 4). Construct 4 included 9 items with positive loadings that covered the items in practicing DDDM in the leadership dimensions of both collaborative partnerships and larger-context politics (ELCC, 2002; Standards 5 and 6). Six items with negative loadings were eliminated from P3DMI. Therefore, the final P3DMI version for analyses was a 30-item instrument.

Reliability analyses were conducted by using Cronbach’s alphas on each of the four constructs of the P3DMI and the three subscales of the SDQAAS. The reliability coefficients of Cronbach’s alphas for the P3DMI’s four dimensions of DDDM in (a) school vision, (b) school instruction, (c) school organizational operation and moral perspective, and (d) collaborative partnerships and larger-context politics were .88, .84, .88, and .95, respectively. The reliability coefficients for the SDQAAS’ data quality subscale, data accessibility subscale, and data analysis subscale were .87, .87, and .84, respectively. The results of Cronbach’s alphas confirm the high reliability of all the constructs.

Survey Participant Characteristics

Table 1 presents the description of the 183 principals and their high schools’ demographic and other information. The majority of the high school principal respondents were male (80.6%) and white (97.8%), reflecting the fact that the high school population in the state is predominantly male and Caucasian. There were more principals in the age group of more than 51 to 62 (44.7%). Respondents with master’s degrees were 58.2%, whereas only 12.1% of the respondents received doctoral degrees. 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). A majority (64.3%) of the high schools were small sized (fewer than 500 students). Almost half (47.5%) of the respondents had reported that the percentage of their students receiving reduced or free lunches was within the range of 20% to 40%. A majority (65.2%) of the high schools had their team responsible for collecting and analyzing data. Nearly three quarters of the total respondents (73.2%) reported that their school districts from a policy perspective required DDDM at school level.
### TABLE 1
Demographic Information of the Survey Respondents and Their Schools

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>145</td>
<td>80.6</td>
</tr>
<tr>
<td>Female</td>
<td>35</td>
<td>19.4</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29-40</td>
<td>34</td>
<td>19.0</td>
</tr>
<tr>
<td>41-50</td>
<td>65</td>
<td>36.3</td>
</tr>
<tr>
<td>51-62</td>
<td>80</td>
<td>44.7</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>4</td>
<td>2.2</td>
</tr>
<tr>
<td>Caucasian</td>
<td>178</td>
<td>97.8</td>
</tr>
<tr>
<td><strong>Educational attainment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PhD or EdD</td>
<td>22</td>
<td>12.1</td>
</tr>
<tr>
<td>EdS (educational specialist)</td>
<td>54</td>
<td>29.7</td>
</tr>
<tr>
<td>Master’s degree</td>
<td>106</td>
<td>58.2</td>
</tr>
<tr>
<td><strong>Years of total school administrative experience</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1-5</td>
<td>34</td>
<td>19.4</td>
</tr>
<tr>
<td>6-10</td>
<td>44</td>
<td>25.1</td>
</tr>
<tr>
<td>11-15</td>
<td>28</td>
<td>16.0</td>
</tr>
<tr>
<td>16-20</td>
<td>28</td>
<td>16.0</td>
</tr>
<tr>
<td>21+</td>
<td>41</td>
<td>23.4</td>
</tr>
<tr>
<td><strong>Years holding the principal position at current school</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1</td>
<td>23</td>
<td>13.1</td>
</tr>
<tr>
<td>1-3</td>
<td>46</td>
<td>26.3</td>
</tr>
<tr>
<td>4-6</td>
<td>41</td>
<td>23.4</td>
</tr>
<tr>
<td>7-10</td>
<td>32</td>
<td>18.3</td>
</tr>
<tr>
<td>11+</td>
<td>33</td>
<td>18.9</td>
</tr>
<tr>
<td><strong>School size (enrollment)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500 or fewer</td>
<td>108</td>
<td>64.3</td>
</tr>
<tr>
<td>501-1,000</td>
<td>24</td>
<td>14.3</td>
</tr>
<tr>
<td>1,001+</td>
<td>36</td>
<td>21.4</td>
</tr>
<tr>
<td><strong>School socioeconomic status (reduced or free lunch)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 20%</td>
<td>46</td>
<td>25.7</td>
</tr>
<tr>
<td>20%-40%</td>
<td>85</td>
<td>47.5</td>
</tr>
<tr>
<td>41%+</td>
<td>48</td>
<td>26.8</td>
</tr>
<tr>
<td><strong>Schools having a team for data collection and analysis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>118</td>
<td>65.2</td>
</tr>
<tr>
<td>No</td>
<td>63</td>
<td>34.8</td>
</tr>
<tr>
<td><strong>Schools required to implement data-driven decision making by district (n = 179)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>131</td>
<td>73.2</td>
</tr>
<tr>
<td>No</td>
<td>48</td>
<td>26.8</td>
</tr>
</tbody>
</table>
DDDM Practices of the Four Leadership Dimensions

Table 2 presents the descriptive statistics of overall mean scores and standard deviations for each of the four constructs of DDDM practices in (a) school vision, (b) school instruction, (c) school organizational operation and moral perspective, and (d) collaborative partnerships and larger-context politics. 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 an order from the highest to the lowest mean for the purpose of understanding the extent of differences of principals’ DDDM practices among the individual items.

The overall mean scores revealed that high school principals sometimes or often practiced DDDM in addressing administrative problems in all the four leadership constructs. The highest overall mean score among these four constructs was the leadership dimension of school instruction ($M = 3.99, SD = 0.54$). The frequency of principals’ DDDM practices in the leadership areas of school organizational operation was also relatively high ($M = 3.88, SD = 0.67$). The overall mean scores of the frequency of principals’ DDDM practices in the leadership dimension of school vision were in third place ($M = 3.71, SD = 0.71$), but close to the overall means of the above two dimensions. In comparison to the above three dimensions, the principals’ DDDM practices were frequently low in the leadership dimension of collaborative partnerships ($M = 3.29, SD = 0.77$).

The one-way within-subject ANOVA yielded results of significant difference among the mean scores on the four leadership 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 and moral perspective versus school instruction, was nonsignificant, $t(177) = 2.509$, $p = .013$. The data use frequency of the leadership construct of collaborative partnerships and larger-context politics was significantly lower than that of all the other three constructs: (a) school organizational operation and moral perspective, $t(174) = −14.471$, $p < .001$, (b) school instruction, $t(175) = −16.112$, $p < .001$, and (c) school vision, $t(174) = −10.321$, $p < .001$. The data use frequency of the leadership construct of school vision was significantly lower than that of school organizational operation and moral perspective, $t(176) = −4.328$, $p < .001$, and school instruction, $t(177) = −7.189$, $p < .001$. 

Downloaded from http://eq.sagepub.com at EMPORIA STATE UNIV on November 25, 2008
<table>
<thead>
<tr>
<th>Item</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Leadership in School Vision</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. I use data to develop a school vision of learning that promotes the success of all students.</td>
<td>4.01</td>
<td>0.92</td>
</tr>
<tr>
<td>2. I use data to make decisions in aligning resources with the school vision.</td>
<td>3.98</td>
<td>0.87</td>
</tr>
<tr>
<td>21. I use data to determine what strategies to use in achieving the goals of advocating for all students.</td>
<td>3.76</td>
<td>0.90</td>
</tr>
<tr>
<td>5. I use data to generate potential elements of a vision statement.</td>
<td>3.56</td>
<td>1.01</td>
</tr>
<tr>
<td>19. I use data to develop alternatives for implementing the vision.</td>
<td>3.49</td>
<td>0.87</td>
</tr>
<tr>
<td>22. I use data to define possible problems in vision implementation.</td>
<td>3.36</td>
<td>0.96</td>
</tr>
<tr>
<td><strong>Leadership in School Instruction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23. I use data to identify problems in student learning.</td>
<td>4.24</td>
<td>0.69</td>
</tr>
<tr>
<td>7. I use data to generate approaches to curriculum improvement.</td>
<td>4.23</td>
<td>0.71</td>
</tr>
<tr>
<td>6. I use data to make recommendations regarding learning programs.</td>
<td>4.20</td>
<td>0.73</td>
</tr>
<tr>
<td>28. I use data to determine whether specific programs lead to improved achievement.</td>
<td>4.16</td>
<td>0.70</td>
</tr>
<tr>
<td>9. I use data to plan professional development programs.</td>
<td>4.04</td>
<td>0.78</td>
</tr>
<tr>
<td>17. I use data to evaluate the instructional efficiency of the school.</td>
<td>3.84</td>
<td>0.86</td>
</tr>
<tr>
<td>15. I use data to assess learning equity for different populations.</td>
<td>3.77</td>
<td>0.96</td>
</tr>
<tr>
<td>18. I use data to predict the outcome of new instructional programs.</td>
<td>3.66</td>
<td>0.90</td>
</tr>
<tr>
<td><strong>Leadership in School Organizational Operation and Moral Perspective</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. I use data to promote an environment for improved student achievement.</td>
<td>4.28</td>
<td>0.72</td>
</tr>
<tr>
<td>27. I use data to monitor instructional practices of the school organization.</td>
<td>4.18</td>
<td>0.75</td>
</tr>
<tr>
<td>10. I use data to advocate for policies that promote success for all students.</td>
<td>4.10</td>
<td>0.87</td>
</tr>
<tr>
<td>8. I use data to assign human resources in ways that promote student achievement.</td>
<td>3.93</td>
<td>0.82</td>
</tr>
<tr>
<td>3. I use data to insure that staff members are treated fairly.</td>
<td>3.90</td>
<td>1.02</td>
</tr>
<tr>
<td>11. I use data to identify safety issues.</td>
<td>3.83</td>
<td>0.92</td>
</tr>
<tr>
<td>13. I use data to judge my performance in effective management.</td>
<td>3.68</td>
<td>0.86</td>
</tr>
</tbody>
</table>

*(Continued)*
<table>
<thead>
<tr>
<th>Item</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership in Collaborative Partnerships and Larger-Context Politics</td>
<td>3.29</td>
<td>0.77</td>
</tr>
<tr>
<td>29. I use data to measure the effectiveness of outreach to the community.</td>
<td>4.16</td>
<td>0.70</td>
</tr>
<tr>
<td>24. I use data to develop effective communication plans.</td>
<td>3.70</td>
<td>0.90</td>
</tr>
<tr>
<td>4. I use data to understand the larger context of the community, which affects opportunities for students.</td>
<td>3.66</td>
<td>0.93</td>
</tr>
<tr>
<td>25. I use data to determine what type of community input should be gained.</td>
<td>3.32</td>
<td>0.94</td>
</tr>
<tr>
<td>16. I use data to mobilize community resources for the benefit of student learning.</td>
<td>3.28</td>
<td>1.01</td>
</tr>
<tr>
<td>14. I use data to gauge the effectiveness of collaborative relationships with the community.</td>
<td>3.21</td>
<td>0.96</td>
</tr>
<tr>
<td>20. I use data to develop effective approaches for school–family partnership.</td>
<td>3.20</td>
<td>0.94</td>
</tr>
<tr>
<td>30. I use data to generate approaches with school stakeholders that reflect their concern.</td>
<td>3.20</td>
<td>1.02</td>
</tr>
<tr>
<td>26. I use data to negotiate with political decision makers for the improvement of students’ educational opportunities.</td>
<td>3.18</td>
<td>1.11</td>
</tr>
</tbody>
</table>

NOTE: P3DMI = Principal Data-Driven Decision Making Index.
Structural Equation Models for Data Use in the Leadership Dimensions

The most important purpose of this study was to develop SEM models to examine the factors that affect data use in the four leadership dimensions: (a) school vision, (b) school instruction, (c) school organizational operation and moral perspective, and (d) collaborative partnerships and larger-context politics. SEM has been increasingly seen as a useful quantitative technique for specifying, estimating, and testing hypothesized models describing (causal) relationships among a set of meaningful variables (R. H. Hoyle, 1995; Kline, 2005; Pearl, 2000).

For each of these models, the analysis initially used a fully SEM recursive model, which tested all the SDQAAS constructs (latent variables of the three subscales of data quality, data skills and data accessibility) and the other variables (school district requirement of DDDM, school team for data analysis team, principal’s level of education, length of total school administrative experience, school size, and school socioeconomic status) as a direct cause of data use in each of the P3DMI leadership dimensions. Paths that did not contribute were removed. In order to decrease the chances of making a Type II error (saying there is no relationship between the variables when in fact there is) and increase power (the odds that you will observe an effect when it occurs), paths that had a significance level of less than .10 were also included in the SEM models. By estimating the most likely relationships between variables, the model was also modified by adding paths of statistical significance between the variables that made theoretical sense in order to improve the fit until a final best model was obtained.

Because chi-square is severely influenced by sample size, each of the four modified models was evaluated and specified by examining the measure of fit—root mean square error of approximation (RMSEA). RMSEA takes into account the error of approximation. A value of less than 0.06 indicates a good fit (Hu & Bentler, 1999). Values ranging from 0.06 to 0.08 indicate acceptable fit (MacCallum, Browne, & Sugawara, 1996). Other goodness-of-fit statistics of relative fit index (RFI), and comparative fit index (CFI) were also examined. RFI provides a measure of model fit versus the degrees of freedom needed to achieve that fit. CFI compares the existing model fit with a null model, which assumes that the latent variables in the model are uncorrelated. Values RFI and CFI close to 0.9 or above for these indexes suggest acceptable fit (Bentler, 1992).

Figure 1 displays the final best data use recursive model for DDDM in school vision and its standardized parameter estimates and goodness-of-fit
statistics. The values displayed above the observed variable are reliability estimates for the individual subtests in the model. Path parameter estimates measure the degree of effect produced by one variable on the arrow-pointed variable. School district requirement of data use from a policy perspective (.23, \( p < .05 \)) and principals’ data skills (.22, \( p < .05 \)) had significant positive direct effects on principals’ data use in school vision leadership. Principals’ data accessibility (.21, \( p = .070 \)) had a moderate effect on their data use. These three variables contributed 21% of the variance in data use of school vision. District requirement (.43, \( p < .05 \)) and principal data skills (.33, \( p < .05 \)) significantly predicted data accessibility, accounting for 29% of the data accessibility variance and bringing about some positive indirect effect on data use in leadership of school vision. The findings showed that the factors of district requirement and principal data skills were strong predictors of data use in the leadership dimension of school vision, contributing both direct and indirect effects.

Figure 2 presents the final data use recursive model of best fit for leadership in school instruction. The parameter estimates and goodness-of-fit statistics of the model are also presented. This model found that principals’ perception of data quality (.18, \( p < .05 \)), data accessibility (.25, \( p < .05 \)), data skills (.26, \( p < .05 \)), and their education level (.15, \( p < .05 \)) significantly affected data use in school instruction leadership. School team of data analysis (.13, \( p = .093 \)) had a moderate effect on principals’ data use in instructional leadership. These five variables had direct positive effects on data use in the leadership dimension of school instruction, accounting for 28% of its variance. Although school district requirement of data use from a policy perspective did not directly impact data use, its positive effects on data accessibility (.40, \( p < .05 \)), perceptions of data quality (.18, \( p < .05 \)), and school team of data analysis (.30, \( p < .05 \)) were significant. Data skills also significantly predicted data accessibility (.35, \( p < .05 \)). These results revealed that school district requirement of data use and principals’ data skills had some positive indirect effects on data use in leadership of school instruction.

The data use recursive model for leadership in school organizational operation and moral perspective is presented in Figure 3. The results indicated that school enrollment (.19, \( p < .05 \)) significantly affected principals’ data use in school organizational and moral leadership. Principals’ data skills (.17, \( p = .062 \)) and school district requirement of data use (.17, \( p = .092 \)) had a moderate effect on principals’ data use in organizational and moral leadership. These three variables had positive direct effects on data use in the leadership dimension of organizational operation and moral perspective, accounting for 18% of its variance. District requirement of data
Figure 1. Data Use Model for Leadership in School Vision (sample size = 183; chi-square = 76.823; degrees of freedom = 60; probability level = .071; RMSEA = .039; RFI = .882; CFI = .981)

NOTE: RMSEA = root mean square error of approximation; RFI = relative fit index; CFI = comparative fit index; DA = data accessibility; DS = data skills; DU = data use; res = residual; err = error; Distri_Require = district requirement of using data for decision making.

Figure 2. Data Use Model for Leadership in School Instruction (sample size = 183; chi-square = 342.815; degrees of freedom = 181; probability level = .000; RMSEA = .070; RFI = .846; CFI = .881)

NOTE: RMSEA = root mean square error of approximation; RFI = relative fit index; CFI = comparative fit index; DA = data accessibility; DS = data skills; DU = data use; DQ = data quality; res = residual; err = error; Distri_Require = district requirement of using data for decision making; Sch_Team = school team for collecting data; Prin_Ed = principal’s education level.
use from a policy perspective (.43, p < .05) and data skills (.34, p < .05) also significantly predicted data accessibility, accounting for 30% of the data accessibility variance and bringing about some positive indirect effects on data use in leadership of school organization and moral perspective.

Figure 4 displays the final fit model for leadership in collaborative partnerships and larger-context politics. Principals’ data accessibility (.27, p < .05) and students’ social economic status of their schools (.18, p < .05) significantly affected data use in leadership of collaborative partnerships and larger-context politics. School district requirement of data use from a policy perspective (.16, p = .065) had a moderate effect on principals’ data use in leadership of collaborative partnerships and larger-context politics. These three variables accounted for 15% of the variance in data use. School district requirement of data use (.43, p < .05), principals’ data skills (.35, p < .05), and students’ socioeconomic status (-.18, p < .05) also significantly influenced principals’ data accessibility, explaining 34% of its variance. These variables had some indirect impact on principals’ data use.
DISCUSSION

The Extent of DDDM Practice

The results of this study indicate that the overall high school principals’ frequency level of using data for decision making transcended “sometimes” and reached “often” for the following four constructs of school leadership in (a) school instruction, (b) school organizational operation and moral perspective, (c) school vision, and (d) collaborative partnerships and larger-context politics. The self-reported responses reveal an overall encouraging picture of the principals’ high frequency in using data for their decision making, particularly in the leadership of instruction and organizational operation. These results are consistent with the previous literature on principals’ DDDM practices (Armstrong & Anthes, 2001; LaFee, 2002; Leithwood et al., 2001; Mathews, 2002; Salpeter, 2004; Wallace, 1985).

NCLB (2001), acting as a driving force of DDDM, has added new responsibilities for schools to exercise more efforts in collecting, analyzing and reporting data to prove their bottom line of the educational accountability.
After years of reinforcement of DDDM in various efforts, it seems that an increased interest in DDDM is apparent and its practices are encouragingly spread. Principals seem to commonly recognize the benefits and values of DDDM, and respond to the call in using data as a guide for decision making during the course of a decade in framing how schools would react to the accountability environment. Principals will continue their efforts with regard to student achievement and quality teaching and learning, and to seriously evaluate and analyze the existing data in their schools (Creighton, 2001).

**Leadership Dimension Differences of DDDM**

The one-way within-subject ANOVA yields results of significant difference in DDDM among the four leadership constructs. The findings illustrate that principals, as instructional leaders, used the highest frequency of data for decision making. As organizational and visionary leaders, principals comparatively used less data for decision making in their administrative problems, but still in a high frequency. Data were used the least frequently in the leadership dimension of collaborative partnerships and larger-context politics.

The results support the notion that a high school principal’s problems emerging in the school context define the shape of his or her information seeking and use. Problem dimensions that are the characteristics and nature of the typical problems faced by the particular set of people (principals) can have an effect on their data use (Taylor, 1991). The focused use of data in solving problems of school improvement in teaching and learning (Bernhardt, 1998; Thornton & Perreault, 2002) reveals that principals who assume the role of instructional leaders value information and are more likely to gather and rely on information in making decisions (McColskey et al., 1985). The moderate frequency of data use in the leadership dimension of school–community partnerships and larger-context politics may reflect that the fact or principals’ beliefs that in this leadership aspect, quantitative data may not be as helpful in negotiating coordination as other processes or information.

The varying frequencies of use of data across the leadership dimensions may also reveal that data use for decision making is influenced by the well-structured and ill-structured problem dimensions (Leithwood & Steinbach, 1995; Taylor, 1991). Structured problems demand less conscious thought processes whereas ill-structured problems require more thought and create a significant role for information collection skills. The highest frequency of data use by principals in addressing problems in curriculum, teaching, and learning at school could possibly suggest that student achievement and school improvement are believed to be complex or ill-structured problems.
(Streifer, 2002). If this notion is true for the principals, the administrative problems in school–community collaborative partnerships and larger-context politics could be perceived by the principals or in fact as less complex and ill-structured problems.

**Interactive Factors Affecting DDDM**

The information behaviors of decision making process are the product of the elements of IUEs. IUE includes 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. In addition to the problem dimensions discussed in the above section, other contextual elements of IUE include sets of people, work settings, and perceptions of information (Taylor, 1986; 1991). To some degree, results of the SEM models illustrate the theoretical model of IUE.

Among the factors related to “sets of people” defined in IUE (Taylor, 1991) that influence DDDM, principals’ education level had some effects on principals’ DDDM. This supports Taylor’s proposition that education of sets of people generally affects information behaviors. Principals’ data analysis skills were found to have significant direct effects on DDDM in most of the leadership dimensions except for the collaborative partnerships and larger-context politics.

Regarding the factors in the work setting, school size and socioeconomic status significantly affect principals’ data use respectively in the leadership constructs of organizational operation and collaborative partnerships. School district requirement of using data for decision making had significant or moderate direct effects on data use in all the leadership dimensions except for school instruction, whereas data accessibility had direct effects on all the leadership dimensions. School team of data analysis and principals’ perceptions of data quality only contributed to principals’ data use in instruction. These results reveal that information behavior such as principals’ data use for decision making was situational (Choo, 1998; O’Reilly, 1983; Taylor, 1991). Generally, data analysis skills, attitudes toward data, the data demands of the leadership domain, the access to data, and the requirement of school district in using data are aspects of the school environment that could affect DDDM.

Information behavior is also a dynamic process, in which elements of the information environment interact actively with each other (Choo, 2002). Within the information environment, the high school principals’ characteristics, the structure of the typical problem dimensions, the setting of school district and the school in which the principals work all combine to establish
a context for data use in decision making. This notion was also illustrated by this study’s results of interactive effects of the IUE (Taylor, 1991) factors observed. For instance, the models revealed that school district requirement of data use and principals’ level of data skills had indirect effects on data use through their impact on data accessibility. So was the case in the indirect effect of school data analysis team on data use in the instruction leadership.

The contextual and dynamic nature of information behavior of DDDM could also be supported by examining the results of the SEM’s models in an integrated and synthesized approach. School district requirement of using data for decision making served as the significant direct predictor for three dimensions of DDDM in (a) school vision, (b) school organizational operation and moral perspective, and (c) collaborative partnerships and larger-context politics, but not in the important dimension of DDDM in school instruction. Principals’ data analysis skills contributed significantly to principals’ DDDM in the two leadership dimensions of school instruction and vision, in which principals practiced DDDM in high frequency. Principals’ perceptions of data quality were significantly influential in predicting their DDDM in only, but a most important, leadership dimension of school instruction in data use. Data accessibility significantly predicted data use for decision making only in the leadership construct of collaborative partnerships and larger-context politics. School team of data collection and analysis did not significantly predict any of the four constructs of principals’ data-driven decision making.

The synthesized approach of analyses seems to imply that person-related or internal factors such as perceptions of data quality and data analysis skills tended to significantly contribute to principals’ data use in the leadership areas, for instance, school instruction in which DDDM was extensively practiced and for ill-structured problems. On the contrary, the organization-related or external factors such as school district requirement and data accessibility tended to be influential in affecting principals’ data use for decision making in the leadership areas, for instance, collaborative partnerships and larger-context politics, in which DDDM was less frequently practiced and for well-structured problems (see Figure 5).

As Simon (1997) suggested, an individual’s behaviors (such as decision making and information use) in an organization are impacted by two aspects of influence: the stimuli with which the organization seeks to influence the individual, which is termed as “external” influence; and the psychological “set” of the individual that determines his or her response to the stimuli, which is termed as “internal” influence. These two aspects of influence on an individual’s behaviors are distinguishable from each other (p. 177). On the other hand, higher-order needs are satisfied internally, whereas lower-order needs are predominantly satisfied externally (Maslow, 1954).
In this study, the external influence of school district requirement of using data for decision making mostly affected the lower-level frequency of data use in decision making, whereas the internal influence of principals’ attitude toward data affected the higher-level frequency of DDDM. If these two factors are compared to each other based on principals’ recognition and acceptance level, it is not difficult to find that principals’ attitude toward data quality is at the higher order and school district requirement of using data for decision making is at the lower order.

From the perspective of information processing (Choo, 1998), data accessibility affected the lower frequency level of DDDM whereas data analysis skill affected the higher level of DDDM. Again, if these two factors are compared based on principals’ cognitive ability of information processing, data analysis skill is at the higher-order level and data accessibility is at the lower-order level. Therefore, the recognition level of DDDM and information processing level seemed to match or positively relate to the frequency level of principals’ DDDM.
Limitations

There are several limitations in this study. First, it was limited to public high school principals in a Midwestern state during one school year. Second, the sample size tended to be small for the SEM model development, particularly for the models that included more variables, which may influence the significant level of the path relationships. Multivariate normality of the data was not tested. Third, the credibility of this study might be influenced by the principals’ potential different understanding and inadequate knowledge about the definition of data, especially the perceptions data when answering the survey questions. A final concern is that although the factors observed in this study explain a good bit of the variance of data use in principals’ decision making, the low R-squared values in the models account for only about 15% to 28% of the variance, which also indicates that other factors may influence data use for decision making.

Implications for Practice and Research

Despite these limitations, the findings of this study do have practical and research implications. The following presents an integrated framework of practical strategies to create a supportive IUE for better DDDM with suggestions and insights framed around the research results and those found elsewhere in the empirical literature on the topics of IUE and DDDM. First, use school district policy requirement to reinforce the practice of DDDM. As revealed by this study, school district requirement of using data for decision making plays a key role in ensuring principals’ DDDM practices. These requirements heighten principals’ awareness of issues in delving deeper into the data for problem solutions (Mathews, 2002). The impact of a policy requirement from a school district on DDDM is even more pronounced in relatively new areas of DDDM.

Second, strengthen principals’ information literacy. Information literacy is a set of data and information skills that enable principals to recognize how to locate, collect, analyze, evaluate, integrate, and communicate information. As shown in this study, these skills are critical in dealing with the daily information and in using the broad array of tools to search and organize information, analyze results, and communicate and integrate the results for decision making (Bennet, 2004). Third, increase data credibility and reliability. Principals are more likely to use data for their decision making if it is from a source deemed as credible and reliable. Reliability of data remains a challenge for school leaders to conduct DDDM (Salpeter, 2004). It is essential to develop validation processes, procedures, and definitions to deliver reliable data that users trust.
Fourth, make data easily accessible. As supported by the models in this study, information must be easily accessible by the relevant decision makers before it can have an impact on decision making. Failure of information availability can result in nonutilization, particularly for principals learning to practice DDDM. It is a top priority to bring all educational data together for easy access and analysis (Bernhardt, 2003; Streifer, 2002). Fifth, create supportive and effective teamwork. This study also suggested that teamwork of data collection and analysis has positive effects on DDDM. Data-driven decision making teams are most likely to be successful when members are assessment and data analysis literate, have time and interest to take the responsibilities, understand the team’s mission, establish a strong relationship of trust, and practice good communication skills.

Finally, use different strategies for different administrative dimensions. Strategies for promoting DDDM should be used in an integrated approach based on the notion that information behaviors are situational and the factors of the IUEs interact with each other. This notion is strongly supported by the findings of this study. For instance, in improving DDDM in instructional leadership that has been practiced frequently, school districts or policy makers should focus their time, efforts, and financial support on enhancing the internal factors such as principals’ data analysis and upgrading their perceptions of toward data quality. If it is necessary to improve DDDM in the leadership areas such as school–community partnership and school vision that have not been practiced as frequently, the external factors such as school district requirement from a policy perspective and data accessibility should be strongly emphasized.

Based on the limits and the findings of this study, the following suggestions are made for further study. First, broadened study subjects are recommended. There is a strong need for more studies of differing populations working in varying contexts, how individuals in these populations use specific information, and how its use or nonuse affects their concerns (Taylor, 1991). Second, measurement of other contextual factors is suggested in studying their relationships with information behaviors. Further studies can investigate the effects of other IUE factors such as people’s social network, people’s attitude toward technology, organization structure, and decision process. Third, future studies might look at what specific types of data are mostly used or preferred by principals in different dimensions of leadership, and how principals acquire and use data in the process of decision making. Finally, more practical topics about DDDM should be investigated. Future studies may look at what level of data use for decision making in different leadership dimensions is effective and well accepted by principals, and whether data-based rationality contradicts “gut feeling” in decision making.
CONCLUSIONS

This study used SEM to model the survey data for examining the emerging topic of DDDM by adopting the theoretical model of IUE (Taylor, 1991) on the contextual factors that impact information behaviors. The results of this study generally support the core proposition of IUE—that information behavior is situational, multidimensional, and dynamic (Choo, 1998; 2002). Different problem dimensions shape the frequency of data or information use for decision making as insisted by Taylor (1991). This study further suggests that within the IUE’s factors of set of people, problem, and setting, data or information use for decision making in different problem dimensions are impacted by different factors of set of people and work setting. For instance, school district requirement of using data for decision making and accessibility of data are significantly influential in predicting principals’ DDDM in collaborative partnerships and larger-context politics, whereas principals’ perceptions of data quality and data analysis skills are the two most influential variables in predicting principals’ data use in decision making in the leadership dimension of school instruction.

This study suggests that the IUE model provides a useful structure with which to describe the relationships between the contextual factors and the information behavior of principals’ DDDM practices. Results of this study generate some useful implications for practice, research, and theoretical foundations for the emerging topic of DDDM, which is essential for school improvement and educational accountability with the deeper implementation of NCLB (2001).

REFERENCES


Mingchu Luo is a senior institutional researcher at Emporia State University, Kansas. He earned his EdD in educational administration from the University of Nebraska. His research interests include principalship, data-driven decision making, program evaluation, and student flow.