Sources of Systems Thinking in School Leadership

ABSTRACT: Systems thinking, a framework for seeing the whole, is an effective means of dealing with real-world problems. This study explored the sources of systems thinking in school leadership. Qualitative data were collected via 82 semistructured interviews and 6 focus groups, among pre-service principals, novice principals and experienced principals. Data analysis included four stages: condensing, coding, categorizing, and theorizing. The analysis yielded four sources of systems thinking in school leadership: (1) managerial experience, (2) role model, (3) academic study, and (4) natural tendency. The findings expand limited existing knowledge about systems thinking in school leadership, and may assist in establishing ways to enhancing and accelerating the development of systems thinking among prospective and active school principals.

KEY WORDS: Systems Thinking, School Principals, Educational Leadership

Leading a school has never been an easy job. However, practitioners and researchers alike agree that current-day school principals face particularly complex challenges (Eller, 2010; Walker & Qian, 2006), as the present “era of accountability” in education systems is characterized by high expectations from school leaders (Carter, 2012; Comber & Nixon, 2011; Jennings, 2010). School principals are expected to align all aspects of schooling to support the goal of improving instruction to ensure that all students will succeed (Daring-Hammond, LaPointe, Meyerson, Orr, & Cohen, 2007).

Systems thinking may be helpful in dealing with the challenges faced by today’s school principals. Systems thinking is a holistic perspective, which focuses on how the parts work together in networks of interaction, not on breaking down systems into parts in order to understand them (Gharajedaghi, 2011). Systems thinking is considered an effective means of facing real-world problems (e.g., Jackson, 2003; Kasser, 2013), making it a useful tool for managers dealing with complex organizational problems (e.g., Gharajedaghi, 2011; Senge, 2006). School principals, who face today’s educational leadership complexities, are among those who could benefit from systems thinking (Fullan, 2005; Senge et al., 2012).

In a previous study, we explored the characteristics of systems thinking in school leadership, looking at the practical ways in which principals lead schools through systems-thinking concepts and procedures (Shaked & Schechter, 2014). The current study took our investigation further in order to explore the sources of systems thinking in school leadership, searching for the enablers of systems-thinking development among school principals. Identifying the sources of systems thinking in school leadership may narrow the considerable gaps in the current knowledge base available regarding this topic, leveraging the development of the Systems School Leadership conceptual framework. In addition, it may assist in finding ways to support the development of systems thinking among prospective and currently performing school principals.

THEORETICAL BACKGROUND

SYSTEMS THINKING

Systems thinking was first mentioned toward the end of the first half of the 20th century (Von Bertalanffy, 1939, 1960), as a method of scientific investigation that contrasted with Descartes’ scientific reductionism. In scientific reductionism, complex phenomena are understood by reducing them to their simpler basic parts (Rosenberg, 2006). In contrast, according to systems thinking, the only way to fully understand why a phenomenon arises and persists is to understand its parts in relation to the whole (Hammond, 2006).

Systems thinking is not a discipline, but rather an interdisciplinary conceptual framework used in a wide range of areas; it is “an orientation to the world, and a model for thinking about and learning about systems of all kinds—scientific, organizational, personal, and public” (Cabrera, 2006, p. 93). Thus, the literature on systems thinking encompasses a broad range of fields and journals, yielding a variety of definitions, among them:
The art and science of making reliable inferences about behavior by developing an increasingly deep understanding of underlying structure (Richmond, 1994, p. 141).

The art of simplifying complexity. It is about seeing through chaos, managing interdependency, and understanding choice (Gharajedaghi, 2011, p. 335).

The ability to see the world as a complex system, in which we understand that "you can't just do one thing," that "everything is connected to everything else" (Sterman, 2000, p. 4).

An epistemology which, when applied to human activity, is based upon the four basic ideas: emergence, hierarchy, communication, and control as characteristics of systems. When applied to natural or designed systems, the crucial characteristic is the emergent properties of the whole (Checkland, 1999, p. 315).

A discipline for seeing wholes. It is a framework for seeing interrelationships rather than things, for seeing patterns of change rather than static "snapshots" (Senge, 2006, p. 68).

Despite the absence of a common and agreed-upon definition, it is quite clear that systems thinking has two main complementary meanings: rising above the separate components to see the whole system, and thinking about each separate component as a part of the whole system. These two meanings will be used in this article to explore the excerpts provided by principals.

CHARACTERISTICS OF SYSTEMS THINKING

To date, there is no consensus as to the characteristics and components of systems thinking, and the pertaining literature is scanty. Richmond (2000) listed the skills necessary to become a systems thinker and included dynamic thinking—focusing on change and structure, system-as-cause thinking—placing responsibility for a behavior on internal actors who manage the system's policies, and forest thinking—believing that to know something requires understanding the context of its interrelationships. Richmond also presented these skills as steps in a process of becoming a systems thinker, to clarify when to best employ each skill. Senge (2006) listed "laws" of systems thinking, such as "today's problems come from yesterday's solutions" (p. 57), "behavior grows better before it grows worse" (p. 60), and "the easy way out usually leads back in" (p. 60). Ossimitz (2001) identified four basic dimensions of systems thinking: (1) interrelated thinking—thinking in interrelated, systemic structures; (2) dynamic thinking—thinking which is not restricted to grasping just snapshots of a situation, but takes into account evolution over time; (3) thinking in models—awareness that we always deal with a model of a complex situation, which is usually massively simplified compared to the "actual" situation; and (4) systemic action—the practical ability of steering systems. Although all these lists have restricted scientific validation, they are important for understanding what constitutes systems thinking.

To learn about the characteristics and components of systems thinking we will turn to professionals who utilized it. Frank (2010) identified the characteristics of successful systems professionals, composing a list of four sub-lists: (1) general cognitive characteristics such as understanding the whole system and seeing the big picture, understanding interconnections, and thinking creatively; (2) capabilities such as analyzing the need, analyzing and/or developing the concept of operations, and analyzing/capturing the requirements; (3) individual traits such as management skills and good human relations; and (4) background and knowledge, such as interdisciplinary knowledge, broad experience, and education. Frank (2012) also presented the CESF Competency Model, which includes a list of cognitive competencies that are all related to systems thinking and each one of them can be assessed separately.

SOURCES OF SYSTEMS THINKING

Are there any sources to which systems thinking may be attributed? Zonnenshain (2012, p. 1) stated that "there is an ongoing argument in the literature about whether systems-thinking ability is inherent (innate) or learned (acquired)." Some argue that the only source of systems thinking is natural talent (e.g., Hitchins, 2009), while others claim that systems thinking can be developed as can any other skill (e.g., Frank, 2006).

Zulauf (2007) read 120 journals of graduate students in a systems-thinking course, and concluded that systems thinking can be learned, so that academic study may be considered one source of systems thinking. Several methods have been proposed as means of teaching systems thinking, such as hypermedia (Thurston, 2000), metaphors (Taber, 2007), case studies (Blizard, Klots, Pradhan, & Dukes, 2012), hybrid models (Levin & Levin, 2013), and modeling (Hunz, 2008).

Davidz (Davidz, 2006; Davidz & Nightingale, 2008), who explored the sources of systems thinking among engineers, found the primary mechanisms that enable systems-thinking development in engineers. These include experiential learning, which incorporates both work experience and life experience; specific individual characteristics, such as type of thinking, problem-solving style, interpersonal skills, and communication:
and a supportive environment with regard to factors such as scheduling, cost constraints, and work design. However, the empirical knowledge about this topic remains meager.

SYSTEMS THINKING AND SCHOOL LEADERSHIP

Systems thinking in school leadership did not receive sufficient academic attention. Only a few researchers have examined the uses of systems thinking in school leadership, describing systems thinking mainly as a means for handling a particular area within the school. Wells and Keane (2008), for example, demonstrated how Senge’s (2006) “laws” of systems thinking (mentioned above) may be implemented to develop professional learning communities in school systems. Kessler and colleagues (2011) asserted that because educational leaders have access to large volumes of data but lack the skills to use them effectively for continuous school improvement, systems thinking may assist evidence-based practice development. Dyethouse and her colleagues (2009) argued that systems thinking can provide a framework for representing many of the components in a complex curricular program and may serve as a more precise and explicit method of interpreting and assessing program results. In addition, several guidebooks are suggesting ways to implement systems thinking in educational leadership, offering practical advice on using it for facing today's educational demands and challenges, including structured models for successful educational reforms (e.g., Fullan, 2005; Hoban, 2002; Senge et al., 2012; Zmuda, Kuldig, & Kline, 2004).

In a previous study, we investigated how effective school principals use systems thinking (Shaked & Schechter, 2014). We found that systems thinking may be considered not as a tool for school leaders but as a school leadership approach, calling this approach Systems School Leadership, defined as the approach whereby principals lead schools through the systems-thinking concept and procedures, applying the systems view and performing at the systems level. In addition, we identified four characteristics of Systems School Leadership: (1) Leading wholes—a holistic point of view, oriented toward seeing the big picture and not only its separate parts, understanding all aspects of school life as one large system. (2) Influencing indirectly—facing school’s tasks and challenges circuitously, based on the awareness that countless reciprocal influences are at play among various elements within the school, each of which is connected to others, affecting them and being affected by them. (3) Using a multidimensional view—seeing several aspects of a given issue simultaneously; noticing a wide range of reasons for its emergence and existence, taking into account a variety of its consequences and predicting various options for its future development.

(4) Evaluating significance—considering elements of school life according to their significance for the entire system, distinguishing between important and unimportant issues to be resolved and identifying patterns. In line with systems thinking, these characteristics of Systems School Leadership should not be viewed as a linear series, but as overlapping, interconnected, and interrelated, and school leaders should possess the ability to apply the conceptual framework of systems thinking to the reality of schools.

These four characteristics are related to the two major meanings of systems thinking. As illustrated in Figure 1, leading wholes and using a multidimensional view reflect seeing the whole beyond the parts, while influencing indirectly and evaluating significance are related to seeing the parts in the context of the whole.

After identifying the characteristics of systems thinking in school leadership, the next purpose of the study is to explore the sources that facilitate systems-thinking development. As above, the knowledge about enablers and barriers of systems-thinking development in general is limited. To date, no such knowledge has been found regarding school leaders.
The present study was designed to begin investigating the sources of systems thinking in school leadership.

**RESEARCH CONTEXT**

This present study of school principals was conducted in Israel, where the national school system serves about 1.6 million students (about 73% in the Jewish sector and about 27% in the Arab sector). The Jewish sector consists of state schools (58%), state-religious schools (10%), and separate, independent ultra-orthodox religious schools (22%). About 1% of the total student population is enrolled in special education settings (Israeli Central Bureau of Statistics, 2013).

Israel is among the four countries with the broadest gap between rich and poor, alongside the United States, the United Kingdom, and Mexico (Organisation for Economic Co-operation and Development, 2011). Mindful of the great diversity among school populations, recent educational policy in Israel has been directed toward achieving across-the-board high levels of equality in educational outcomes. Nevertheless, Israeli students’ academic achievements remain among the lowest in the industrialized countries, and students’ educational gaps (achievement distributions) remain the widest (BenDavid-Hadar & Ziderman, 2011).

The primary role of Israeli school principals, as articulated by Capstones, the institute which spearheads school principals’ development in Israel, is to serve as an instructional leader in order to improve the education and learning of all students. Four additional areas of management enable and support this function: designing the school’s future image—developing vision and bringing about change, leading the staff and nurturing its professional development, focusing on the individual, and managing the relationship between the school and the community (Capstones, 2008). Thus, as a school leader, the principal has to demonstrate a high level of systems thinking, capturing the multiple dimensions of the school and linking them to ensure the success of all students.

**RESEARCH DESIGN**

Like most research on systems thinking (e.g., Frank, 2002; Frank & Elata, 2006; Hung, 2008; Taber, 2007; Zaalaf, 2007), the present study is qualitative in nature in order to provide rich textual descriptions of the complexities of how people experience a given issue or situation. This qualitative study included diverse sample of school principals, at three different stages of professional development: (1) pre-service principals—24 students attending principal-preparation programs at three different academic institutions. The pre-service principals were 18 females and 6 males, with a mean of 17 years of teaching experience (range: 8–20). They worked in elementary schools (n = 18), middle schools (n = 3), and high schools (n = 3) located in five of Israel’s six school districts. (2) Novice principals—follow-up on 11 of the pre-service principals during their first year after appointment as novice principals. The novice principals were 8 females and 3 males, with a mean of 18 years of teaching experience (range: 11–27). They worked in elementary schools (n = 8), middle schools (n = 1), and high schools (n = 2) located in four of Israel’s six school districts. (3) Experienced principals—28 principals selected as outstanding leaders based on their superintendents’ recommendation and their schools’ achievement. The experienced principals were 24 females, with a mean of 26 years of teaching experience (range: 16–30) and 9 years as principals (range: 5–18). They worked in elementary schools (n = 20), middle schools (n = 2), and high schools (n = 6) in three of Israel’s six school districts. For ethical reasons, all participants were informed that their participation was voluntary and that they could cease their participation at any point in time if they so wished. They were assured of anonymity and confidentiality (pseudonyms were assigned), and were asked to provide written consent to participate, based on understanding of the research purpose.

Data were collected through interviews and focus groups, both semi-structured, allowing “the researcher to respond to the situation at hand, to the emerging worldview of the respondent, and to new ideas on the topic” (Merriam, 2009, p. 90). The key questions were preplanned, but the interviews and focus groups were conversational, with questions flowing from previous responses when possible. Individual interviews with principals generally lasted 1 hour, and focus groups generally lasted 2 hours.

During the interviews and focus groups, we intentionally avoided mentioning the term “systems thinking,” to prevent priming interviewees to respond in this vein. Without saying so explicitly, we tried to bring interviewees to talk about their systems-thinking sources, with general questions, such as: “What will enable you to succeed as a school principal?” (pre-service principals); “What allows you to do well in your new job?” (novice principals); “How did you learn to run a school?” (experienced principals). The term “systems thinking” was used only in the last part of the interview or focus group, when interviewees were asked about their own sources of systems thinking, including questions such as: “How did you develop your systems thinking? When did this development take place? What accelerates the development of systems thinking and what inhibits it?”
The pre-service principals were interviewed twice during their one-year principal-preparation program, at the beginning of their studies and again toward the end. In addition, three focus groups were held mid-program, attended by 16 out of the 24 participants whose schedule allowed them to participate. Following completion of their pre-service program and their appointment as first-year school principals, the subgroup of 11 novice principals was again invited to two interviews—3 months and again 1 year after assuming their new positions. A focus group was also held mid-year with the six novice principals whose schedules allowed them to participate. Among the group of experienced principals, all 28 participants were offered the option of participating in a focus group. Those 10 principals whose schedules allowed them to participate did so, forming two focus groups of five principals each. The remaining 18 principals who could not participate in the focus groups were then interviewed. The combination of interviews and focus groups permitted deep understanding of participants’ perceptions, uncovering or clarifying information through multiple data collection methods. In total, 82 interviews and 6 focus groups were conducted.

Data analysis was a four-stage process—condensing, coding, categorizing, and theorizing. Once data were collected, we found that not all the material collected could serve the purpose of the study, and a sorting process was necessary (Miles, Huberman, & Saldaña, 2014). Thus, we looked for the portions of data that in any way related to systems-thinking sources, which was the topic of this study. In the second stage, coding, each segment of data (utterance) was coded by the aspect of systems thinking it expressed (Gibbs, 2007). In contrast to the previous stage, this stage was data driven and not theory driven because we did not use a priori codes but rather inductive ones, developed by direct examination of the perspectives articulated by participants (Flick, 2009; Marshall & Rossman, 2011; Rossman & Rallis, 2012). After capturing the essence of utterances in the second stage, in the third stage, categorizing, similar utterances were clustered in order to generalize their meanings and derive categories. At this point, categories were reworked in order to reconcile disconfirming data with the emerging analysis. Finally, the theorizing stage was aimed at reaching a conceptual construct of the categories derived in the previous stage, and seeing how they were interconnected and influenced each other as parts of one abstract construct (Richards & Morse, 2013).

Several measures were taken to ensure trustworthiness. First, the diversity of study participants was maintained, in terms of level of school where they work (elementary, middle, and high), educational system (state, religious state), and districts. Second, data collected were coded on two different occasions to ensure consistency (Saldaña, 2009).

Third, triangulation was employed, in order “to map out, or explain more fully, the richness and complexity of human behavior by studying it from more than one standpoint” (Cohen, Manion, & Morison, 2007, p. 141). Thus, we considered findings to be supported by the evidence when they emerged from participants at three different levels of professional experience (Denzin, 2006). It should be noted that the goal of the triangulation was not to arrive at consistency across data, but as an opportunity to uncover deeper meaning in the data (Patton, 2002). Fourth, a member check was held, giving the data, transcription, and tentative themes, to participants and asking for their feedback (Schwartz-Shea, 2006). Fifth, throughout the study period, we used reflective journals in order to ensure critical thinking. Reflective journals have been recognized as an important aspect of qualitative research (Etherington, 2004; Ortlipp, 2008).

FINDINGS

Qualitative data analysis yielded four main sources of systems thinking in school leadership: managerial experience, role model, academic study, and natural tendency.

MANAGERIAL EXPERIENCE

According to study participants, the primary source of systems thinking in school leadership is managerial experience, as was expressed by 14 of the pre-service principals, 8 of the novice principals, and 16 of the experienced principals. For instance, during a focus group, Aaron, an experienced principal who serves in this role for 8 years, attributed his systems thinking to his professional experience:

I want to go back to your question about how we developed our systems thinking. I think that the main factor that contributed and actually still contributes to my systems-thinking ability is my experience. In my opinion, you can’t develop your systems-thinking skills except through years of experience. There is no substitute for experience, and there are no shortcuts in this matter.

Eric, an experienced principal who serves in this role for 11 years, who participated in the focus group with Aaron, agreed with him about the importance of experience in the development of systems thinking, adding that principals must also learn from their experiences:
I agree with Aaron, that you can’t be a good school principal and you can’t develop your systems thinking without experience. However, experience does not necessarily result in expertise. Twenty years of experience can be one year’s mistakes repeated nineteen times. So in my opinion experience will only contribute to development of systems thinking if principals are capable of learning from it.

In another focus group, Noah, an experienced principal who serves in this role for 8 years, likewise identified experience as the main source of systems thinking among school principals:

If I look for the roots of my systems thinking, I believe that being a school principal is a continuous chain of events and happenings, each of which teaches you something you didn’t know before. Over the years you gain work experience that makes you a skilled principal. I can point to some important events, not necessarily prominent ones, which especially taught me a lot, but basically I learned a little bit at a time, and over time I developed my systems thinking.

Leah, an experienced principal who serves in this role for 9 years, also emphasized the importance of experience in developing the ability “to see the big picture,” which is one of the characteristics of systems thinking:

You know, it’s scary to try to perform a task for which you’re unprepared. But this is the situation of beginning school principals, because you can’t be prepared without doing it for several years. There is no other way to learn it. So you have to begin unprepared, and then acquire the ability to see the big picture.

Managerial experience is often acquired even before being appointed as a school principal, when teachers hold school managerial roles. In an interview held during her principal-preparation program, Natalie, a pre-service principal with 20 years of teaching experience, described the expanding systems-thinking viewpoint that she gained when she began working as an assistant elementary school principal:

When I became an assistant school principal I began to see the whole school rather than only a single class. As long as I was a teacher in my class I didn’t understand how things looked from point of view of the whole school, but since my appointment as the school’s assistant principal I learned over time that there are many considerations to be taken into account.

Likewise, in an interview held during her principal-preparation program, Miriam, a pre-service principal with 8 years of teaching experience, described how she developed systems thinking gradually with her new roles:

The development of my systems thinking was gradual. Initially, as a math teacher, I can now say that I didn’t really have systems thinking. All I cared about was that my students would succeed on a math exam. I did not take into consideration that the students were also studying other subjects, which had their own requirements. I gave my students assignments without any regard for the rest of their school subjects. Obviously this caused grievances among my students and among other teachers. Later I was appointed to be the coordinator of mathematics, and then I was responsible for the success of all students in mathematics. I began to see a broader picture of the range of students and teaching staff. Then, when I was appointed to be a pedagogical coordinator, my view of the system became even broader. It’s not just math, but accountability for other subjects too. I began to be exposed to interactions between different coordinators, different tests, internal and external exams, and more.

In a focus group during her first year as a novice elementary school principal, Shoshana described her pre-service years, when she worked as an educational counselor, as helping to prepare her to be a school principal by learning to “understand the school as a whole system”:

As an educational counselor I worked closely with the school principal. She consulted with me on many things, and I advised her in all deliberations relating to school. I was party to all key processes in the school, and participated in many meetings. There were also quite a few processes that were my responsibility, and I led them. That’s how I learned to understand the school as a whole system, so I feel I was prepared for this position of school principal.

Dinah, a pre-service principal with 10 years of teaching experience, was exposed to her school’s complexity and therefore took “a new look at the whole picture,” when she became part of the school’s management team. In an interview held during her principal-preparation program, Dinah said:

I’ve been working at my school for ten years, but just three years ago, I joined the school’s management team, and that was a turning point for me. Since being appointed as a management team member, I began to understand how the school works, because I was exposed to the uncertainty, deliberations, connections, and consequences of everything. I see a lot of things I didn’t see before, and it gives me a new look at the whole picture. I learned how to think as a school principal, who takes a lot of considerations into account and combines them all to reach the optimal decision.
These statements demonstrate that holding school managerial roles helps develop systems thinking. The change from teacher to manager is a shift from the narrow focus of subject matter or classroom to the complexity of the school system. However, being a position holder at school is not always sufficient in itself; the significance of the role is also important, as noted by Ada, a pre-service principal with 24 years of teaching experience. At the time, Ada worked as a grade-level coordinator of a high school, but she reported that she only began to think at the systemic level when her principal assigned the grade-level coordinators to the management team:

In our school the role of grade-level coordinator used to be limited. As a grade-level coordinator I'd guide the teachers in my level and arrange activities, but I was never a party to thinking about what was happening at the school in general. The level coordinators weren't part of the school administration and were not connected to it. But then the current principal, who sees things broadly, came and made the change. He added the level coordinators to the management team, and we began to participate in the regular meetings of this team every week. This step gave a new meaning to our role and pushed us forward, because it made us an integral part of the school leadership. That is what changed my view: I started to think differently, think broadly. I see the entire school.

The managerial experience that helps develop systems thinking may also have its source beyond the school system. Jacob, a pre-service principal with 18 years of teaching experience, saw his holistic view as originating in his military service. As a commander, Jacob had to assimilate different aspects of the system, and this managerial experience developed his systemic approach. In an interview held during his principal-preparation program, Jacob related:

Before I began my educational career I had a significant military career, filling several command positions. Being a commander has many meanings that later assisted me as an educator: having responsibility for your people, motivating them, striving for excellence, and more. One of the aspects of a command position is the need to integrate a lot of your unit’s features, components, and connections. Without the integration of everything related to the unit—your unit won’t be able to function and excel. That’s how I learned to see systems as a one large entity.

ROLE MODEL

The second source of systems thinking in school leadership that emerged from the current data was the role model, working alongside someone who was performing at the systems-thinking level, as was expressed by five pre-service principals, two novice principals, and four experienced ones. In an interview held toward the end of his first year as a novice elementary-school principal, Gabriel cited his previous school principal as the person from whom he learned system thinking:

I worked under several school principals, but I learned the most from my last principal, who was an unusual person. He made me think systematically. He always thought about things in an original way, looking a few steps ahead and suggesting innovative ideas. He inspired me, and I now think more broadly about things, trying to connect different things all into one process.

Similarly, Shirley, a pre-service principal with 10 years of teaching experience, said in a focus group conducted during her preparation program that she had developed a holistic point of view when she worked alongside a principal who had linked everything at school to a clear vision:

Almost all schools these days have a "vision," but all too often the vision isn’t worth the paper it’s written on, because it includes empty pronouncements that no one really intends to realize. In our school it's different: We have a vision that embodies the best thinking about our school's improvement, inspiring us to reach for ambitious goals. The school principal led the articulation of this powerful vision, and since then she has linked every decision, every project, and every deliberation to the vision. Since I was exposed to her worldview for a long time, I learned, bit by bit, how every element of school is linked to the overarching concept, which affects everything.

Abigail, a pre-service principal with 13 years of teaching experience, who also participated in the focus group conducted during the preparation program, added:

I also work with a school principal who consistently expanded our point of view. She always explained her decision-making considerations, the likely consequences of a certain event, the implications of a planned process, and so on. That’s how we learned to understand the school’s mindset, seeing things broadly, deeply, and holistically.

According to Abigail, her principal not only gave a personal example of systems thinking but was also careful to explain it, showing how different elements in the system influence each other. In doing so, she helped her staff develop systems thinking. Similarly, Esther, a pre-service principal with 20 years of teaching experience, described a principal who took the time to teach position holders at her school "to see a lot of options in any given situation," a view that reflects systems thinking.
I think that the principal’s schedule tells you a lot about his or her priorities. My principal spends a great deal of time in personal meetings with the school’s position holders. The goal of these meetings is not just practical issues but also to help to gain a deeper understanding of educational work. One of the things I have learned thanks to these weekly meetings is to see many options in any given situation. I used to think that there are always only two options, two extremes, two opposites, and my principal taught me that there are always many more options and that even conflicting options can be chosen at the same time.

Most of the participants who attributed their systems thinking to a role model spoke about their school principal. However, other persons could also serve as a model. For example, Rafael, an experienced principal who serves in this role for 6 years, said that he enriched his systems thinking, learning “to take a macro view of the entire domain,” due to joint work with the educational counselor:

Last year a new educational counselor came into our school, from whom I learned a lot. She has a deep understanding of the school. She understands processes in a comprehensive way, and I would even say that she is able to forecast, anticipate, and foresee the future. She is able to imagine how things will evolve in the future and, thus, to plan accordingly. I learned from her to take a macro view of the entire domain, not just the specific minutiae of the immediate domain.

Ethan, an experienced principal who serves in this role for 8 years, also expanded his systems thinking thanks to one of the teachers on his team. He referred to this young teacher as helping him “consider issues from a wide range of perspectives”:

I have a young teacher who does not yet have a teaching certificate, and he understands the school’s essence much better than any other teacher. Consulting with him and listening to him is more valuable to me than consulting with the school’s senior teachers. After each meeting with him I feel I increased my ability to consider issues from a wide range of perspectives, to appreciate their differences, and to make appropriate decisions.

ACADEMIC STUDY

Academic study was cited as another source of systems thinking in school leadership by 16 of the pre-service principals, 7 of the novice principals, and 6 of the experienced principals. Some principal-preparation programs offer an academic course on systems thinking, and Adina, a novice high school principal who had participated in such a course during her preparatory studies the previous year, said in a focus group held during her first year on the job:

As part of our studies in the principal-preparation program we were exposed to the laws of systems thinking. One of the laws that I use sometimes, because I found it significant for my work, is the mistake of “I am my position.” This happens when a teacher focuses only on his own role within the school, that is, as a teacher of a particular class or a particular subject, because a teacher mustn’t think just about his own role at school, but has to think about the whole school. I’ll give you an example. Recently I told a teacher, who taught a certain age group for many years, that I plan to move her to a different age group next year. She was strongly opposed, and I explained to her that she doesn’t work only with that specific age group; she works at our school, which includes several age groups.

Due to her academic studies in the preparation program, Adina’s point of view as a new principal took an important systems-thinking construct into account, focusing on her school as one whole organization rather than as separated age groups. Similarly, Rachel, a pre-service principal with 10 years of teaching experience, said that she had implemented the systems-thinking approach following a course she took while working as a grade-level coordinator:

As a coordinator of the young grade level, I organize the ceremony when the children receive their first prayer book. I do this every year, and every year I get angry at the other teachers who don’t help me enough. I have to beg them to help me, as if it were my own daughter’s private party. They don’t understand that these celebrations establish our school’s good name. However, this year, when I was about to prepare the ceremony, I’d just learned about systems thinking in the school principal’s preparation program, so I decided to apply it. The plan was that the students would travel to several locations in the city, and in each they’d find a teacher who was dressed as a historical figure, so I had to recruit teachers. But considering the concept of systems thinking I acted differently from the way I’d done in previous years. When I approached a teacher, I didn’t just ask her to help me in a concrete task; I explained the concept of the entire festivity to her, explicating the whole program. It was amazing: Every teacher I talked to became enthusiastic about the festivity, agreed to help, and even offered more help and more ideas.

Learning from her academic studies, Rachel used systems thinking to face challenges in her work. In this context, she showed her colleagues the whole picture and therefore received much more help.
Academic study of systems thinking can take place in settings other than principal-preparation programs. In an interview conducted during his principal-preparation program, Israel, pre-service principal with 14 years of teaching experience, said that he had developed his systems thinking through an in-service teacher-training program:

During an advanced study program in which I participated, we learned how to construct a work plan for the school. We learned a tool called “vision deployment matrix,” but the main topic was the systemic view. We were exposed to the school’s systemic map, which consists of several components. Among these components were the human, the organizational, and the pedagogical components. This advanced study program was significant for me, because I understood that the systemic approach involves thinking in ways that are not defined and not known in advance, and it usually leads to multiple solutions, each with its advantages and disadvantages.

Another example of academic study as a source of systems thinking was cited by Michal, a novice high school principal, who reported that she learned to see her staff as “one unit” rather than “individuals” due to something that she learned during her advanced studies for in-service principals:

One of the lecturers introduced us to the prisoners’ dilemma, where two inmates are prevented from speaking to each other. When interrogated, if neither of them confesses—they each get a punishment that is less severe than if they both confess, and if just one of them confesses the other one gets punished severely while the prisoner who confessed goes free. What emerges is that if each prisoner thinks just about himself, ignoring the big picture, it is better for them to betray each other. However, their reward would be better if they both see the big picture and remain silent. When I learned this, I thought about my principalship fundamentals, and this lesson inspired me to determine cooperation as one of the basic expectations from my staff. I often tell them that we have to function as one unit and not as individuals, once in a while explaining the prisoners’ dilemma to them.

NATURAL TENDENCY

The fourth source of systems thinking in school leadership, natural tendency, was cited by 12 pre-service principals, 4 novice principals, and 11 experienced principals. Alexander, a pre-service principal with 20 years teaching experience, explained that his systems-thinking ability came naturally:

Where did my systems thinking evolve? I can’t really pinpoint the place. Going many years back, I can identify many places where it grew: as a guide in a youth movement, in the pre-army preparatory yeshiva, during military service in an elite combat unit, during my officer training course, working as an educator, serving as an assistant principal, and even while studying for my MBA at the university. But it did not begin there. All those places were a continuation of my naturally wide-ranging view, and that view is what directed me toward all those places. Those places I mentioned did not give me this view, although they helped it advance, mature, and evolve, each in its own way. But that view existed before.

Similarly Aaron, an experienced principal who serves in this role for 8 years, said in the focus group: “I suppose I’ve had the holistic perspective from birth.” David, an experienced principal who serves in this role for 10 years, also considered his systems-thinking ability as a personality characteristic. He described his holistic understanding of an educational plan:

When I plan a project I initially have a vision of it complete, and this vision guides me all the way through, up until the implementation of the idea. The vision shows me the whole picture of the project, including its details. I’ll give you an example: When there was a war going on in southern Israel I had an innovative idea—to adopt a school from there. This meant that I, as the school principal, contacted the principal of the adopted school, and each teacher in my school contacted one teacher from the adopted school, and each student in my school contacted one student of the same age from the adopted school, and my school’s secretary contacted the adopted school’s secretary, etc.

David asserted that when he planned an educational program related to a national situation (fighting in southern Israel), he did not compile a list of separate activities; rather, he saw the whole. Understanding an educational plan from the overall concept to the details reflects systems thinking in school leadership, which involves a holistic point of view not only regarding the whole school, but also regarding any given issue from any sort of school-life arena—be it a program, event, or pupil. David also explained how this understanding emerged:

When thinking about this unique idea, I first had the overall concept, together with its details. Visions like this come to me suddenly, like lightning striking. I see a need and I ponder it; then the solution comes from within, in a powerful way, at once, like a flash . . . I didn’t learn it; I’ve just got it.

David described his holistic view not as a plan that he builds gradually but as “lightening striking” that comes suddenly and considered this ability to
be a personality characteristic rather than a learned capability. Likewise, Ethan, an experienced principal who serves in this role for 8 years, said during a focus group that some teachers are talented in systems thinking:

As a school principal I often think about issues related to the school as a whole, such as what its current goals are or what changes are required, and in many cases I talk about these issues with the teachers. Most of the teachers aren’t able to express a profound opinion on these issues; they are good teachers but don’t understand the school as a whole, which is fine by me. Only a few teachers see the school’s major needs, opportunities, or risks. Those teachers are not necessarily the most experienced or the most educated.

Ethan went on to describe the aforementioned young teacher who had not yet attained his teaching certificate but who seemed to innately understand “the school’s essence” as a whole, even “more than . . . the school’s senior teachers.” He referred to this teacher as helping him “consider issues from a wide range of perspectives” (see above Role Model).

DISCUSSION

The many statements by principals of different levels of professional experience captured the four sources of systems thinking—managerial experience, role model, academic studies, and natural tendency—and provided examples of their manifestation within the school and the workings of schools. As reviewed earlier, Davidz (Davidz, 2006; Davidz & Nightingale, 2008) explored the sources of systems thinking. She found that the primary mechanisms enabling systems-thinking development in engineers include experiential learning, which incorporates both work experience and life experience; specific individual characteristics, such as thinking modes, problem-solving styles, and interpersonal and communication skills; and a supportive environment, such as schedule and cost constraints and work designs. The current research is innovating in that it examines the sources of systems thinking among educational leaders. Two of the sources of systems thinking, which this study found among educational leaders—academic study and role model—were not mentioned by Davidz. Her finding about the contribution of a supportive environment was not substantiated in this study.

How can systems thinking be learned effectively through academic studies? As mentioned above, some methods were suggested for systems-thinking learning, such as hypermedia (Thurstorn, 2000), metaphors (Taber, 2007), case studies (Blizzard et al., 2012), and modeling (Hung, 2008). Findings of the current study imply that beyond the question of method, school principals’ development of systems thinking due to learning occurs mainly in relation to their active educational work. The connection to the school’s daily challenges is central to the learning itself. This is in alignment with the constructivist approach that emphasizes the importance of learning in a meaningful context rather than abstract instruction out of context (e.g., Keaton & Bodie, 2011; Powell & Kalina, 2009). According to this approach, the study of new methods as decontextualized knowledge is less effective than learning them by linking the learned theory to authentic situations (Marlowe & Page, 2005).

Role model as a source of systems thinking heightens the significance of mentoring in school leadership. To ease the adjustment to their new role, it is becoming increasingly prevalent for novice principals to be paired with an experienced guide (Wallace Foundation, 2007). This practice is consistent with findings that new principals feel that mentoring programs are necessary for their professional development during their first years on the job (e.g., Kingham 2009; Woolsey, 2010; Zepeda, Bengston, & Parylko, 2012). According to the current study, a mentor—role model—who demonstrates a high level of systems thinking may contribute to the beginning school leader’s systems-thinking development.

Moreover, this study highlights a further aspect of mentoring in the area of school leadership: not only external mentor who assists the school principal, but also seeing the school principal as a mentor for his or her staff members. One of current-day’s changes in school leadership includes the establishing and then sustaining of a collaborative workplace environment and professional learning community within school (e.g., Eaker, DuFour, & DuFour, 2002; NAESP, 2008; Schmoker, 2006). In this context, a primary role of the school principals is to build leadership capacity among staff members (Cotton, 2008), serving as a guide and coach for teachers (Hord & Sommers, 2008). The current study shows that a school principal who is a role model for the school teachers, and in particular for those who hold a school position like educational counselor or grade-level coordinator, may enhance and accelerate their systems-thinking development.

Debate continues as to whether systems thinking is a natural talent or an acquired ability (Zommershain, 2012). The finding here confirm both ideas: principals’ natural tendency is one source of systems thinking, but managerial experience, role models, and academic study also contribute to its development. Thus, dichotomy between natural talent and acquired ability is incompatible with the concepts of systems thinking, and when looking for the origins of individual differences, the focus should be on developmental processes rather than on the separation between natural talent and acquired ability. Instead of dichotomizing behavioral capacities into those that are innate and those that are learned, personal development
through the influence of one factor in the context of other factors should be emphasized (Blumberg, 2008; Lewkowicz, 2011; Licklider, 2007; Spencer et al., 2009), as summarized in Figure 2.

At the center of Figure 2, the characteristics of Systems School Leadership are associated with the two meanings of systems thinking. Leading wholes and Using a multidimensional view characteristics reflect Seeing the whole beyond the parts, while the Influencing indirect and Evaluating significance characteristics reflect Seeing the parts in the context of the whole (Shaked & Schechter, 2014). The outside circle shows the four sources of Systems School Leadership as a developmental process that occurs by interaction between the four sources: managerial experience, role model, academic study, and natural tendency.

IMPLICATIONS

Because academic study was found to be a contributing factor to the development of systems thinking in school leadership, imparting the basics of systems thinking to prospective school principals during preparation programs may increase the likelihood that they will perform at this level. Direct teaching of systems thinking should include opportunities to contextualize prospective school principals’ learning in school leadership. For example, pre-service principals may analyze conflicts, decisions, or dilemmas taken from their daily lives through the prism of systems thinking, as well as applying systems thinking in their own school reality.

Managerial experience is also a major source of systems thinking in school leadership. Thus, it may be beneficial to add a work experience internship requirement to principal-preparation programs, which aims to provide on-the-job managerial training in systems thinking in school leadership. In doing so, aspiring principals will be expected to put into practice the systems-thinking skills that they have learned.

Optimization of the selection process for new principals may also occur if candidates’ managerial experience is taken in account. A candidate who has not had enough experience in a school managerial position such as coordinator, educational counselor, or assistant principal may encounter difficulties in successfully leading a school, even if he or she did have extensive experience as a teacher. Experience in more than one school position is even better, because acquisition of different points of view about the school reality can expand the candidate’s ability to perform at the level of systems thinking in school leadership.

After entering the job, novice school principals need mentoring. Systems thinking may furnish a valuable conceptual framework for the mentoring of beginning principals, providing them with a perspective through which they can better understand their everyday reality and find effective strategies for creating well-functioning schools. The mentor as a role model may contribute to the novice principal’s development of systems thinking. Moreover, learning systems thinking may be timely for principals not only during their preparation program, as mentioned above, but even after entering the job—during the first few years on the job, when many new principals struggle to survive, and even after. Thus, it is advisable that systems thinking will be taught in in-service training of school principals.

Knowledge about enablers and barriers of systems-thinking development is extremely limited. The current study is the first research on the sources of systems thinking in school leaderships. Inasmuch as the findings were collected in a particular context, their cross-cultural validity is not proven. This study should be replicated elsewhere in various contexts.
enabling generalization of the findings to a broader population and substantiating their international validity. In addition, this study discussed the sources of systems thinking in school leadership regardless of the stages in its developmental process. It is important to explore also the developmental process of systems thinking among school leaders, corresponding to principals' career milestones.

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**A Social Network Approach to Examine K-12 Educational Leaders’ Influence on Information Diffusion on Twitter**

**ABSTRACT:** This study investigated the relationship between the leader’s gender, leadership position, Twitter use, and influence on information diffusion in the communication network on Twitter. We collected the 30,200 latest tweets of 151 active Twitter users who held educational leadership positions. Results of social network analysis and multiple regression analyses suggest a gender inequity in the leader’s influence on information diffusion in the network. Findings also indicate a significant relationship between leadership position (district vs. building) and a leader’s influence in the network. Moreover, Twitter following was positively associated with the leader’s influence in the network, whereas the number of followers, weekly tweets, and the time of Twitter account creation did not predict the leader’s influence. Practical implications on how leaders use Twitter to disseminate information are discussed.

**KEYWORDS:** Communication, Educational Leadership, Social Network Analysis, Diffusion of Innovation, Educational Technology Leadership

Twitter, as an emerging means of communication, accentuates the potential for individuals and organizations to disseminate information without mass media (Gruzd & Wellman, 2014; Otterbachers, Shapiro, & Hemphill, 2013; Wang, 2013; Xu, Sang, Blasioa, & Park, 2014). Using Twitter for communication in education has not gone unnoticed. Educational leaders use Twitter to share and acquire resources, collaborate with other educators, build professional

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