e-Leadership of school principals: Increasing school effectiveness by a school data management system

Ina Blau and Ofer Presser

Ina Blau holds a PhD in E-Learning and Cyber-Psychology from the University of Haifa, Israel. She is a senior faculty member in the Department of Education and Psychology at the Open University of Israel. In addition, she teaches in the Department of Information and Knowledge Management, Graduate School of Management, University of Haifa. Her research interests include social aspects of Internet use and e-communication, integration of innovative technologies in education systems and organizations, e-leadership, online participation patterns, e-collaboration, online risks and safety. For other details, see http://www.openu.ac.il/Personal_sites/ina-blau/. Ofer Presser holds an MEd in Educational Leadership from the Oranim Academic College of Education, Israel. He is a department head and educator in a regional high school in Northern Israel. His main interests are educational leadership and physical education. He promotes leadership and community contribution by students, among others, by supporting adolescents and adult athletes in preparation for 'Special Olympics'. Address for correspondence: Dr Ina Blau, Education and Psychology, The Open University of Israel, 1 University Road, P.O.B. 808, Ra'anana 43107, Israel. Email: inabl@openu.ac.il

Abstract

In recent years, school management systems have become an important tool for effective e-leadership and data-based decision making. School management systems emphasize information flow and e-communication between teachers, students and parents. This study examines e-leadership by secondary-school principals through the Mashov school management system, implemented in 500 Israeli schools in order to increase school effectiveness. Semistructured interviews were conducted at the end of academic year 2010/2011 with 10 participants: eight secondary-school principals, a Ministry of Education supervisor, and a director of the school principals' training program. The results indicate that the system provides extensive support for school principals in managing the organization, delegating responsibilities and promoting e-leadership by teaching staff and, consequently, increases the pedagogical effectiveness of their school. e-Leadership through the school management system changes the entire school culture. It includes making data-based decisions; monitoring curriculum implementation and learning performance; interacting with teachers, students and parents; improving the school climate; and raising the level of student and parental involvement. The results are discussed in terms of the islands-of-innovation and comprehensive-innovation models of technology implementation. In order to enhance e-leadership, we recommend that school principals expand the implementation of school management systems among students and parents, delegate e-leadership responsibilities and monitor the level of teacher activity within the system.

Introduction

Online school management systems have become an important tool for effective management of pedagogical information and student data. The Israeli education system has begun a reform towards comprehensive integration of information and communication technologies (ICT) in order to develop and enhance students' 21st-century skills. As a part of this process, schools should implement a school data management system in order to support e-leadership and e-communication among teaching staff, students and parents.

Practitioner Notes

What is already known about this topic

- e-Leadership is the ability of a person to influence the behaviour of others in a digital technology-mediated environment
- The rate of adopting e-leadership is normally distributed among school principals according to individual differences in innovation adoption
- The main models of technology implementation are islands of innovation (starting with part of the organization) and comprehensive innovation (immediately implementing the technology in the entire organization)
- Implementation among both teachers and families increases the level of teacher activity within a school management system compared with implementation among teaching staff alone

What this paper adds

- School management systems provide extensive support for e-leadership by school principals and increase pedagogical effectiveness of schools
- e-Leadership is realized by data-driven decision-making; monitoring curriculum implementation, learning performance and student activity; and e-communication among staff, students and parents
- The expanded innovation model of implementation—including students and parents—enables e-leadership among teaching staff, in addition to e-leadership by principals

Implications for practice and/or policy

- e-Leadership through school management systems should become an integral part of daily practice for school principals and teaching staff
- School principals should monitor the level of teacher activity within the system, delegate e-leadership responsibilities and promote data-driven decisions and e-communication among all stakeholders
- In order to enable e-leadership by teaching staff, students and parents should have access to the school management system data, instead of teaching staff only

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School data management systems emphasize organizational aspects and the transfer of pedagogical information, such as curriculum performance and student activity and achievement. One of these systems examined in this study is Mashov ("feedback" in Hebrew, and the acronym of "Immediacy, Transparency and Supervision"; http://www.mashov.info, website in Hebrew), which operates, in academic year 2012/2013, in more than 500 Israeli schools (approximately 13% of schools in the country). The system helps improve the work patterns of the management staff, especially in the area of decision-making, which is based on data and improved communication with teachers and students—essential components of school effectiveness.

This study focuses on e-leadership of secondary-school principals through the school management system. By interviewing 10 participants coming from diverse schools and professional backgrounds, the study explores (1) how the school management system supports secondary-school principals' e-leadership, (2) how the school principals' e-leadership promotes their teaching staff's e-leadership and (3) how e-leadership affects school effectiveness.

The literature review section first discusses the roles of school principals, traditional leadership and e-leadership. Following that, the implementation of technology is presented from the

perspective of individual differences and organizational decisions. To conclude the review section, the parameters of school effectiveness are discussed.

Literature review

A school principal is a leader in the educational organization, and his or her main role is to lead continuous improvement in the school environment, promoting student learning and education (Chirichello, 2010). Traditional leadership is a process in which one member of an organization influences and controls the behaviours of others in order to achieve common goals (Burns, 1978). Leadership in educational organizations is a significant factor affecting the effectiveness of the school. The school principal must look at the entire organization and try to create a tight connection between its different dimensions for helping students to succeed. All of this should be done while trying to change processes, to promote teaching and learning, and to increase performance and student achievement.

By analogy to traditional leadership, e-leadership refers to the ability of a person to influence the behaviour of others in a digital technology-mediated environment (Chamakiotis & Panteli, 2011). Different terms have been used in various papers to refer to the use of technology to support leadership in educational institutions, including ICT leadership (Yee, 2000), IT leadership (Hollingsworth & Mrazek, 2004), educational technology leadership (Kearsley & Lynch, 1994) and school technology leadership (Anderson & Dexter, 2005; Tan, 2010). This paper adopts the term e-leadership (Gurr, 2004), emphasizing the leading process empowered by technology instead of the technology itself. In addition, some papers use the terms mentioned above in different ways. For example, school technology leadership was defined in Anderson and Dexter's (2005) survey as presence of a technology committee; technology leadership in Dexter's (2007) paper referred to principals' involvement in technology-related responsibilities at schools introducing laptops in classrooms. This paper defines e-leadership as the usage of a school management system (not just any educational technology) for exchanging updated pedagogical data and for e-communication in order to increase school effectiveness through data-based decision-making and instant interactions among different stakeholders.

In the research on virtual teams the idea of distributed leadership in digital environments in opposition to traditional organizational leadership has become popular (Mehra, Smith, Dixon & Robertson, 2006). Distributed leadership is defined as "a social distribution where the leadership function is stretched over the work of a number of individuals and the task is accomplished through the interaction of multiple leaders" (Spillane, Halverson & Diamond, 2001, p 20). In contrast to virtual teams, Israeli schools are traditional organizations with a hierarchical structure, and the idea of distributed leadership seems to be hardly applicable to them. Thus, e-leadership in educational organizations mostly reflects the leadership style of the school principal and varies on a continuum from authoritarian-style (eg, top-down leadership) to a responsibility-delegating approach (Raybould & Fauska, 2005; Tan & Aloysius, 2011; Timperley, Wilson, Barrar & Fung, 2007).

The Mashov school management system studied in this paper supports both hierarchy and the responsibility-delegating approach (see Blau & Hameiri, 2010). Each member of the organization receives access to the data according to his or her position: school principals have access to all the pedagogical information concerning their institution; heads of departments can see all the data concerning their departments; homeroom teachers have access to the information regarding the performance of their students in different subjects; students can access their own information entered by different teachers; parents have access to the data concerning their children's learning and activity. Thus, e-leadership by school principals is empowered by the possibility of monitoring, communicating and making data-based decisions at the whole-school level; heads of departments and homeroom teachers' leadership is strengthened by monitoring pedagogical data and by e-communication at the level of their departments or classes.

The adoption of e-leadership in educational organizations can be discussed at the level of school principals from the perspective of individual differences among the participants, as well as at the organizational level. Rogers's (2003) diffusion-of-innovation theory explains variety in the rate of adopting new technologies by individual differences. The continuum of innovation adoption is normally distributed in a Bell curve and ranges from innovators (2.5%) and early adopters (13.5%) to early majority and late majority (34% each) and finally laggards (16%). Based on this approach, e-leadership through a school management system would differ according to individual differences in innovation adoption among the school principals.

Analysing the literature focused on implementing technology in schools at the organizational level, Avidov-Unger and Eshet-Alkalai (2011) found two main models of implementation: "islands of innovation" and "comprehensive innovation." In the islands-of-innovation model, the innovation is implemented only by a small fraction of the organization and is usually focused on a particular content area or a particular task (Mioduser, Nachmias, Tubin & Forkosh, 2006). In contrast, in the comprehensive-innovation model, the implementation involves all levels of the organization, thus creating a new organizational culture. Based on the findings of numerous studies Avidov-Unger and Eshet-Alkalai (2011) concluded that the assumption of success automatically spreading from the island of innovation to the rest of the organization is erroneous. The island of innovation remains isolated from the rest of the organization and even creates among decision makers the false illusion of an innovative organization.

In the context of implementing a school data management system, the islands-of-innovation model seems to be unsuitable—the data pool and e-communication through the school are valuable only if at least most of the teaching staff are entering data and using the system on a regular basis (Blau & Hameiri, 2012b). Therefore, instead of gradual adoption, on starting the implementation of a school data management system a principal should from the beginning include in the process the entire teaching staff. Moreover, according to Fuchs (1995), successful implementation of changes in schools is influenced by all stakeholders involved in the process, and to be substantial, the change should include not only teaching staff but also students and their parents. Consistent with Fuchs's approach, some systems connect student data regarding school performance, curriculum resources, intrastaff communication and school–home linkages (Wayman, 2007; Yee, 2000). Blau and Hameiri's claim received empirical support in large-sample comparisons between the implementation of the Mashov system investigated in this study among school staff only versus the implementation of the system by teachers *and* families (Blau & Hameiri, 2010). The results showed that the implementation among teachers and families, which can be called the "expanded-innovation" model (Blau & Hameiri, 2012a), led to a higher level of daily data exchange and e-communication among school staff compared with the "comprehensive-innovation" model of implementation.

School principals are the central figure in leading technological change in educational institutions (Tan, 2010). They can promote school effectiveness through data-driven decision-making (Main, 2009), by identifying and articulating vision and goals, developing high performance expectations, and fostering communication (Knapp, Copland, Plecki & Portin, 2006). Principals also affect the instructional quality of schools through promoting teacher professional development and organizational structures to support instruction and learning (Harris, Rutledge, Ingle & Thompson, 2010).

School data management systems can help school principals work more efficiently by improving the tracking of learning outcomes, behaviour, and curriculum and other pedagogical data. These systems can significantly increase school effectiveness by providing on-demand updated data at different levels—individual student, class, subject, or the entire school—and by strengthening communication among teaching staff, students and parents (Blau & Hameiri, 2012b). For

example, Wayman, Conoly, Gasko and Stringfield (2008) described how principals concerned about school ratings used a school data system to track and provide special help to at-risk students.

The Mashov system investigated in this study includes two applications (Blau & Hameiri, 2012a): the school staff application, which enables a secure online or mobile exchange of pedagogical information and communication between school staff, as well as online or mobile interactions with students and their parents; and the family application, which opens access to student data for students and their parents and offers them the possibility for two-way e-communication with the school staff. Each member of the organization receives access to the data according to his or her position: school principals and vice principals have access to all the information concerning their institution; heads of departments can see all the data concerning their departments; home-room teachers have access to the information regarding the performance of their students in different subjects; students can access their own information entered by different teachers; parents have access to the data concerning their children's learning and activity.

Online interactions in the Mashov system are conducted via two main modes: (1) exchange of data among teachers regarding their lessons, such as lesson topics, educational materials and homework, as well as information about their students, such as attendance, discipline, homework preparation and grades; and (2) direct two-way interactions among school staff, students and parents through logging into the system via a computer or mobile device and sending/receiving messages through the system. Users can instantly access the system from computers or their mobile devices to view statistics on how a student or class is performing—formative and summative evaluations, numbers and frequencies of late arrivals and absences, remarks on behaviour, and lesson topics and homework (Blau & Hameiri, 2012a).

The mere presence of a school management data system does not ensure its effective use by the school principal and teachers. Data systems are a cost-effective, efficient investment when data are used to help inform decisions and improve practice; otherwise, they are expensive wastes of school resources (Wayman & Cho, 2008). There is much to be learned about the effective application of school data management systems and, as Wayman, Jimerson and Cho (2010) argued, the greatest lesson is the understanding that more explorations and learning are needed.

Research questions
This study explores how the implementation of a school management system enables e-leadership by secondary-school principals and their teaching staff and promotes school effectiveness. The three research questions were:

1. How does implementing the school management system support e-leadership by secondary-school principals?
2. How do secondary-school principals promote e-leadership by their teaching staff?
3. How does e-leadership through the system affect school effectiveness?

Method
Participants
The participants were eight secondary-school principals in northern Israel, a Ministry of Education supervisor, and the director of the school-principals' training program who was involved in training the principals during the implementation of the system. Six out of 10 of the participants were men (60%). Previously the supervisor and the director of the training program had implemented the Mashov system in the schools they managed, and they viewed the research questions from the broader perspective of their present positions.

As 86% of Israeli schools implementing the Mashov system in 2011 were secondary schools, this study focused on secondary-school principals. The eight participating secondary-school principals were implementing the Mashov school data management system in order to promote their

own and the teaching staff's e-leadership, which consequently increased school effectiveness. In order to increase representativeness, the sample included principals of rural schools and schools situated in cities, principals from religious and non-religious sectors, participants having more and less seniority as school principals, and principals who were more experienced (4–5 years) and less experienced (2–3 years) in using the school data management system. A previous quantitative log analysis of all schools implementing the Mashov data management system (Blau & Hameiri, 2012a) showed diversity in their level of activity within the system. Thus, for external validity reasons the principals were *not* chosen according to a high level of activity within the system or the activity of the schools they led.

Instruments

Semistructured interviews were conducted with eight secondary-school principals in order to investigate their e-leadership experiences with the school data management system. The interviews explored how the school principals used the system for making decisions based on updated pedagogical data and for communication with school staff, students and parents. In addition, the interviews investigated how the principals monitored and promoted data exchange and e-communication among heads of departments and homeroom teachers in order to increase school effectiveness. Table 1 presents the interview questions and topics they addressed.

For triangulation of the data presented by the school principals, a Ministry of Education supervisor and the director of the school principals' training program were interviewed. Similarly to the principals, these participants viewed e-leadership at the whole-school level. As some previous studies (e.g., Dexter, 2007; Lai & Pratt, 2004) have shown that middle-level school leaders have unique needs and possess alternative interpretations of e-leadership, we did not collect data from such school personnel.

Procedure

The study was conducted at the end of the academic year 2010/2011. It was the sixth year since implementation of the Mashov online system by Israeli schools and the year in which its mobile interface was launched (Blau & Hameiri, 2012a). Informed consent was obtained from all the participants. The participants were assured that they and their schools would remain anonymous.

Semistructured interviews were conducted in the office of each participant. The interviews lasted about an hour and a half. They were recorded and the transcripts were analysed using qualitative content analysis via a bottom-up grounded approach (Bryant & Charmaz, 2012). Categories were formed by iterative reading of a sample of the interviews and then applied to the entire set of transcripts. The coding categories were exclusive; thus, each statement could be coded in only one category. Thirty per cent of the transcripts were randomly chosen and their themes reestimated by another rater. The interrater agreement was 91% (Cohen's $\kappa = 0.88$).

Results and discussion
e-Leadership by the school principals

Concerning the first research question, the study found that principals made extensive use of the school management system for e-leadership: data-driven decision making; monitoring the performance of teachers and students; delegating e-leadership responsibilities to teaching staff; and interacting with teachers, students and parents. School principals based their pedagogical decisions and dialogue with teaching staff on up-to-date data regarding student performance, including achievement in the state tests, and daily student activity, such as attendance, lateness and homework preparation. They monitored progress of individual students and classes in different subjects and checked its concordance with the curriculum and pedagogical goals. Thus, the system supported the school principals' e-leadership by providing extensive on-demand up-to-date data at different levels and enabling data-based pedagogical decisions.

Table 1: The research instrument and topics addressed

Interview topics	Interview questions
School background	Please give a short overview of the school you lead—the quantity and background of your students and teachers, the vision and key objectives of the school.
Principal's background	Tell me about yourself as a school principal—how many years have you been in management positions? What roles have you filled before this position?
Principal's vision of educational leadership	What are, in your opinion, the key characteristics of a school principal?
The system as a management tool for a school principal	Describe the patterns of your work with the Mashov school management system. What functions of the system do you use for management?
	Please give examples of your main goals as the school principal in the past two years. Which of them did the system help you to accomplish and which of them couldn't it help you to achieve?
The added value of e-management for a school principal	What new management options are open to you because your school uses the system? Which of your management routines could not be done or would be very difficult without the system?
Benefits and costs of e-management at an organizational level	From conversations with school principals who don't have a school management system or from the period before the implementation of the system in your school, what are in your opinion the main benefits and costs of using a management system for educational organizations?
The system as a management tool for teachers	Please describe the level of use of the system for management by your teaching staff. Are you satisfied with it? What do you do to increase or maintain the usage? What advice can you give other principals in order to raise the level of use?
The system as a tool for curriculum planning and teamwork by teachers	Please describe how your teaching staff uses the system for curriculum planning and teamwork between homeroom and subject-matter teachers.
The system as an information source for students and parents	Please describe the level of use of the system by students and their parents. Are you satisfied with it? What do you do to increase or maintain the usage by families?
e-Communication of a principal with teachers, students and parents	Please describe your communication patterns with teachers, students and parents through the system.
	Does e-communication affect your face-to-face interactions with teachers, students and parents, and if so, how?
e-Communication of teachers with students and parents	Based on monitoring the system, please describe online interactions among the teaching staff, between teachers and students and between teachers and parents.
	In your opinion, does e-communication on the organizational level affect face-to-face relationships among the school staff and teacher–student and teacher–parents interactions, and if so, how?
Information exchange and e-communication as part of school culture	In your opinion, to what extent is information exchange and e-communication with students and parents via the system important or not important, and why?
	Does information exchange and e-communication through the system affect the school culture, and if so, how?
The system as a tool for enhancing authority and delegating responsibilities	As a school principal, there are areas of personal responsibility and those in which you delegate responsibility. Would you characterize the school management system as a tool that enhances your authority as a principal or a tool that allows you to delegate responsibilities? Why?

N: We can look at a student's performance with his or her homeroom teacher, comparing student performance in different subjects. We make pedagogical decisions regarding this student seeing "the big picture". . . It is so different from leading the school in the pre-system period! I feel that the system upgraded our work, making leadership more effective. I cannot imagine my work without it . . . e-Leadership through the system makes me feel like the school leader of the 21st century.

Some of the school principals had themselves led the implementation of the system, and it was clear that they were satisfied with the results and felt a sense of ownership of e-leadership through the system.

L: There was no culture of e-leadership before I arrived to this school. Everyone said: "I feel that . . ." and I changed things radically. I need to manage the school based on the real data. It is a culture of e-leadership that I brought to the school.

In contrast, the principals who managed schools where the system had been implemented before they got their position reported a good level of implementation but also noted their difficulties with exploiting the full potential of the system for e-leadership immediately after being exposed to it. These data are consistent with a previous log analysis of the system (Blau & Hameiri, 2010), according to which exploration of different functions of the system takes from a year to 3 years. The data in the current study also reflect the idea of "digital wisdom" (Prensky, 2009), according to which "digital immigrants" who did not grow up in the digital era can successfully adopt and wisely use technological tools. After the initial period of adaptation, even the principals who did not lead the implementation of the system in their institutions could successfully realize its potential for e-leadership.

The results showed that the offline leadership style of the school principals on the continuum between an authoritarian approach and a responsibility-delegating approach was reflected in their e-leadership and vice versa; lessons learned from e-leadership experience impacted their offline decisions and actions. This is consistent with the results of Jang and Ryu's (2011) study, which focused on e-leadership skills learned through digital games and showed a significant relationship between in-game and offline leadership by the participants.

e-Leadership by teaching staff promoted by school principals
Regarding the second research question, the results revealed that in some schools the implementation was done in two stages—the first among school staff and the second phase among students and parents. The results indicate that participants monitored the exchange of pedagogical data and the amount of e-communication among school staff and between teachers and families in their schools. Based on this monitoring, they understood that implementing the system among school staff mostly enhanced their own e-leadership, while implementation among students and families promoted e-leadership by both school principals *and* teaching staff.

L: Teachers use the school management system as a tool for e-leadership because they can receive a detailed map of students in classes they teach and easily communicate with them.

The school principals demonstrated willingness to expand the implementation among the parents and the community. Following the "comprehensive-innovation" or "islands-of-innovation" models of implementing technology (Avidov-Unger & Eshet-Alkalai, 2011), this form can be seen as "expanded innovation" (Blau & Hameiri, 2012a), which includes important stakeholders outside the organization—students and parents.

School principals claimed that e-leadership through the school management system has raised the level of parental involvement, which is reflected inter alia in greater participation of parents at school events. It seems that school principals who led the implementation of the school management system among families (and not only among the school staff), entered data relevant to students and parents and promoted e-leadership by teachers enhanced student and parent involvement in school issues. This conclusion, based on the interviews with school principals and

on the interview with the Ministry of Education supervisor, is consistent with the quantitative log analysis of teachers' activities by Blau and Hameiri (2012b, which showed that regular data entering by teachers enhanced involvement through the system of students and parents. Despite the importance of implementing the system among families, some of the principals did not know how to monitor through the system the extent of usage by students and parents.

Concerning the individual differences among school principals in promoting e-leadership among teaching staff, one of the participants described how the school vice principal delegates the responsibilities of e-leadership and encourages the staff, especially homeroom teachers and heads of departments, using the technology to lead students and colleagues, while the previous school principal clearly preferred traditional ways of leading the school. These differences in adopting innovations are consistent with the diffusion of innovation theory (Rogers, 2003). It seems that this school vice principal is one of the "innovators" or "early adopters" of technological tools, while her previous school principal could be numbered among the "late majority" or even the "laggards". The findings of this qualitative investigation are also consistent with quantitative findings regarding the influence of teachers' openness to change and their attitudes towards ICT on online communication with students and colleagues and with regard to pedagogical information search (Blau & Peled, 2012).

Some principals and the school supervisor described their own concerns before and during the implementation of the system. These included fear of change among some teachers, technical difficulties and the concern that e-communication would damage the quality of the school discourse taking place offline. It seems that these fears also reflect individual differences in adopting innovations as described by Rogers (2003).

e-Leadership and school effectiveness
Regarding the third research question, the study participants described how their own uses of the system and the promotion of e-leadership by teachers consequently enhanced the pedagogical effectiveness of their schools. These uses included making data-based decisions at the level of individual students, classes and strata; tracking in concordance with curriculum goals, level of performance and student achievement; decentralization of leadership; and time management during pedagogical meetings.

H: If your aim is managing your organization effectively, focusing on specific goals, and achieving them, you cannot lead without data . . . Regarding the time management, before the implementation of the school management system we were sitting hours and talking, talking, talking . . . Today pedagogical meetings are significantly more effective, because the homeroom teacher comes with data . . . Time management is an important component of school effectiveness.

The school management system improves school effectiveness by enhancing e-leadership by middle-level school personnel. It helps heads of departments in planning and monitoring the implementation of the curriculum in different subjects and enhancing student learning. Teachers enter into the system the topics of their lessons, homework and student data; answer student questions; and focus students in preparation for tests. Some of the principals described the use of class or subject-matter websites built using the school management system for transmitting learning materials to students. Despite this option of having a class website interconnected with management functions of the system, most of the school principals were unaware of it and, consequently, did not promote it among their teaching staff.

It was also noted by the participants that the system improved curriculum planning, increased levels of communication with the school community and changed the school culture. The instant flow of up-to-date information between different stakeholders created an atmosphere of transparency and connectedness, improving the school climate and therefore enhancing school effectiveness.

S: The implementation of the system has changed our work patterns, ways of exchanging information, and the entire school culture.

The results revealed that principals extensively used the system for e-communication with teachers, students and parents. These qualitative data obtained from school principals are consistent with previous quantitative log analyses of actual behaviour within the Mashov system by teachers (Blau & Hameiri, 2010), students and parents (Blau & Hameiri, 2012b). In accordance with the idea of ubiquitous 24/7 communication supported by a school management system (Chen, Hwang, Yang, Chen & Huang, 2009), participants highlighted the importance of instant access to the data and ubiquitous interaction among teaching staff and between teachers and families.

H: First we were concerned that online communication is distant and does not support high-quality interaction. Over time we realized that communicating through the system not only does not damage the quality of interaction, but actually enhances it.

The interviews revealed that the system opens up the possibility of e-communication for students who are shy and have difficulties in expressing themselves in face-to-face communication. These students feel significantly more comfortable in written interactions with teachers and administrators. This finding is consistent with the cyberpsychology literature stating that the characteristics of the Internet as a protected social environment assist introverts to express themselves more freely online than offline (Amichai-Hamburger, 2007; Barak & Suler, 2008; Blau & Barak, 2012).

The findings show that school principals are sensitive to the appropriateness of different media for different purposes and understand that in many situations e-communication through the school management system cannot replace face-to-face meetings or telephone conversations. One of the participants described how with complex or sensitive topics she stops written discussions through the system and asks for spoken conversation. Based on her arguments, it can be concluded that in sensitive complex discussions with teachers, students or parents, it is important to convey nonverbal social communication cues. Thus, nonverbal cues, for example, emotions conveyed through facial expressions and body language in face-to-face interactions or through the human voice in telephone conversations, are missing in written interactions via the system. This finding is consistent with the idea of media richness theory (Daft & Lengel, 1984) regarding the interconnections of medium features and characteristics of the conveyed message, as well as with quantitative data regarding teachers' choice of media for communication with their colleagues and students (Caspi & Blau, 2011).

Conclusions and implications

This study investigated e-leadership by secondary-school principals through a school data management system, their promotion of e-leadership by teaching staff, and the effect of e-leadership on school effectiveness. The results showed that successful implementation of the school data management system enables e-leadership by school principals and teaching staff and consequently increases the effectiveness of their schools. This is realized through data-driven decision-making; monitoring curriculum implementation, learning performance and student activity; e-communication with teaching staff, students and parents; delegating responsibilities; and improving the school environment. e-Leadership by teaching staff requires that school principals lead the expanded form of technology implementation, which includes students and parents; delegate e-leadership responsibilities; and promote daily data entering and two-way teacher–family e-communication in order to strengthen student and parental involvement and initiate significant changes in the entire school culture.

In order to enhance e-leadership through a school data management system we recommend using the expanded-innovation model of implementation (ie, implementation among school staff *and* families), monitoring of the level of teacher activity within the system, and delegating e-leadership responsibilities instead of using a hierarchical e-leadership approach. Regarding

e-communication via the system, increasing online school discourse and especially promoting e-communication between school staff and students are recommended. However, school staff should be sensitive to the appropriateness of communication media for different purposes and, when needed, replace written interactions by face-to-face meetings or telephone conversations.

This study is a qualitative investigation in a relatively small sample of secondary-school principals implementing one school data management system. Further research might explore the expanded innovation model of implementation in larger samples, in other school data systems or in different cultural contexts. It would be interesting to cross-check the findings based on the interviews with a quantitative log analysis of actual e-leadership behaviour of school principals within a school management system and with observations of school staff using the data during pedagogical meetings.

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