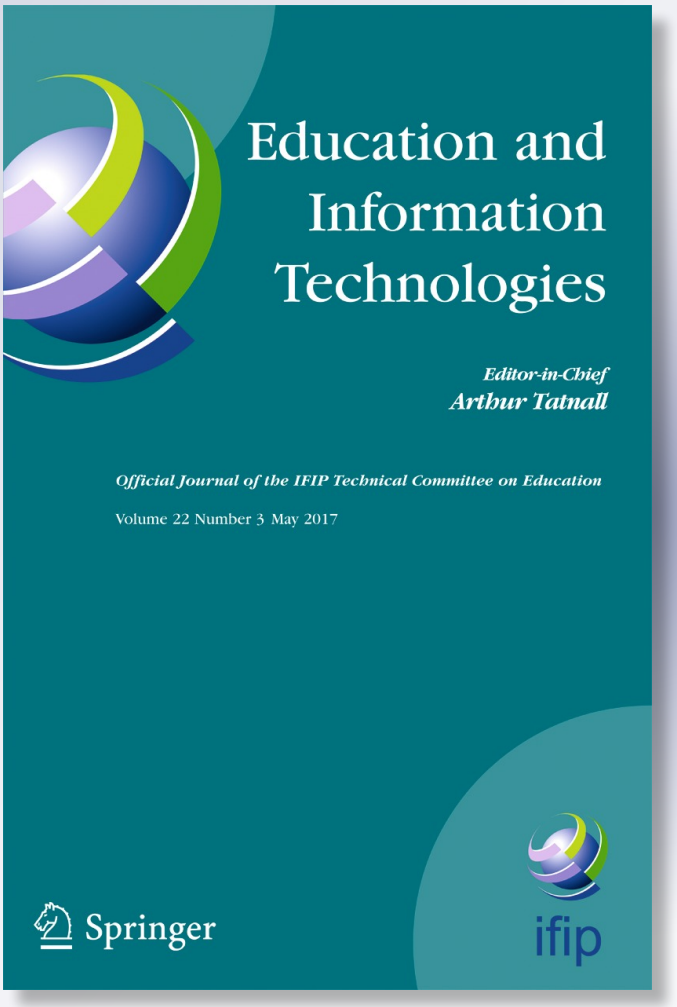
Ubiquitous mobile educational data management by teachers, students and parents: Does technology change school-family communication and parental involvement?

Ina Blau & Mira Hameiri

Education and Information Technologies
The Official Journal of the IFIP Technical Committee on Education

ISSN 1360-2357
Volume 22
Number 3

Educ Inf Technol (2017) 22:1231-1247
DOI 10.1007/s10639-016-9487-8



Springer

Educ Inf Technol (2017) 22:1231–1247
DOI 10.1007/s10639-016-9487-8

Ubiquitous mobile educational data management by teachers, students and parents: Does technology change school-family communication and parental involvement?

Ina Blau[1] · **Mira Hameiri**[2]

Published online: 12 April 2016

Abstract Digital educational data management has become an integral part of school practices. Accessing school database by teachers, students, and parents from mobile devices promotes data-driven educational interactions based on real-time information. This paper analyses mobile access of educational database in a large sample of 429 schools during an entire academic year. Using learning analytics approach, the study compares students, their mothers' and fathers' mobile logins onto the database between schools with frequent, occasional, and no mobile (i.e., computer only) teacher access. In addition, this paper explores gender differences in parental involvement through mobile monitoring of their children' function in school. The results supported both study hypotheses. (1) Mobile accessing of the database by teachers promoted mobile accessing of the database by their students, mothers, and fathers. It seems that ubiquitous mobile data management is a modeling process in which students and parents learn from teachers. (2) Compared to fathers, significantly more mothers used the mobile school database. Moreover, among parents-uses, mothers accessed educational data of their children significantly more frequently than fathers. The results suggest that mothers are still more actively involved than fathers in mobile monitoring of how their children function in school. The results are discussed in terms of *School Community of Innovation* model and *technological determinism* approach.

✉ Ina Blau
inabl@openu.ac.il; http://www.openu.ac.il/Personal_sites/ina–blau/

Mira Hameiri
hameirie@gmail.com

[1] Department of Education and Psychology, The Open University of Israel, 1 University Road, P.O.B. 808, 43107 Ra'anana, Israel

[2] Department of Advanced Studies, Oranim Academic College of Education, 36006 Tiv'on, Israel

Keywords Ubiquitous mobile educational database · Teachers, students, and parents · Gender differences in mobile parental involvement · Distributed leadership and accountability · School Community of Innovation model · Technological determinism

1 Introduction

A fundamental change is taking place in schools around the globe as they respond to rapid advances in new technologies (Zhao 2012). Technological tools are coupled with the requirements for accountability, data-driven decision-making, and instant communication between educational institutions and their communities (Taylor 2010). Schools generate a massive amount of data, effective use of which can promote pedagogical goals and change patterns of educational management (Blau and Presser 2013). Some researchers (e.g., Perelman 2014) argue that the use of educational database is a reflection of the "data-obsessed" discourse based on the perception of schools as service providers, students as consumers, and education process as a service offered to clients. However, the generation and processing of data through digital technologies - 'Big Data' and data mining and analytics - is an integral element of contemporary society in general and education systems in particular (Selwyn 2015). Focus on data-driven decision-making and on interactions among school staff as well as between teachers and students is common for schools that focus on making improvement (Taylor 2010). Student academic achievement is positively related to continuous monitoring of achievement and instruction, since monitoring ensures that specific educational goals remain the driving force behind a school's actions (Marzano and Waters 2009).

Effective tools for managing school data are highly important for data-driven pedagogical decisions (Taylor 2010). One of the well-known examples of educational databases is the National Pupil Database established in 2002 by the UK government (Williamson 2015). Digital educational databases manage student information and learning content as well as support pedagogical communication within teaching staff and between teachers, students, and their parents. School databases are both a tool for student data management (e.g., storing and monitoring student function data, assessments, state test results, and custom reports) and a platform for building courses, sharing learning content, communicating and collaborating with students and parents (Blau and Hameiri 2012). Such 'learning analytics' platforms enable "real-time" policy by tracking and predicting students' performance through their digital data traces. These processes are essential for digital education governance, since they enable "to know, govern, and manage education" (Williamson 2015). Surprisingly, research on school databases holds a relatively peripheral position in the study of Information and Communications Technologies (ICT) in education (Perelman 2014). Moreover, while the literature advocates that school databases enhance administrative efficiency and effectiveness (Marzano and Waters 2009; Selwood and Visscher 2007), it appears as if the number of studies that examine the realization of such potential of educational management is rather scarce (Harris et al. 2013; Jamerson 2013).

This paper focuses on mobile school data management that has a potential for changing information flow and establish ubiquitous interactions between educational institutions and their communities. Previous studies regarding school databases focused

exclusively on their usage from computers (Blau and Hameiri 2010, 2012; Perelman 2014; Taylor 2010; Turner 2010). Mobile communication among schools staff and between teachers and students was previously explored in the context of SMS exchanges (Caspi and Blau 2011b; Ho et al. 2013). The very high level of smartphone use in the society raises the importance of instant 24/7 accessing student data, updating learning materials, and communication among different stakeholders - not only from computers, but also from mobile devices when computers are unavailable (Blau 2011). Moreover, smartphones, tablets, and notebooks are converging and for some product lines (e.g., larger android tablets, Surface Pro devices, etc.) it is becoming increasingly difficult to distinguish between "mobile device" and "computer". Mobile devices could be a convenient tool for enhancing teacher-families communication (Ho et al. 2013), since they provide ubiquitous access to up-to-date school data in different levels, and thus enable data-based instead of gut feeling-based pedagogical decisions of school principals, teaching staff, and educational policy-makers (Blau and Presser 2013).

This paper analyses the data of all Israeli schools that have adopted on different levels a school database called MASHOV ("feedback" and the acronym of Immediacy, Transparency, and Supervision in Hebrew), which, in addition to online data management, has recently opened up the possibility of ubiquitous mobile data access and pedagogical communication by teaching staff, students, and families. Using learning analytics approach, the study compares mobile logins of students, their mothers, and fathers onto MASHOV school database between schools with frequent, occasional, and no mobile (i.e., only computer) data access by teachers during the first year of implementing the mobile application. In addition, this paper explores gender differences in mobile involvement of parents in function of their children in school.

2 Literature review

This section begins with an introduction of different frameworks relevant to the adoption of educational data management at the organizational and individual level. This is followed by a presentation of possibilities for mobile school data management. To conclude, we discuss gender differences in offline, online, and mobile involvement of parents in function of their children in school.

2.1 Frameworks of adopting schools data management on organizational and individual levels

Analyzing the literature focused on adopting technology in schools on *organizational level*, Avidov-Ungar and Eshet-Alkalai (2011) described two main ways of implementation: *Islands of Innovations* and *Comprehensive Innovation* models. In the Islands of Innovation model, the innovation is implemented only by a small fraction of an educational organization and is usually focused on a particular content area or a particular task (Forkosh-Baruch et al. 2010). In contrast, in the model of Comprehensive Innovation, the technology is adopted on all levels of the organization, and, if implemented effectively, creates a new organizational culture (Blau and Shamir-Inbal 2016). Based on the findings of numerous studies, Avidov-Ungar and Eshet-Alkalai concluded that the assumption of gradual spontaneous spread from Island of

Innovation to the rest of the organization is erroneous. Island of Innovation usually remains isolated from the rest of the organization and even creates among the educational leadership and decision-makers the false illusion of innovative organization.

In the context of adopting an educational database, the Islands of Innovation model is clearly unsuitable - the data pool and e-communication through the school database are valuable only if at least most of the teaching staff enter educational data and communicate via the database on a regular basis (Blau and Hameiri 2012). In a general organizational context, Resource Dependence Theory suggests that technology-related collaboration often exist between partners who are mutually interdependent (for the review see: Davis and Eisenhardt 2011). For example, microprocessors and software of firms like Intel and Microsoft are both needed for a final solution – personal computer. Similarly, in the context of schools, educational data entered by different homeroom teachers, subject teachers, department heads, a school consulter, etc. is complementary for successful data-driven decision-making by each member of the school staff (Blau and Hameiri 2010). Therefore, instead of a gradual spread, the entire teaching staff should be included into the implementation process at the starting point of adopting a school database.

In addition to teaching staff, successful change in schools requires the involvement of all stakeholders. The ultimate goal of each educational change is improving learning and education of students; thus, in order to be substantial, the change should include not only teaching staff, but also involve students and their parents (Fuchs 1995). This claim received empirical support in large-sample comparisons between the adoption of a school database among teaching staff only versus its adoption by teachers *and* families (Blau and Hameiri 2010). The results showed that the adoption of the platform by teachers and families, which can be called *School Community of Innovation* model, leads to a higher level of educational data exchange and more animated e-communication among teaching staff, compared to the Comprehensive Innovation model - exchanging data within school staff only.

On *the level of individual user*s, one of the central frameworks for analyzing the adoption of technology is Rogers (2003) *Diffusion of Innovation Theory*. This framework explains the variety in the rate of adopting new technologies by individual differences of the users in general (Blau and Neuthal 2012a, 2012b) and teachers in particular (Blau and Peled 2012). According to Rogers, the continuum of adopting innovations is normally distributed in the population and ranges in a bell curve from Innovators (2.5 %) and Early Adopters (13.5 %), to Early Majority and Late Majority (34 % each), and finally to Laggards (16 %).

Based on the Diffusion of Innovation Theory, we can expect that within education organizations, the rate of adopting innovative technologies for teaching and e-communication with students in general (Benamotz and Blau 2015; Blau and Caspi 2010; Peled et al. 2015), and for ubiquitous mobile management of students' data in particular would reflect individual differences in adopting innovations among the teachers. In addition to within-school differences, the rate of adopting mobile access to a school database would vary between schools, according to differences in adopting innovation among their school principals and other educational policy-makers. In case of MASHOV database, new mobile educational data management was available to all schools that use the system and without additional costs. Despite this opportunity, during the first phase of integration, we can expect significant differences - between

schools and among teachers within each school - in the adoption of the new ubiquitous mobile data management. In terms of Rogers (2003), teachers and school principals who promote the adoption of the mobile school data management in its first phase can probably be defined as Innovators and Early Adopters, or at least, Early Majority (Blau et al. 2014).

It should be taken into consideration that the rate of adopting technological innovations in general and new ways of educational data management in particular does not necessary change the leadership style. Garrison and Vaughan (2013) argued that transformational changes in higher education institutions required *distributed leadership* that involves all levels of the institution. Distributed leadership refers to the situation in which the leadership functions are stretched over the work of a number of individuals, and tasks are accomplished through interactions, collective actions, and co-performance (Harris 2013; Harris et al. 2013). Equalization effect of digital technologies can enhance inter-personal communication (Blau and Barak 2009, 2012) and promote educational interactions (Blau et al. 2009, 2013; Weiser et al. 2016). For instance, a school database can enhance distributed leadership, if a school principle provides additional school staff with access to the entire school information, in order to share responsibilities and facilitate pedagogical dialogue and decision-making (Blau and Presser 2013). However, if the aim of educational leadership is maintaining the power status quo or even abusing his/her authority (Lumby 2013), a school database can magnify the abuse of power and control and hide behind the principals of efficiency, effectiveness, and accountability the aim to transform schools into "business-like" organizations (Perelman 2014).

2.2 Mobile school data management

Recently MASHOV school database, which is investigated in this paper, has developed secure mobile applications: (1) *teacher mobile application* for organizational e-communication, accessing and updating student data and learning materials and (2) *family mobile application* for accessing student data and for e-communication of students and their parents with teachers. The school database is accessible from every type of mobile device with cellular or Wi-Fi internet connection– smartphones or tablets, devices that operate on Android or iOS.

Users can instantly access the database from their mobile device and view statistics of how a student or a class functions – the data includes formative and summative evaluations, numbers and frequencies of lateness, absences, behavior remarks, as well as lesson topics and homework (Blau and Hameiri 2013). Each user receives access to the data according to his or her position: school principals and vice-principals have access to all the information in their institution; heads of departments can see all the data concerning their departments; homeroom teachers have access to the information regarding the function of their students in different subject-matters; students can access their own information entered by different teachers; parents have access to the data concerning learning and functioning of their children.

The interface of teacher mobile application (Fig. 1 on the left) shows the icons of a teacher's schedule, today's lessons, and current lesson, a list of students and a list of a school staff, student search function, notifications, and organizational email. Figure 1 on the left demonstrates how a teacher actually reports-by-click different lesson events.

Fig. 1 Mobile application of MASHOV database for teachers – interface and class data view

The interfaces of application for students and parents (Fig. 2 on the left) shows icons of grades, behavior and function, student's schedule, current lesson information, search function, notifications, a school email, list of classmates and of a school staff. Figure 2 on the left illustrate how a student or a parent monitor grades in different assessment types (exams, papers, homework) and different subjects.

Note that the use of the school database investigated in this study is essentially different from the one-way involvement of parents in schooling of their children through visibility of formal and static data reported in a previous study (Selwyn et al. 2011). "Accountability" to parents in Selwyn et al.'s study refers to "show-case" of students' learning outcomes and reports regarding the progress of the *entire class*. Instead, the database analyzed in the current study enables a separate access for students, his or her mother, and father to all educational data concerning learning and functioning of *individual student*. In addition, the database supports online and mobile two-way teacher-student and teacher-parent communication in relation to a child's learning and functioning.

The effectiveness of a school database increases as more teachers enter student data on a daily basis and instantly connect with colleagues, students, and their parents (Blau and Hameiri 2010, 2012). Many Israeli classrooms, especially in the secondary

Fig. 2 Mobile application of MASHOV database for students and parents – interface and student data view

education, still do not have internet-connected computers in their classrooms (Dror et al. 2012). Therefore, teachers deal with the educational data twice: they fill forms of the class journal during the lessons and copy this data onto the school database after the lesson, sometimes several days later. On the other hand, almost all teachers have smartphones with mobile internet connection package and many Israeli schools have wireless connection. Ubiquitous mobile data update and communication ensure real-time reporting and enable real-time reaction by a school staff and, when needed, by parents (Ho et al. 2013). For example, homeroom teachers and parents would benefit from being informed and immediately react to in case of a student who arrived to school, but did not show up in the lesson. In addition, students would prefer to be informed as soon as possible about their grades and assessments.

However, the actual use of a database for mobile teacher-families interactions, especially in the initial phase of its adoption, depends not only on teachers, but also on educational policy (Ho et al. 2013). Educational policy-makers and school principals can ignore administrative and pedagogical potential of smartphones, and, in some cases, even prohibit any use of them by teachers and students (Blau and Presser 2013). Alternatively, school principals can perceive smartphones as devices for one-to-one computing, consistent with Bring Your Own Device (BYOD) approach, and embrace their productive use by teachers and students during the lessons for administrative and pedagogical purposes.

2.3 Gender and offline and online/mobile parental involvement

Studies regarding the offline parental involvement found that its impact on a child functioning in educational institutions is important for future academic success (for review see: Yoder and Lopez 2013). Parental involvement refers to involvement of parents in activities that advance education and learning of their children in order to increase their academic and social well-being (Fishel and Ramirez 2005). Previous findings showed that discussing school issues with a child positively correlates with student grades, while checking homework does not correlate or even negatively relates to achievement (Jeynes 2005). In addition to achievement and academic performance, parent involvement in education and learning of their children in school is associated with improved self-regulation, fewer discipline problems, stronger study habits, and more positive attitudes toward the school (Fan and Chen 2001). In addition, findings indicated that showing interest in school issues of 16 years old teenagers correlates with their latter decision to continue post-secondary education (Hango 2007).

However, only long-term parental involvement seems to be effective: showing short-time interest in problematic situations led to a low academic self-efficacy of teenagers (Kaplan Turan 2004). More recent papers use the term "family-school partnership" to emphases the *long-term* and *two-ways communication* between family members and teachers for supporting learning and functioning of children in school (Moorman Kim et al. 2012; Sheridan et al. 2010).

The use of interactive technologies with accessible resources can help in developing *online involvement of parents* in function of their children in school (Lewin and Luckin 2010). School databases enable data-driven educational interactions between teachers, students, and parents. In addition, the information automatically stored into a school database opens the possibility to analyze online parental involvement (Blau and

Hameiri 2012). Moreover, a school database enables to explore gender differences in family roles and compare online involvement of mothers versus fathers.

Studies of offline parental involvement show that mothers are more actively involved in the education of their children (Hango 2007; Jeynes 2005). However, these studies were critiqued (Lamb 2010) for the small and an unrepresentative sample, for using self-report questionnaires as the only method of investigation, for measuring father involvement by such technical parameter as the amount of time spent with a child, for the lack of gender comparisons, and for focusing on parents of young children and ignoring parents of teenagers. Using reliable research methods, Lamb found that, even when both parents held a full time job, father parental involvement (measured as direct interactions with children and the degree of responsibility for them) was significantly lower in comparison with mothers.

Similarly to offline behavior, investigation of online parental involvement revealed (Blau and Hameiri 2012) that compared to fathers, mothers have a higher level of involvement - they log more into the school database and send more messages to teachers. Moreover, mothers adapted the level of online parental involvement to the activity of teachers within the database: they logged significantly more into the database in classes of highly active teachers compared to mothers in classes of teachers less active within the school database.

Unfortunately, previous findings have shown that compared to offline parental involvement (Lamb 2010), online school database does not change the traditional family roles (Blau and Hameiri 2012). However, it is possible that the school database application for smartphones, as relatively new technology, would promote more active involvement of fathers in monitoring function of their children in school. This possibility would be consistent with the argument of *technological determinism* that technologies can change the way that people function and interact. According to this approach, technological tools are "autonomous forces that compel society to change" (Nye 2007, p.27).

In contrast to offline self-report studies, learning analytics approach permits the investigation of *actual* behavior of the participants (Zuckerman et al. 2009), in this case - online or mobile behavior of parents within a school database during long period of time. Giving each parent his or her own username and password for logging onto the database allows the exploration of gender differences in parental involvement, since parents have the same easy access and independent possibility to be informed in real-time concerning the function of their child in school (Blau and Hameiri 2012). Thus, the analysis of parental online or mobile activities via school database can help understanding how parents monitor function of their child in school far beyond the traditional self-report studies. However, surprisingly few studies (e.g., Blau and Hameiri 2012, 2013; Ho et al. 2013; Lewin and Luckin 2010) explore issues related to online or mobile parental involvement and the function of their children in school.

2.4 Research goals and hypotheses

The purpose of this study was to examine different forms of actual (in contrast to self-report) mobile behavior of teachers, students, and their parents during the first year of integrating mobile access and update of school database. Specifically the study explored the impact of teacher activity measured as frequent, occasional, and no mobile teacher access onto MASHOV school database (i.e., accessing educational data and e-communicating exclusively via computers) by students and their parents. In addition,

the study compares parental involvement of mothers versus fathers via mobile devices in function in their child in school.

The research hypotheses were:

(1) Based on the *Island of Innovation*, *Comprehensive Innovation*, and *School Community of Innovation* models of technology integration in educational organizations (Avidov-Ungar and Eshet-Alkalai 2011; Blau and Hameiri 2012) and the framework of implementing essential changes in schools by including *all* stakeholders into this process (Fuchs 1995), we hypothesized that mobile accessing of teachers onto the school database would augment the ubiquitous mobile use of the data by their students and parents. Thus, students and parents' mobile data accessing would be the highest in schools with frequent teachers' mobile logins, medium in schools with occasional mobile logins by teaching staff, and the lowest in schools with no mobile data accessing by teachers (i.e., in schools with all teachers managing educational data and e-communication within the platform exclusively from computers. Please note that mobile applications are independently available for all users; therefore, students or/and parents could embrace mobile data monitoring and communication even if teachers ignore it.)
(2) Similarly to the data regarding gender differences in offline parental involvement (see: Lamb 2010) and online parental involvement in function of their children in school through school database accessed via computers (Blau and Hameiri 2012), we hypothesized that compared to fathers, mothers would show higher level of ubiquitous parental involvement in function of their children in school by more frequent accessing the school database via mobile devices.

3 Method

3.1 Participants

This study analyzes the mobile activities of all 429 Israeli schools that used MASHOV school database (about 13 % of all schools in the country), a prominent Israeli-developed school database that has been in use since 2007 (Perelman 2014). Thus, *the entire population* of users of this database was included in the analysis: 369 of the schools were secondary schools (grades 7–12) and 60 - elementary schools (grades 1–6). The analysis was performed for all data exchange and interactions among teachers, students, and parents in these schools during an entire school year.

Note that Israeli schools required databases that support right-to-left written languages - Hebrew and Arabic. In addition to MASHOV, there are three other school databases that support right-to-left languages and are integrated in many Israeli schools; however until now (2016) none of them provide the possibility of mobile educational data management and communication, except for the database analyzed in this study.

3.2 Instruments and procedure

Using data analytics approach, the automatic data was extracted for the log analysis: the number of mobile application users per school (Table 1) and the number of users'

Table 1 Number of mobile **users per school** - descriptive statistics (n = 429)

	Number of users-teachers	Number of users-students	Number of users-mothers	Number of users-fathers
Mean	3.44	28.68	3.17	2.18
Median	2	2	0	0
SD	4.25	64.11	6.68	4.63
Skewness	2.43	5.32	4.96	6.68
S.E. of Skewness	.12	.12	.12	.12
Min	0	0	0	0
Max	31	730	76	64

mobile logins onto the database per school (Table 2) by teachers, students, their mothers, and fathers during the 2012–2013 school year.

As can be seen from the data presented in Tables 1 and 2, none of the variables is normally distributed – long-tail distribution of all of them is skewed towards left. Therefore, non-parametric statistic was used for the data analysis. Small number of users of the mobile application and the number of their mobile logs during the first year of implementation presented in Tables 1 and 2 are consistent with the prediction of the Diffusion of Innovation Theory: these users are mostly Innovators and Early Adopters of the new ubiquitous way of educational data management and communication.

Spearman's rank correlations are used for the analysis of relationships between the number of users - teachers, students, mothers, and fathers - and the number of their logins onto the mobile application, r_s = .90, .99, .97, .96 consequently, p's < .001. In behavior sciences, very high correlations (> .80) indicate that both variables apparently measure the same phenomenon. Therefore, the following section presents the results only for one of the measures - the number of *mobile logins* onto the database per school (and not the number of *mobile users* of the database per school).

It should be emphasized that despite the focus on mobile behavior of teaching staff and families within the database, in order to explore "the big picture" in the entire population (instead of sample), the **unit of analysis** in this study was the activities of a

Table 2 Number of mobile **logins per school** - descriptive statistics (n = 429)

	Number of teachers' logins	Number of students' logins	Number of mothers' logins	Number of fathers' logins
Mean	98.61	668.15	70.60	40.45
Median	8	9	0	0
SD	208.07	3260.02	236.80	110.87
Skewness	3.31	15.76	9.0	6.92
S.E. of Skewness	.12	.12	.12	.12
Min	0	0	0	0
Max	1589	61,671	3510	1492

school. Since the schools using the database significantly differ on number of teachers and students, in order to perform the analysis we used the *relative* numbers of mobile logins per school instead of the absolute numbers of mobile logins onto the database: (1) the number of teachers' mobile logins divided by the number of teaching staff in each school * 100, (2) the number of students', (3) their mothers', and (4) fathers' mobile logins divided by the number of students in each school * 100. Dividing parents' mobile logins by the number of students instead of the number of parents was used for controlling the cases in which more than one child per family studies in the same school.

For statistical analysis the school were divided into three categories: (1) schools with *frequent* ubiquitous teacher mobile logins (160 schools - 37.3 %), (2) *occasional* teacher mobile logins (161 schools - 37.5 %), and (3) schools *without* mobile logins by teachers (i.e., schools with all teachers managing educational data and communication within MASHOV database exclusively from computers; 108 schools - 25.2 %). No statistically significant differences in representation of elementary schools among these categories were found. Dividing into frequent and occasional mobile data access was made according to the median number of mobile logins only in schools with mobile access of the database by some teachers. Schools that received the median number of logins (50) were attributed to the occasional level of mobile data access.

4 Results

Since the dependent variables were not normally distributed, non-parametric Kruskal-Wallis tests were used for the analysis of variance instead of One-Way ANOVA and Mann-Whitney *U* tests were used for pair comparisons.

4.1 Mobile educational data accessing by students

The Kruskal-Wallis test showed statistically significant effect of teachers' mobile logins on students' mobile logins, kw (2) = 117.49, $p < .001$. The Mann-Whitney *U* tests revealed statistically significant differences in ubiquitous student mobile data accessing between schools with frequent, occasional, and no mobile educational data accessing by teachers (Mean Rank =281.51, 211.39, and 121.86 logins respectively, p's < .001). This finding suggests that the more teachers were active within the database via mobile, the more students accessed their data and communicated with teachers through the system from mobile devices.

4.2 Mobile educational data accessing by parents

The Kruskal-Wallis tests revealed that mobile teachers logins influenced the number of ubiquitous mobile logins by mothers, kw (2) = 96.84, $p < .001$, and fathers, kw (2) = 99.1, $p < .001$. The Mann-Whitney *U* tests showed significant differences in mobile logins by parents in schools with frequent, occasional, and no mobile educational data access by teachers: for mothers Mean Rank =276.32, 206.66, and 136.60 logins respectively, p's < .001, and for fathers Mean Rank =275.01, 209.28, and 134.62 logins respectively, p's < .001. Thus, the more teachers were active within the school

database through mobile, the more parents accessed educational data of their children via mobile devices.

4.3 Gender differences in mobile parental involvement

The Mann-Whitney *U* tests showed that compared to fathers (M = 2.17), significantly more mothers (M = 3.17) used mobile devices for accessing their children' educational data, $Z = -6.43$, $p < .001$. (As was explained in the Method section, since the schools using the database significantly differ on number of teachers and students, the number of participants and their logins are *relative* numbers instead of absolute ones). In addition, in comparison to fathers (M = 40.45), mothers (M = 70.6) logged significantly more onto the school database using ubiquitous mobile devices, $Z = -3.11$, $p < .01$.

5 Discussion

This study explored differences in ubiquitous mobile accessing the school database by students and their parents among schools with frequent, occasional, and no mobile access of educational data by teachers. In addition, this study investigated gender differences in mobile involvement of parents in function of their children in school. The results support both study hypotheses: (1) The number of mobile logins of teachers onto the school database influenced the number of ubiquitous mobile assess by students, their mothers, and fathers; (2) Compared to fathers, significantly more mothers used the mobile application during the period of investigation, and among parents who used the system from mobile devices, mothers login significantly more than fathers onto the database to monitor the function of their children in school.

According to Bandura's social-cognitive approach to learning (Bandura 1977; Rosenthal and Bandura 1978), a significant part of human learning occurs by *modeling*. It seems that adoption of the mobile educational data management is, at least partly, a modeling process. Note that the lack of mobile use of the database by teachers does not prevent its ubiquitous use by students and/or their parents. However, the finding showed that the more teachers access educational data via mobile, the more students and parents use the database from mobile devices. Students watch teachers entering educational data, updating, and accessing it via mobile devices during the lessons; parents watch teachers and a school principal accessing the data of their children through mobile phones during reunions and learn a new way to be informed on the function of their children in school. Mobile data access becomes a part of the "*hidden curriculum*" (see Kently, 2009): by entering and accessing data during the lessons and meetings, teachers implicitly convince students and their parents that they will persist in preparing student data pool and using this data for pedagogical purposes and data-driven decision-making. Thus, we recommend school principals to encourage mobile data entering and usage by teachers during lessons and meetings with students and their parents.

However, by changing the organizational culture and online communication between schools and their communities, it is important to encounter a golden mean between promoting an *accountable autonomy* (Blau and Presser 2013) via the mobile database versus obsessive instant *supervision* of teachers by school principals and

students by teachers/parents. Similarly to other education systems around the world (Selwyn 2015), in recent decades the Israeli education system has gone through considerable changes associated with global values that seek to revolutionize and improve public services (Perelman 2014). The research literature suggests (for review see: Harris, 2011) that high-performing education systems balance support and pressure; they generate professional energy and commitment, while hold educators accountable for performance. Distributed leadership can enhance the commitment of educators to the transforming change (Harris 2013) of ubiquitous school data management and making pedagogical decisions based on real-time information. Instead of maintaining the power status quo (Lumby 2013), a school database may be used to accomplish educational tasks through interactions, collective actions, and co-performance (Caspi and Blau 2011a; Harris et al. 2013), to share responsibilities and facilitate dialogue in pedagogical decision-making (Blau and Presser 2013; Perelman 2014). Future studies should use qualitative methodology for exploring mechanisms of modeling behavior, supervision-autonomy issues, and distributed leadership in the context of mobile and online educational data management.

The results of this study regarding ubiquitous mobile data management are consistent with previous studies that explored integration of school databases accessed via computers (Blau and Hameiri 2010, 2012). It seems that successful adoption of a mobile school database by teachers spreads out and widens data accessing by students and their parents. The results support broadening Island of Innovation and Comprehensive Innovation models of integrating new technologies (Avidov-Ungar and Eshet-Alkalai 2011) into the *School Community of Innovation* approach. In addition to teaching staff, School Community of Innovation model of adopting technologies by educational organizations includes students and their parents (Blau and Hameiri 2012). Note that this extension is not limited to integration of school databases. The School Community of Innovation model would be relevant for diverse technologies adopted by educational organization, for example, for implementing one-to-one computing with tablet PCs (Shamir-Inbal and Blau in press). In future studies we recommend exploring the adoption of other technological tools based on the School Community of Innovation model.

Concerning *gender differences in mobile parental involvement*, the results of ubiquitous mobile parental involvement in this study are consistent with previous findings regarding offline (Lamb 2010) and online parental involvement in function of children in school via computers (Blau and Hameiri 2012). Our results do not support the belief of *technological determinism*, which assumes that adoption of technology can produce social or behavioral changes (Nye 2007). It seems that technology does not change the traditional family roles: mothers are still more actively involved than fathers in ubiquitous mobile monitoring of how their children function in school. School principals and teachers should communicate more with fathers, including through the school database, promote their online and mobile access of educational data and enhance parental involvement of fathers in function of their children in school.

6 Implications and limitations

Based on the results of this study, we recommend school principals and educational policy-makers to address smartphones similarly to computers or tablet PC and embrace

their ubiquitous use in schools as one-to-one technology for pedagogical and administrative purposes. Unfortunately, the pedagogical and administrative potential of mobile devices in educational organizations is usually ignored, and in some cases the use of smartphones by students and teachers during the lessons is explicitly prohibited. Our findings question this educational policy. Encouraging teachers to enter data via mobile devices during lessons and access data in meetings with students or/and with their parents not only can improve data-based pedagogical decision-making, but also serves as modeling that can promote the adoption of the school database's ubiquitous mobile use by families. In many countries there are schools without wireless internet connection. On the other hand, many of teachers, students, and parents use smartphones with package of cellular internet connection that have a range of possibilities similar to computers or tablet PCs, and these mobile devices "stick" to users 24/7. Mobile data entering during the lessons can diminish the workload on teachers by avoiding double-noting (in a class journal during the lessons and on a school database after the lessons). This would free time for more essential pedagogical processes and encourage mobile use of the data by other stakeholders.

This study contributes to both research and practice. The paper demonstrates the success of implementing technology based on the *School Community of Innovation* model, including teachers, students, and their parents. In contrast to self-report studies, this paper adopts learning analytics approach and analyzes actual behavior of teachers, students, and their parents. Different to case-studies with small samples, this paper analyzes all activities conducted by the population of all the database users - 429 schools - during entire academic year. Educational policies based on the findings can promote practice of effective adoption of innovative technologies in schools, as well as establish culture of ubiquitous educational data management and interaction between schools and their communities.

However, this study explores the adoption of the mobile school database during the first year of its integration and is exclusively based on quantitative methodology. Further research may explore the School Community of Innovation model over a longer period of time, in a different school databases, or using other technology. It would be interesting to cross-check quantitative log analysis with interviews of school principals, teachers, students, and parents or/and with observations of school staff using a school database for data-driven decision-making during pedagogical reunions and meetings with students and parents.

References

Avidov-Ungar, O., & Eshet-Alkalai, Y. (2011). The islands of innovation model: opportunities and threats for effective implementation of technological innovation in the education system. *Issues in Informing Science and Information Technology, 8*, 363–376.

Bandura, A. (1977). *Social learning theory*. Englewood. Cliffs, N.J.: Prentice-Hall.

Benamotz, R., & Blau, I. (2015). *Implications of teacher-student relationships via a social network on teaching, learning, and classroom atmosphere* (pp. 3082–3085). Las Vegas, US: In Proceedings of the Society for Information Technology & Teacher Education International Conference.

Blau, I. (2011). Application use, online relationship types, self-disclosure, and internet abuse, among children and youth: implication for education and internet safety programs. *Journal of Educational Computing Research, 45*, 95–116.

Blau, I., & Barak, A. (2009). *Synchronous online discussions: participation in a group audio conferencing and textual chat as affected by communicator's personality characteristics and discussion topics* (pp. 19–24). Lisbon, Portugal: In Proceedings of the International Conference on Computer Supported Education - CSEDU'09.

Blau, I., & Barak, A. (2012). How do personality, synchronous media, and discussion topic affect participation? *Educational Technology & Society, 15*(2), 12–24.

Blau, I., & Caspi, A. (2010). Studying invisibly: media naturalness and learning. In N. Kock (Ed.), *Evolutionary psychology and information systems research: A new approach to studying the effects of modern technologies on human behavior* (pp. 193–216). New-York: Springer.

Blau, I., & Hameiri, M. (2010). Implementing technological change at schools: the impact of online communication with families on teacher interactions through learning management system. *Interdisciplinary Journal of E-Learning and Learning Objects, 6*, 245–257.

Blau, I., & Hameiri, M. (2012). Teachers-families online interactions and gender differences in parental involvement through school data system: do mothers want to know more than fathers about their children? *Computers & Education, 59*, 701–709.

Blau, I., & Hameiri, M. (2013). *Mobile school data management by teachers and families: Innovative practices for changing educational institutions? Paper presented at the international conference of "technology, innovation and social change". Tata Institute of Social Science*. India: Mumbai.

Blau, I., & Neuthal, T. (2012a). Tweeting educational technology: a tale of professional community of practice. *International Journal Cyber-Society and Education - IJCSE, 5*(1), 75–80.

Blau, I., & Neuthal, T. (2012b). Twitter as a platform for an Israeli community of information science professionals. *Issues in Informing Science and Information Technology, 9*, 177–186.

Blau, I., & Peled, Y. (2012). Teachers' openness to change and attitudes towards ICT: comparison of laptop per teacher and laptop per student programs. *Interdisciplinary Journal of E-Learning and Learning Objects, 8*, 73–82.

Blau, I., & Presser, O. (2013). E-leadership of school principals: increasing school effectiveness by a school data management system. *British Journal of Educational Technology, 44*(6), 1000–1011.

Blau, I., & Shamir-Inbal, T. (2016). Digital competences and long-term ICT integration in school culture: the perspective of elementary school leaders. *Education and Information Technologies*, 1–19. doi:10.1007/s10639-015-9456-7.

Blau, I., Mor, N., & Neuthal, T. (2009). Open the windows of communication: promoting interpersonal and group interactions using blogs in higher education. *Interdisciplinary Journal of E-Learning and Learning Objects, 5*, 233–246.

Blau, I., Mor, N., & Neuthal, T. (2013). Interacting for learning: digital portfolios for a learning community in a university course. *Learning, Media and Technology, 38*(3), 241–255.

Blau, I., Peled, Y., & Nusan, A. (2014). Technological, pedagogical and content knowledge in one-to-one classroom: teachers developing "digital wisdom". *Interactive Learning Environments*. doi:10.1080/10494820.2014.978792.

Caspi, A., & Blau, I. (2011a). Collaboration and psychological ownership: how does the tension between the two influence perceived learning? *Social Psychology of Education: An International Journal, 14*, 283–298.

Caspi, A., & Blau, I. (2011b). Media choice for intra-school communication: the role of environment, user, and medium. *Journal of Educational Multimedia and Hypermedia, 20*(4), 337–360.

Davis, J. P., & Eisenhardt, K. M. (2011). Rotating leadership and collaborative innovation recombination processes in symbiotic relationships. *Administrative Science Quarterly, 56*(2), 159–201.

Dror, Y., Gershon, S., & Blau, I. (2012). *Learning with technology*: *A survey of Israeli youth on the role of technology in teaching and learning.* Research report. The College of Management Academic Studies. Rishon Le-Zion, Israel. Retrieved Mar 29, 2016 from http://www.colman.ac.il/research/research_institute/Israel_project_Digital/Documents/Israelis_digital_eng_.pdf

Fan, X., & Chen, M. (2001). Parental involvement and students' academic achievement: a meta-analysis. *Educational Psychology Review, 13*, 1–22.

Fishel, M., & Ramirez, L. (2005). Evidence-based parent involvement interventions with school-aged children. *School Psychology Quarterly, 20*, 371–402.

Forkosh-Baruch, A., Mioduser, D., & Nachmias, R. (2010). *Cross-case analysis of innovative pedagogical practices using technology, In Proceedings of the International Conference on Education Technology and Computer - ICETC (pp. 603–607)*. China: Shanghai.

Fuchs, I. (1995). *Change - a way of life in schools*. Tel-Aviv: Cherikover publishers [in Hebrew].

Garrison, D. R., & Vaughan, N. D. (2013). Institutional change and leadership associated with blended learning innovation: two case studies. *The Internet and Higher Education, 18*, 24–28.

Hango, D. (2007). Parental investment in childhood and educational qualifications: can greater parental involvement mediate the effects of socioeconomic disadvantage? *Social Science Research, 36*, 1371–1390.

Harris, A. (2011). System improvement through collective capacity building. *Journal of Educational Administration, 49*(6), 624–636.

Harris, A. (2013). *Distributed leadership matters*. Thousand Oaks, CA: Corwin Press.

Harris, A., Jones, M., & Baba, S. (2013). Distributed leadership and digital collaborative learning: a synergistic relationship? *British Journal of Educational Technology, 44*(6), 926–939.

Ho, L.-H., Hung, C.-L., & Chen, H.-C. (2013). Using theoretical models to examine the acceptance behavior of mobile phone messaging to enhance parent-teacher interactions. *Computers & Education, 61*, 105–114.

Jamerson, J. (2013). E-leadership in higher education: the fifth "age" of educational technology research. *British Journal of Educational Technology, 44*(6), 889–915.

Jeynes, W. H. (2005). Effects of parental involvement and family structure on the academic achievement of adolescents. *Marriage & Family Review, 37*, 99–116.

Kaplan Turan, N. (2004). *Parental involvement, self esteem, and achievement among junior high-school students*. Doctoral Dissertation: Department of Education, University of Haifa, Israel [in Hebrew].

Lamb, M. E. (2010). How do fathers influence children's development? In M. E. Lamb (Ed.), *The role of father in child development* (5th ed.). New Jersey: John Wiley & Sons Inc.

Lewin, C., & Luckin, R. (2010). Technology to support parental engagement in elementary education: lessons learned from the UK. *Computers & Education, 54*, 749–758.

Lumby, J. (2013). Distributed leadership the uses and abuses of power. *Educational Management Administration & Leadership, 41*(5), 581–597.

Marzano, R. J., & Waters, T. (2009). *District leadership that works, striking the right balance*. Bloomington, IN: Solution Tree Press.

Moorman Kim, E., Coutts, M. J., Holmes, S. R., Sheridan, S. M., Ransom, K. A., Sjuts, T. M., & Rispoli, K. M. (2012). *Parent involvement and family-school partnerships*: *Examining the content*, *processes*, *and outcomes of structural versus relationship-based approaches*. Meta-analysis. Nebraska Center for Research on Children, Youth, Families and Schools (CYFS). Retrieved Mar 29, 2016 from http://cyfs.unl.edu/docs/working_papers/CYFS_Working_Paper_2012_6.pdf

Nye, D. (2007). *Technology matters: Questions to live with*. Cambridge MA: MIT Press.

Peled, Y., Blau, I., & Grinberg, R. (2015). Does 1:1 computing in a junior high-school change the pedagogical perspectives of teachers and their educational discourse? *Interdisciplinary Journal of e-Skills and Lifelong Learning-IJELL, 11*, 257–271.

Perelman (2014). What are the relationships between teachers' engagement with management information systems and their sense of accountability? *Interdisciplinary Journal of E-Learning and Learning Objects, 10*, 217–227.

Rogers, E. M. (2003). *Diffusion of innovations* (5 ed.). New York: Free Press.

Rosenthal, T. L., & Bandura, A. (1978). Psychological modeling: Theory and practice. *Handbook of Psychotherapy and Behavior Change: An Empirical Analysis, 2*, 621–658.

Selwood, I., & Visscher, A. (2007). The potential of school information systems for improving school performance. In N. Soguel & P. Jaccard (Eds.), *Governance and performance of education systems*. Berlin: Springer.

Selwyn, N. (2015). Data entry: towards the critical study of digital data and education. *Learning, Media and Technology, 40*(1), 64–82.

Selwyn, N., Banaji, S., Hadjithoma-Garstka, C., & Clark, W. (2011). Providing a platform for parents? Exploring the nature of parental engagement with school learning platforms. *Journal of Computer Assisted Learning, 27*(4), 314–323.

Shamir-Inbal, T. & Blau, I. (in press). Developing digital wisdom by students and teachers: the impact of integrating tablet computers on learning and pedagogy in an elementary school. *Journal of Educational Computing Research*.

Sheridan, S. M., Knoche, L. L., Edwards, C. P., Bovaird, J. A., & Kupzyk, K. A. (2010). Parent engagement and school readiness: effects of the getting ready intervention on preschool children's social-emotional competencies. *Early Education and Development, 21*, 125–156.

Taylor, R. T. (2010). Leadership to improve student achievement: focus the culture of learning. *Journal of Scholarship & Practice, 7*(1), 10–23.

Turner, E. (2010). Technology use in reporting to parents of primary school children. *ACM SIGCAS Computers and Society, 40*(3), 25–37.

Weiser, O., Blau, I., & Eshet-Alkalai, Y. (2016). *The role of pedagogy, media, and students' personality in synchronous learning: Comparing face-to-face and video conferencing participation. In Proceedings of the 10th annual International Technology, Education and Development Conference- INTED2016* (p. 5005). doi: 10.21125/inted.2016.0226. Valencia, Spain.

Williamson, B. (2015). Digital education governance: data visualization, predictive analytics, and 'real-time' policy instruments. *Journal of Education Policy*, (ahead-of-print), 1–19. doi:10.1080/02680939.2015.1035758.

Yoder, J. R., & Lopez, A. (2013). Parent's perceptions of involvement in Children's education: findings from a qualitative study of public housing residents. *Child and Adolescent Social Work Journal, 30*(5), 415–433.

Zhao, Y. (2012). *World class learners: Educating creative and entrepreneurial students*. Thousand Oaks, CA: Corwin.

Zuckerman, O., Blau, I., & Monroy-Hernández, A. (2009). Children's participation patterns in online communities: an analysis of Israeli learners in the scratch online community. *Interdisciplinary Journal of E-Learning and Learning Objects, 5*, 263–274.