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Teacher-Families Online Interactions and Gender Differences in Parental Involvement through School Data System: Do Mothers Want to Know More than Fathers about their Children?

Abstract

The integration of School Systems in K-12, opens new possibilities for online interaction among teachers, students, and their parents. This paper examines three years of teacher-student and teacher-parent online interactions in seven Israeli secondary schools during the implementation of a school system called Mashov (meaning "feedback" in Hebrew, as well as the acronym of "Immediacy, Transparency, and Supervision"). The three hypotheses were supported: (1) Consistent with the Diffusion of Innovation Theory (Rogers, 2003), findings revealed that implementation time positively influence both logging into the system as well as sending messages to and receiving messages from teachers, students, and parents; (2) Similarly to gender differences in offline parental involvement, the findings showed that compared to fathers, mothers have higher level of online parental involvement - they log more into the system and send more messages to teachers. Moreover, mother activity was in accordance with levels of teacher activity in the system; (3) Consistent with the approach of implementing changes in schools by expanding circles of interactions beyond the teaching staff, teacher entering of pedagogical data on a daily basis improved the use of the system by students and their parents. Students and parents' logins into the system was significantly higher in classes taught by high-activity teachers than in classes taught by low-activity teachers. It seems that students and parents in classes taught by high activity teachers regularly logged into the system in order to receive pedagogical information. We recommend that teachers and school administrators seek ways for augmenting the online activity of teachers and encourage fathers to have higher levels of parental involvement.

Keywords: architectures for educational technology system; computer-mediated communication; gender studies; interactive learning environments; pedagogical issues

1. Introduction

If you cannot measure something in your organization, you cannot manage it (Drucker, 2007). The main objectives of online systems in educational organizations are to simplify the administration of learning programs and support communication (Nichani, 2001). Effective school system helps to target, deliver, track, analyze, and report the learning "condition" within the organization. (Rengarajan, 2001). Recently online systems became a necessary management tool in K-12 education. School principals and educational administrators often need to decide which system will better suit their specific needs and open channels for communication (Cameron & Mahoney, 2008). Some researchers have exploited the potential of school systems, many of which automatically keep logs of user activity, both for research and the design of practical online learning applications (Black, Dawson, & Priem, 2008; Blau & Hameiri, 2010).

This study explores the interactivity of teachers as well as its impact on students and their parents based on logs of their activities within a school data system. In addition, the study investigates gender differences in online parental involvement. The introduction section is divided into four parts: The first one discusses online school systems that help to manage learners versus systems that focuses on content provided to the learner; the second section presents the theoretical frameworks of this study

and discuss interactivity – a variable measured in this research; the third section describes the Mashov school system studied in this research and presents its two applications: for teacher staff and for families – students and their parents; the last section overviews studies regarding gender differences in parental involvement that are explored in this paper.

1.1 Online Educational Systems

Management of content and management of learners through online educational systems are described in the literature in different terms. The most popular term - LMS - generally refers to systems for managing learners, but sometimes used for systems that include different content components (Chen & Epperson, 2008). However, such terminology usage neutralizes the distinction between LMS and so called Content Management Systems - CMS (Tsai & Ernst, 2009) or Learning Content Management Systems – LCMS. Greenberg (2002) argued that the primary objective of LMS in educational settings is to manage *learners*, i.e., to keep track of their progress and performance across different types of learning activities. In contrast, CMS or LCMS manage the *content* provided to the learner (for detailed discussion about differences between LMS and LCSM see also: Maleh, Lee, Ho, & Chong, 2004).

To avoid confusion, this paper adopts more general term - "school data systems" referring to systems that connect student data regarding school function, intra-staff communication, and school-home linkages (Caspi & Blau, 2011; Wayman, 2007). Pedagogically meaningful information can be extracted from student tracking data (Macfadyen and Dawson, 2010). The main functions of school data systems are learner data management, e.g., storing and retrieving student function data, formative and summative assessments, state test results, and preparing custom reports. In addition, by providing data concerning teacher activities, school data system opens possibilities to monitor and evaluate the process of change in educational institutions, as well as to plan, take decisions and design future policies (Heathcote & Dawson, 2005). However, the adoption of educational technology is a complex issue; even if teachers are proficient in using technologies for personal needs, this does not mean that they believe it is a valuable tool when used in educational settings (Steel, 2009).

1.2 Theoretical Frameworks

Technological innovations are accepted by people at different rates. Diffusion of Innovation Theory (Rogers, 2003) defined five types of technology adopters: innovators, early adopters, early majority, late majority, and laggards. The distribution of these types follows standard deviations in a bell curve. *The innovators* (2.5%) are eager to adopt innovations and technology is a central interest in their life. *The early adopters* (13.5%) understand and appreciate the benefits of a new technology and relate potential benefits to their own needs. The *early majority* (34%) is driven by a sense of practicality and wants to be sure that the new technology is stable. The *late majority* (34%) prefers to wait until the new technology has become an established standard and receives significant support. Finally, the *laggards* (16%) are resistant to new technologies and will use it only as a part of other products.

In educational settings Dori, Tal, and Peled (2002) classified four categories of teachers in a process of technology adoption: (1) “the initiator” - the enthusiastic, confident teacher, willing to implement online technologies, (2) “the follower” - the conformist teacher, applying online technologies at convenience, (3) “the avoider” - teacher using technologies when he or she is forced to, and (4) “the antagonist” that will not use technologies in school under any circumstances. Shamir-Inbal, Dayan, & Kali (2009) pointed to the fact that Dori et al.'s classification, grounded in educational field, seems to align with the types from the more generic Diffusion of Innovation Theory (Rogers, 2003): The initiating teachers (type 1) mapping to innovators and early adopters, followers (type 2) to early majority, avoiders (type 3) to late majority, and antagonists (type 4) to laggards.

Another perspective in understanding how to fulfill the potential of technology in education is to examine the nature of the change process for schools as a *whole* rather than focus on individual adoption of innovations. Fuchs (1995) suggested a theoretical framework for the classification and evaluation of the change process in educational institutions. Successful implementation of change is influenced by the individuals involved in the process, stakeholders, and the entire school culture. According to Fuchs, for a change process to be substantial, it has to include, among other factors, interactions between circles of various stakeholders - not only interaction within the internal circle of educational institution (i.e., between school principals and teaching staff), but also interactions with students and their parents. This idea recently received empirical support in comparative analysis of a large sample of online activities during three academic years (Blau & Hameiri, 2010). The findings show that in schools choosing to implement a data system among teachers *and* families the process of implementation is deeper and occur faster compared to schools that decide implementing the system among the teaching staff only. However, Blau and Hameiri's study explored how the interactivity among teacher staff through the data system is affected by presence versus absence of the *possibility* for online communication between teachers and families (i.e., by the decision of a school to implement both the system for teachers and the system for families or to use the data system for the teaching staff only). Studies investigating *actual* teacher-student or teacher-parent two-way online interaction through data systems in schools that include students and parents in the process of implementation are needed.

The use of data systems in schools is not limited to a strictly determined pedagogical role mostly emphasized in the research literature; some systems also function as an important way for online communication and interaction (Blau & Hameiri, 2010; Georgouli, Skalkidis, & Guerreiro, 2008; Wayman, 2007). Diverse definitions of interactivity in research literature vary in focus (medium features versus users) and temporal orientation (interactivity as a quality versus interactivity as a process). This research adopted the definition of **interactivity** as "a process-related variable concerning responsiveness" (Rafaeli & Ariel, 2007, p. 84) that fits the context of this study. This definition does not focus on learning or instruction; it refers to human responsiveness rather than medium features, and describes the exchange of different information types that are transmitted between communicators, i.e. the enable to investigate interactivity as a process rather than a quality.

Research showed that interactivity through two-way symmetrical applications provides an opportunity for organizations to build and maintain relationships with their target audiences (Samsup & Yungwok, 2003), leads to favorable attitudes and positive evaluation of target audiences towards the organizations (Cho & Leckenby, 1999; Sundar & Kim, 2004). Most of the users in different online communities, both children (Zuckerman, Blau, & Monroy-Hernández, 2009) and adult participants (Preece, Nonnecke, & Andrews, 2004) are lurkers, who seek information entered by others, but do not write themselves. However, the issue of posters versus lurkers was mostly studied in open online discussion groups. Few studies investigated active and passive communication in online academic discussion groups (Gorsky & Blau, 2009; Soroka & Rafaeli, 2006), and, for the best of our knowledge, this topic was not studied among users of online systems in formal education.

1.3 Mashov School System

This paper examines the implementation process of a school system called Mashov (meaning "feedback" in Hebrew, as well as the acronym of "Immediacy, Transparency, and Supervision"). This technology has been currently adopted in more than 500 Israeli schools (approximately 13% of schools in the country). The system includes two applications: the Mashov staff application which enables a secure online exchange of pedagogical information and communication between teachers, as well as online interactions with students and their parents; the Mashov family application opens access to student data - for the student and his or her parents - and offers the possibility for a two-way communication with the teaching staff. Online interactions in the system are conducted via two main modes: (1) entering daily data by teachers - regarding their lessons, such as lesson topics, educational materials, homework, as well as information about their students, such as attendance, discipline,

homework preparation, grades, and (2) direct two-way interactions among teachers, students, and parents by logging into the system and sending / receiving messages through the system. Each member of the organization receives access to the pedagogical information according his or her position: School principals have access to all of the information concerning their institution; head departments can see all the information concerning their departments; teachers have access to the information regarding the function of their students, including during the lessons of other teachers; students can access their own information entered by different teachers; parents have access to the information concerning learning and behavior of their children.

Log analysis of school data systems such as Mashov enables investigate *actual online behavior* of the participants *over time*, explore the relationships between different stakeholders - teaching staff, students and their parents. Thus, this analysis can help to understand the process of implementing changes in schools far beyond the traditional self-reported studies.

1.4 Parental Online Involvement

The use of interactive technologies with readily accessible resources can help in developing parental involvement with school and their children's learning (Lewin & Luckin, 2010). The data stored into the Mashov school system opens the possibility to explore teacher-student and teacher-parent two-way interactions and investigate parental online involvement. Studies regarding the offline parental involvement found its impact on child function in educational institutions. Discussing school issues with a child positively correlated with student grades, while checking homework did not correlate or even was negatively related to achievement (Jeynes, 2005). Showing interest in 16 years old teens' school issues, correlated with their later decision to continue post-secondary education (Hango, 2007). However, only long-term parental involvement is effective: Showing short-time interest in problematic situations leaded to a low self-esteem of teens, concerning their function at school (Kaplan Turan, 2004).

Moreover, the school system data enabled the comparison of parental online involvement of mothers versus fathers. Studies of offline father involvement showed that mothers are more actively involved in child education (Hango, 2007; Jeynes, 2005), but were critiqued by Lamb (2010) for the small and unrepresentative sample, for the lack of gender comparison, for measuring father involvement by such technical parameter as the amount of time spent with a child, for using self-report questionnaire as the only method of investigation, and for focusing on parents of young children and ignoring parents of teens. Using reliable research method it was found that, even when both parents held a full time job, father parental involvement (measured as the direct interaction with children and the degree of responsibility for them) was significantly lower in comparison with mothers (Lamb, 2010). In contrast to offline self-reported studies, analyzing data of school systems permits the investigation of actual parental online behavior during a long period of time. Giving each parent his or her own username and password for the system allows exploring gender differences in parental involvement, having exactly the same independent and easy access to real time information concerning the function of their child in school. For the best of our knowledge, online parental involvement through school data systems was not explored in previous studies.

1.5 Research Goals and Hypotheses

The purpose of this study was to examine different forms of actual (in contrast to self-reported) online behavior of teachers, students, and their parents during a long period of implementing a new technology in educational organizations. Specifically the study explored passive and active online interactions as (a) logging of teachers, students, their mothers, and fathers into the system, (b) reporting data by teachers on a daily basis, and (c) sending messages to teachers, students, mothers, and fathers during the three years of implementing the Mashov school system in seven Israeli large secondary schools. In addition, the study investigates (d) the impact of teacher activity measured as

daily data is entered, on the use of the system by students and their parents, and (e) compares mother and father passive and active online parental involvement.

The research hypotheses were:

(1) Consistent with the Diffusion of Innovation Theory (Rogers, 2003), it was hypothesized that the implementation time would positively impact both the passive interactivity (i.e., logging into the system) and the active interactivity (i.e., sending messages to and receiving messages from teachers, students, mothers, and fathers);

(2) Similarly to empirical data regarding gender differences in offline parental involvement (see: Lamb, 2010), it was hypothesized that mothers would show a high level of passive and active online parental involvement compared to fathers;

(3) Based on the framework of implementing changes in schools by expanding circles of interaction and including all stakeholders into this process (Fuchs, 1995), it was hypothesized that teacher daily data entering would augment the use of the system by his or her students and their parents.

2. Method

2.1 Participants

The study participants were the entire teaching staff - 828 homeroom and subject-matter teachers working in seven Israeli secondary schools (grades 7 – 12), their students, and parents. Figure 1 presents the age distribution of the participants-teachers whose age was available through the system (Range: 24-67, Average: 48.89, SD: 9.66, Median: 50, Skewness: -.24).

—Please insert Figure 1 here—

The schools started to use the system in September 2006 and according to the date of the analysis, continuously used the system during three academic years. The schools belong to the same geographical region, were under the same type of governmental supervision, and similar in terms of ethnic origin, organizational structure, and educational values. All the schools were large, including at least 80 staff members. Since the study compared three years of implementation, the data from each year was needed for the analysis. Therefore, teachers having a sabbatical during the period of investigation, new or retired teachers were automatically excluded from the analysis by the SPSS application. In addition, since this study explored gender differences in parental involvement, the data of both mother and father activity was needed for the comparison. Thus, single parents were excluded from this analysis.

2.2 Instruments

All the analysis in this study was conducted *at the level of individual teacher* (and not on a school level, neither on the individual student or parent level). The unit of analysis was the summary of activities in the system for an academic year for each teacher. The **passive** online activities measured in this study were: (1) the number of teacher logins, the average number of logins into the system made by all his or her (2) students, their (3) mothers, and (4) fathers. **Active** online activities measured in this study were: (5) the percentage of daily data entered by teachers into the system (e.g., the number of lesson entered –topics, student attendance, behavior events, homework preparation – divided on the number of teacher's total lessons per week), the number of messages *sent* by a teacher to all his or her (6) students, their (7) mothers, and (8) fathers, as well as the number of messages *received* by the teacher from (9) students, their (10) mothers, and (11) fathers through the system.

2.3 Procedure

Log analysis of all system activities during the period of three academic years (September 2006 to August 2009) was conducted for individual teachers, all of his or her students, their mothers and fathers. SPSS 17 application was used for analyzing the data. As mentioned before, only teachers who worked continuously during all of the three years were included in the analysis - new staff members, retired teachers, and teachers having a sabbatical during the period of investigation were automatically excluded from the analysis by the SPSS application. The data was extracted, stored, and analyzed in an anonymous way, which did not enable recognition of individual teachers or schools.

3. Results

The following section includes three parts. First, the results regarding the impact of the implementation time on teacher and student interactions will be presented. Following that, the data concerning gender differences in parental involvement will be reported. We will conclude this section by presenting the results regarding the influence of teacher activity level on using the system by families.

Since this study investigated seven different schools, before analyzing the data we eliminated the possibility that the results might be influenced by differences in the culture of these schools. Hierarchical analysis revealed that participants did not differ in none of the dependent variables (p's > .11). In the absence of statistically significant differences among the participants from different school culture, we analyzed their data altogether. In order to test the study hypotheses, series of ANOVA Repeated Measures tests were conducted.

3.1 The impact of implementation time on teachers and students

Regarding the impact of implementation time on *teachers*, the ANOVA Repeated Measures showed statistically significant main effect of implementation time on the number of **teacher logins** into the system, $F(2, 658) = 107.64$, $p < .001$, $\eta^2 = .25$. Post-hoc Bonferroni tests showed a significant increase in average number of teacher logins into the system during all three years of investigation (212.15, 278.10, and 336.72 logins in average, p's < .001).

Statistically significant main effect of implementation time was also found on the number of **messages sent by teachers to their students** through the system, $F(2, 194) = 57.60$, $p < .001$, $\eta^2 = .23$. Despite the pure voluntary nature of this activity, post-hoc Bonferroni tests showed significant increase in the average number of messages sent by teachers to their students through the system during the first two years of investigation (9.10 and 51.51 messages in average, $p < .001$), but not between the second and the third years of system implementation (57.74 messages, $p = .18$).

Concerning the impact of implementation time on *students*, the ANOVA Repeated Measures showed a statistically significant main effect of implementation time on the number of **student logins** into the system, $F(2, 532) = 773.81$, $p < .001$, and the effect size was very large, $\eta^2 = .58$. Post-hoc Bonferroni tests showed a significant increase in the average number of student logins into the system during all of the three years of investigation (22.57, 50.45, and 70.81 logins in average, p's < .001).

In addition, statistically significant main effect of implementation time was found on the number of **messages sent by students to their teacher** through the system, $F(2, 111) = 58.72$, $p < .001$, and the effect size was large, $\eta^2 = .34$. Post-hoc Bonferroni tests showed that the average number of messages sent by students to their teacher through the system increased dramatically during the years investigated (5.59, 12.70, and 59.86 messages in average, p's< .001). It seems that as the

implementation progressed, students understand the benefits and widely used both login into the system for consuming the information disseminated by teachers and actively communicate with teachers by sending messages through the system.

3.2 Gender differences in teacher-parents interactions and online parental involvement

Regarding the *gender differences in teacher-parents communication*, Table 1 presents means and standard errors for the number of **messages sent by teachers to mothers and fathers** of their students through the system.

—Please insert Table 1 here—

As can be seen from the data, the average number of messages sent by teachers to mothers of their students was higher compared to messages sent to fathers. Moreover, as soon as the teachers started the process of technology implementation, the average number of messages sent to mothers of their students was higher than to student fathers two years later - during the third year of implementation.

The comparison between the number of *teachers sending messages* to students (194), their mothers (250), and fathers (147) versus the number of teachers logging into the system (660) showed that percentage of teacher active interaction with mothers (37.9%) was higher compared to teacher-fathers communication through the system (22.3%). Surprisingly, the percentage of teacher-mothers interactions was even higher than percentage of teacher active online interactions with their students (29.4%).

Regarding the *gender differences in parental involvement*, Table 2 presents means and standard errors for the number of **mother and father logins** into the system, as well as for the number of **messages** sent by mothers and fathers through the system to their child's teacher.

—Please insert Table 2 here—

As can be seen from the data, although the number of mother and fathers who continued logging into the system during all the years investigated was almost the same, the average number of mother logins into the system during the first year of system usage was similar to the number of father logins only two years later - during the third year of implementation. The average number of messages sent by mothers to teacher of their child was higher compared to the number of messages sent by fathers. Moreover, as soon as the process of system implementation started, the average number of messages sent by mothers to a teacher of their child was similar to the number of messages sent by fathers two years later - during the third year of investigation.

The comparison between the number of *messages sent to teacher* by students (113), their mothers (206), and fathers (73) versus the number of family member logins into the system (students – 534, mothers – 588, fathers - 554) showed a higher percentage of mother-teacher active interactions (36.9%) compared to fathers-teacher communication through the system (13.2%), and even in comparison with students-teacher active online interactions (21.2%).

Table 3 summarize the results of the analysis of variance for the effect of implementation time, parent gender, and the interaction effect between these two variables on the number of messages sent by teachers to parents, the number of parent logins into the system, and the number of messages sent by parents to a teacher through the system.

—Please insert Table 3 here—

As can be seen from the data presented in Table 3, statistically significant main effects were found for the system implementation time and parent gender, as well as a significant interaction effect between the two variables. Post-hoc Bonferroni tests showed that the number of messages sent by teachers to parents of their students significantly increased during all three years of investigation (14.40, 20.95, and 27.63 messages in average, p's < .01). Teachers sent as twice messages to mothers of their students as to fathers (28.21 versus 13.78 messages in average, $p < .001$). The analysis of interaction showed that the number of messages sent by teachers to mothers of their students significantly increased from year to year during all the period investigated (p's < .001). However, only marginal increase in the number of messages sent by teachers to fathers of their students occurred from the first to third year of implementation ($p = .054$). Thus, teachers clearly preferred to conduct active interactions through the system by sending messages to the mothers rather than to the fathers of their students.

Regarding the effect on the number of parent logins into the system, statistically significant main effects were found for the system implementation time, parent gender, as well as a significant interaction between these two variables. The effect size was large for the both variables. Post-hoc Bonferroni tests showed that the number of parent logins into the system significantly increased during all three years of investigation (5.55, 11.31, and 14.43 logins in average, p's < .001). In general, mothers logged into the system almost as triple as fathers (15.08 versus 5.78 logins in average, $p < .001$). The analysis of interaction showed that the gender gap in use of the system increased from year to year: mothers logged into the system twice as much as fathers during the first year of implementation, 2.5 as much as fathers during the second year, and tripled that of the amount of fathers during the third year investigated.

Concerning the messages sent by parents to a teacher of their child through the system, statistically significant main effects were found for the system implementation time, parent gender, as well as a significant interaction between the two variables. Post-hoc Bonferroni tests showed that the number of messages sent by parents the teachers through the system significantly increased during all three years of investigation (14.96, 22.61, and 30.48 messages in average, p's < .01). In general, mothers sent twice as much messages to teacher of their child as fathers (31.05 versus 14.31 messages in average, $p < .001$). The analysis of interaction showed that the number of messages sent by mothers to teacher significantly increase from year to year during all the period investigated (p's < .001), while only a marginal increase in the number of messages sent by fathers occurred from the second to third year of implementation ($p = .07$).

3.3 The Impact of Teacher Activity on Students and Parents

For the statistical analysis the teachers were divided into two groups using the median scale score – high activity teachers, who during the period of investigation entered numerous daily data into the system, versus low activity teachers, who received the median activity score or less.

Regarding the impact of teacher activity on **students**, Table 4 shows descriptive statistics for the number of student logins into the system, separately for high and low activity teachers.

—Please insert Table 4 here—

As can be seen from the data, the number of students that continuously logged into the system during all of the period of investigation was 3.5 higher among students taught by high activity teachers (418) than students taught by low activity teachers (116). Among students who continuously used the system, the number of student logins during the first year of implementation was similar in classes of high and low activity teachers. Nevertheless, later students taught by high activity teachers entered into the system significantly more in comparison with students of low activity teachers. During the second year of implementation, students taught by high activity teachers used the system in similar rates to students taught by low activity teachers a year later – during the third year investigated.

Table 5 presents results of the analysis of variance for the effect of implementation time, teacher activity level featured as entering daily data into the system, and their interaction on the number of student logins into the system.

—Please insert Table 5 here—

As can be seen from the data, statistically significant main effects were found for the system implementation time, teacher activity level, as well as a significant interaction between the two variables. Post-hoc Bonferroni tests showed that, in general, students of high activity teachers entered into the system significantly more than students of low activity teachers (50.58 versus 38.35 logins in average, $p < .001$). The interaction effect revealed that despite the similarity in the number of logins into the system among students taught by high and low activity teachers during the first year of implementation, the gap in favor of active teachers' students increased from year to year (52.87 versus 41.41 logins in average during the second year and 75.82 versus 52.80 logins during the third year, p's $< .001$).

Regarding the impact of teacher activity on **parents**, Table 6 shows descriptive statistics for the number of mother and father logins into the system, separately for high and low activity teachers.

—Please insert Table 6 here—

As can be seen from the data, the number of parents that continuously logged into the system during all of the period under investigation was tripled among high activity teachers (387) compared to low activity teachers (117). Among parents who continuously used the system gender differences in favor of the mother were found. The increase of father logging into the system from the first to third year of implementation was higher in classes of high activity teachers - 2.5 compared to 1.5 in classes of low activity teachers. The comparable increase among mothers was triple in classes of high activity teachers versus twice in classes of low activity teachers.

Table 7 shows results of the analysis of variance for the effect of implementation time, teacher activity level featured as entering daily data into the system, parent gender, and their interaction on the number of parent logins into the system.

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As can be seen from the data, statistically significant main effects were found for the system implementation time, teacher activity level, and parent gender. All the interactions between these variables were statistically significant as well. Post-hoc Bonferroni tests showed that in general, parents in classes of high activity teachers entered into the system significantly more than students of low activity teachers (10.75 versus 9.34 logins in average, $p < .01$). The analysis of the interaction between the implementation time and teacher activity level showed that despite the similarity in the number of logins into the system among parents in classes of high and low activity teachers during the first year of implementation (5.31 and 6.30 logins in average respectively), later the gap in favor of parents in active teacher classes increased from year to year (in average 11.72 versus 9.89 logins during the second year, $p < .05$, and 15.22 versus 11.83 logins during the third year, $p < .001$). The analysis of interaction between the implementation time and parent gender showed that among fathers, the increase in logging into the system stopped during the second year of implementation and did not change significantly between the second and the third year of investigation (6.13 and 6.93 logins in average respectively). Among mothers, however, the increase in logging into the system continued also during the third year of implementation (15.48 versus 20.12 logins in average, $p < .001$). The analysis of triple interaction between implementation time, teacher activity, and parent gender showed that during the first year of implementation for both genders there were no differences between parents in classes of high and low activity teachers, while later only fathers continued this trend during the whole period of investigation. However, mothers in classes of high activity teachers

logged significantly more into the system compared to mothers in classed of low activity teachers (in average 16.65 versus 14.30 logins during the second year, $p < .05$, and 22.74 versus 17.50 logins during the third year of implementation, $p < .001$). It seems that mothers were more flexible and adapted the level of parental online involvement to teacher activity.

4. Discussion

The purpose of this study was to examine different forms of online interactions among teachers and families during implementation of new technology - the Mashov school system - in secondary schools, in order to contribute to the conceptual understanding of implementing technological change in educational institutions. All the hypotheses were supported.

According to the *first research hypothesis*, the findings showed that implementation time positively influenced logging into the system, sending messages to and receiving messages from teachers, students, mothers, and fathers. This finding is consistent with the Diffusion of Innovation Theory (Rogers, 2003), as well as with a similar approach presented in the educational field by Peled, Kali, and Dori (2007). The results of the study showed that schools successfully assimilated the system into their school-culture. We refer to the term "assimilation of the system use into school culture" in order to describe the situation in which, in accordance with the schools' vision, almost all teachers would frequently logging into the system, most of them entering daily data regarding their lessons, student performance, and behavior events, as well as maintaining two-way online communication with students and their parents (Blau & Hameiri, 2010). Despite the pure voluntary nature of active interactions such as sending messages, findings showed an increase in the number of messages sent by teachers to students and their parents, as well as messages sent by students and parents to teachers through the system during the years of implementation. Students' use of the system, both for consuming information disseminated by teachers and for actively communicate with them, increased dramatically during the years of investigation. It seems that students are the principal benefiters of implementing school data systems.

However, not all the measures of interactivity increased during all the period of investigation. The significant increase of messages sent by teacher to his or her students was found only from the first to second year of investigation. It is reasonable to assume that teachers were preoccupied by entering data on a daily basis, sending messages to their colleges through the system, and having the possibility for offline interactions with their students, did not feel the necessity to increase the number or messages sent to students beyond a certain level. Regarding father interactivity, the increase of passive interactions such as logins into the system was also found only from the first to second year of investigation. Moreover, the increase of active teacher-father and vice versa interactions by sending messages through the system did not reach statistically significance. Both teacher-family and vice versa interactions showed the same patterns: The most active forms were two-way interactions between teacher and mothers, followed by interactions between teacher and students, and finally - the interactions between teacher and fathers. Parents have no such a possibility to supplement online interactions with teacher of their child with offline ones. However, having the possibility to know almost in real time what happened with the child in school and the ability to interact easily with his or her teacher, did not produce active father involvement and resulted only in a minor level of passive interactions such as logging into the system.

According to the *second hypothesis*, gender comparisons showed that mothers had higher levels of both passive and active online parental involvement than fathers. These results are consistent with findings regarding gender differences in offline parental involvement (Lamb, 2005, 2010). Mothers logged into the system almost triple the amount of fathers, and sent twice as many messages to the teacher of their child as fathers, and the gender gap, which was apparent already in the first year of implementation in both passive and active interactions, increased from year to year. Note that in families studied in this paper normally both mothers and fathers are working. Thus, this result cannot be explained by the availability of staying-at-home mothers. Similarly, father offline parental

involvement was significantly lower in comparison to mothers, even when both parents held a full time job (Lamb, 2010). In addition the findings showed that, in contrast to fathers, mothers are more flexible and adapt their level of parental online involvement to teacher activity, logging significantly more into the system in classes taught by high activity teachers compared to mothers in classes taught by low activity teachers. However, the findings showed that teachers also preferred to conduct active interactions through the system by sending messages to mothers rather than to fathers of their students, starting this tendency from the beginning of the implementation process. We would recommend teachers that they be aware of their gender preferences in online interactions with parents and try to diminish the differences in online parental involvement by actively initiating more interactions with fathers.

According to the *third research hypothesis*, teacher online interactions such as entering data on a daily basis augmented the system use by students and their parents. The number of students and their parents that continuously logged into the school system during all of the period of investigation as well as the frequency of their logging was significantly higher among high activity teachers, who entered more daily data into the system, in comparison to students and parents of low activity teachers. Entering data on a daily basis is a required function, which meets the organizational requirements of school principals by instantly conveying all school pedagogical information and giving the possibility of easily extracting this information from different perspectives and on different levels (e.g., data of individual student, groups, classes, whole school, subject-matter, teacher, or team). Moreover, these functions of the system give teachers themselves the possibility to quickly extract information about their classes or subject-matter groups and use this information for their own educational benefits. The study results showed that the availability of the daily data for the target audience - students and families - leads to high data usage. This finding gives additional internal stimuli for teachers to enter more data into the system on a regular basis. The results are consistent with Fuchs's (1995) approach of implementing changes in schools by expanding circles of interaction, as well as with Bowyer Gerard, and Marx (2008) findings that include the role of stakeholders in incorporating technology within organizational everyday practices as an important step towards the effective and successful implementation of technology.

5. Conclusions and Limitations

This study examines two-way online interactions among teachers, students, and their parents during the implementation of new technology - the Mashov school system - in 7 Israeli secondary schools. All three hypotheses were supported. (1) The implementation time positively influenced the measures of the passive interactivity (i.e., logging into the system) as well as the active interactivity (i.e., sending messages to and receiving messages from teachers, students, and parents). These findings are consistent with the Diffusion of Innovation Theory (Rogers, 2003). (2) In comparison to fathers, mothers had higher levels of both passive and active online parental involvement. These results are in accordance previous findings regarding gender differences in offline parental involvement. Moreover, this study revealed that mothers adapt the level of parental online involvement to teacher activity, logging significantly more into the system in classes of high activity teachers compared to mothers in classes of low activity teachers. (3) Teacher online interactions such as entering data on a daily basis augmented the use of the system by students and their parents. This result is consistent with the framework of implementing changes in schools by expanding circles of interaction and including all stakeholders (Fuchs, 1995). It seems that students and parents in classes of high activity teachers, who enter more daily data into the system, had more reasons to log into the system for receiving pedagogical information on a daily basis compared to students and parents in classes of low activity teachers.

The main limitation of this study was the exclusive use of quantitative methodology. Therefore, in future exploration of issues related to the implementation of the technological change in educational institutions we recommend the use of qualitative treatment based on action research, paying attention to user experiences. We also recommend to teachers and schools administrators to involve educational

institution stakeholders - students and their parents - in the implementation of the technological changes and to seek new ways of augmenting the online passive and active parental involvement of fathers.

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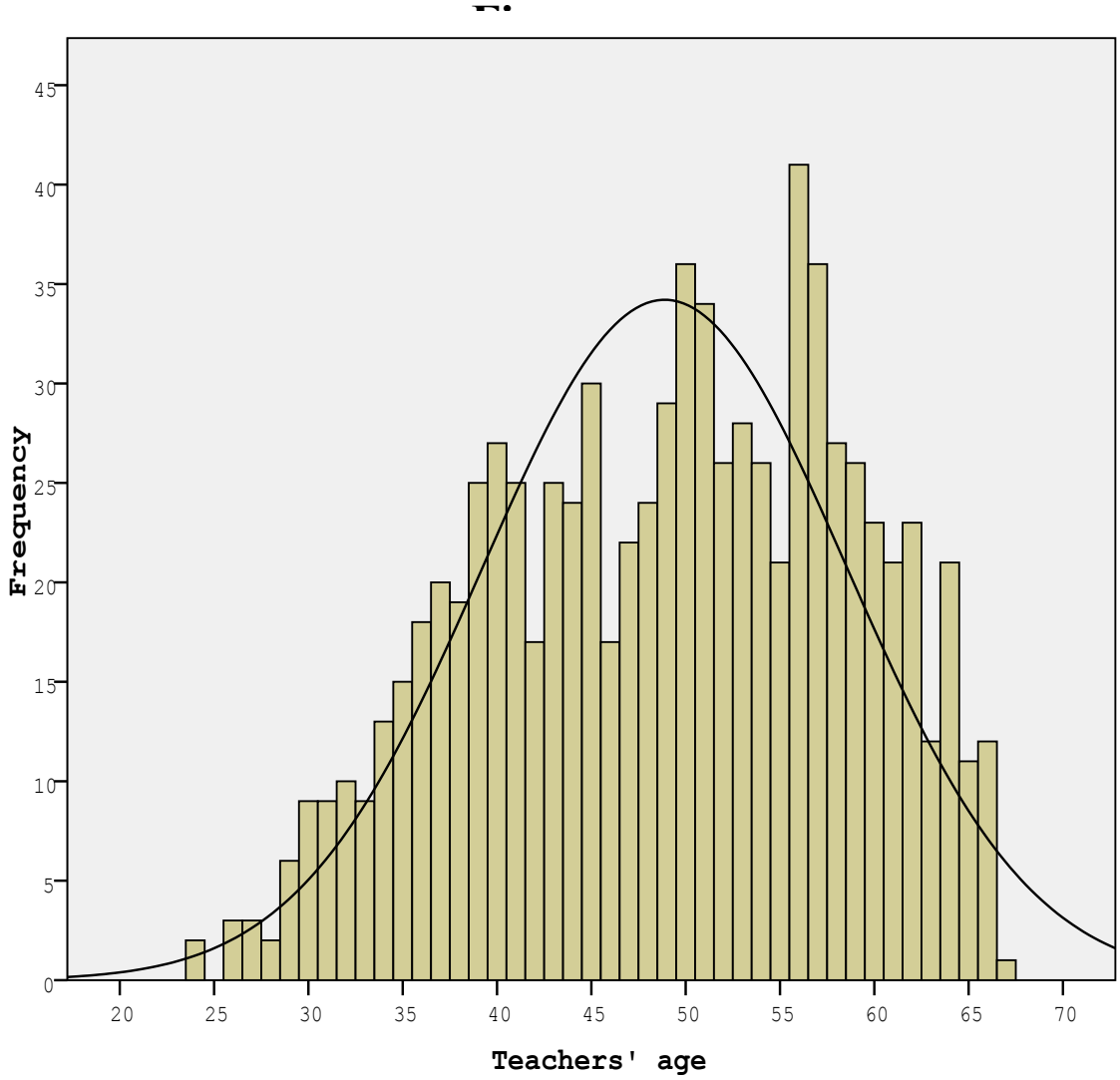

Figure 1: Teacher age distribution (n = 828)

Tables

Table 1: The number of messages sent by teachers to parents of their students through the system

Number of messages sent by teachers during:	Messages sent to mothers (*n* = 250): Average (*SE*)	Messages sent to fathers (*n* = 147): Average (*SE*)
First year	17.43 (1.67)	11.36 (1.82)
Second year	27.27 (1.69)	14.63 (1.63)
Third year	39.92 (2.18)	15.34 (1.81)

Table 2: Mother and father logins into system and messages sent by parents to teacher

Year of investigation:	Parent logins		Parent messages	
	Mother logins (*n* = 588): Average (*SE*)	Father logins (*n* = 554): Average (*SE*)	Messages sent by mothers (*n* = 206): Average (*SE*)	Messages sent by fathers (*n* = 73): Average (*SE*)
First year	7.81 (0.31)	3.28 (0.16)	18.02 (1.87)	11.89 (1.44)
Second year	16.01 (0.55)	6.60 (0.25)	32.11 (2.06)	13.11 (1.57)
Third year	21.41 (0.65)	7.46 (0.29)	43.02 (1.60)	17.94 (1.28)

Table 3: The influence of implementation time, parent gender, and their interaction on the massages sent by teachers to parents, on parent logins, and parent messages to teacher

Factor	*F*	*df*	*p*	η^2
Influence on messages sent by teachers to parents				
Implementation time	17.01	2,122	< .001	.12
Parent gender	58.18	1,123	< .001	.32
Interaction	12.68	2,122	< .001	.09
Influence on parent logins				
Implementation time	303.16	2,517	< .001	.40
Parent gender	644.71	1,518	< .001	.55
Interaction	151.02	2,517	< .001	.23
Influence on messages sent by parents				
Implementation time	6.48	2,45	< .01	.12
Parent gender	20.91	1,46	< .001	.31
Interaction	3.94	2,45	< .05	.06

Table 4: Descriptive statistics for the number of student logins for high versus low activity teachers

Number of student logins during:	Students of high activity teachers (*n* = 418): Average (*SE*)	Students of low activity teachers (*n* = 116): Average (*SE*)
First year	23.04 (1.32)	20.85 (2.51)
Second year	52.87 (1.89)	41.41 (3.58)
Third year	75.82 (2.18)	52.80 (4.14)

Table 5: The influence of implementation time, teacher activity level as daily data entering, and their interaction on the number of student logins into the system

Factor	*F*	*df*	*p*	η^2
Implementation time	408.58	2,532	< .001	.43
Teacher activity	11.98	1,533	< .001	.03
Interaction	24.49	2,532	< .001	.04

Table 6: Descriptive statistics for the number of parent logins for high versus low activity teachers

Number of parent logins during:	**High activity teacher**		**Low activity teacher**	
	Mothers (*n* = 387): Average (*SE*)	**Fathers (n = 387): Average (SE)**	**Mothers (n = 117): Average (SE)**	**Fathers (*n* = 117): Average (*SE*)**
First year	7.54 (0.36)	3.08 (0.19)	8.58 (0.65)	4.01 (0.34)
Second year	16.65 (0.63)	6.79 (0.27)	14.30 (1.15)	5.48 (0.49)
Third year	22.74 (0.75)	7.70 (0.32)	17.50 (1.37)	6.16 (0.58)

Table 7: The influence of implementation time, teacher activity level, parent gender, and their interactions on the number of parent logins into the system

Factor	*F*	*df*	*p*	η^2
Implementation time	161.94	2, 501	< .001	.24
Teacher activity	5.48	1, 502	< .01	.03
Parent gender	433.82	1, 502	< .001	.46
Implementation time * Teacher activity	12.94	2, 501	< .001	.03
Implementation time * Parent gender	94.08	2, 501	< .001	.05
Teacher activity level * Parent gender	3.17	1, 502	< .05	.03
Implementation time * Teacher activity * Parent gender	4.76	2, 501	< .01	.03