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Teachers' Openness to Change and Attitudes towards ICT: Comparison of Laptop per Teacher and Laptop per Student Programs

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Abstract

This study compares three groups of teachers that (1) work in one-to-one laptop classrooms, (2) received a laptop from the state for pedagogical use, and (3) teach without technology. The influence of openness to change and attitudes towards ICT implementation on online communication and information search by 97 Israeli middle school teachers was explored. The results indicate that teachers' openness to changes in professional life and their attitudes towards ICT predict 22.3% of the variance in online communication and 35% of the variance in online information search, both for personal and pedagogical purposes. Teacher openness to change, online communication, and information search were significantly higher among teachers who volunteered to participate in the one-to-one program compared to those who did not volunteer. These results are consistent with the important role of individual differences in explaining the rate of adopting innovations in general and implementing technology by teachers in particular. Compared to other participants, teachers in the one-to-one program showed higher level of awareness to the time invested in preparing digital learning materials. This emphasizes the importance of speeding the development of digital content that is adapted to local context by providers of learning materials. Compared to other participants, teachers who have a laptop reported a higher level of openness to professional changes, to online communication, and information search for both personal and professional purposes. These findings emphasize the importance of providing teachers with personal devices for pedagogical use and online communication.

Keywords: teacher openness to change, teacher attitudes towards ICT implementation, Israeli "laptop per student" – the Katom project, one-to-one laptop classrooms, "laptop per teacher" project.

Introduction

One-to-one laptop programs are becoming more prevalent in schools around the world. Schools seek more engaging tools that will have an impact on school success and preparing students for skills needed for the 21st century. One-to-one programs can help teachers plan lessons and communicate more effectively (Lei,

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Conway, & Zhao, 2007), and deliver richer, more engaging lessons (Livingston, 2006). Having a laptop offers teachers greater possibilities for communication with student, parents, and colleagues (Constant, 2011). For students, laptops provide ubiquitous 24/7 access to information, learning, and communication (Livingston, 2006). However, most of the publications on one-to-one programs are project evaluations (e.g., Larkin & Finger, 2011; Penuel, 2006), while independent research on this topic is still minimal. This study aims to explore the relationships between teachers' openness to changes, attitudes towards ICT, and their use of technology for online communication and information search for personal and professional needs. In addition, the study compares teacher openness to changes and attitudes towards ICT among teachers working the first year in one-to-one classrooms, teachers (but not students) who received their own laptop from the ministry of education, and teachers working without the use of technology.

Literature Review

Research suggests that more widespread access to computers in schools makes it possible for students and teachers to move from supplemental and occasional use of computers in learning process to more integral and frequent use across variety of settings (Lin & Wu, 2010). One-to-one programs have a significant impact on curriculum, instruction, and learning in middle schools (Silvernail, Pinkham, Wintle, Walker, & Bartlett, 2011). Teachers in the Silvernail et al. study report substantial benefits from the laptop program and indicate that the laptops have helped them to individualize their curriculum and instruction, to teach more, in less time, and with greater depth.

In regard to the use of their own laptop, the evidence of Silvernail et al. (2011) indicates that many teachers have reached the equilibrium point in the adoption and integration of laptops in the their curriculum and instruction. Results from the first (January 2006) teacher survey in the Bebell and Kay (2010) longitudinal study reflect a time when teachers had recently received their own laptops but students had not been issued computers. In this early stage of implementation teachers used the Internet for finding relevant information and lesson planning 56.9 school days per year; they also use the technology for communication with teachers, parents, or administrators 89.6 days per year.

However, research into specific technological innovations seems to suggest that many teachers experience difficulty in the implementation of educational technologies in general (Franklin, 2007) and the implementation of one-to-one computing programs in particular (Larkin & Finger, 2011). The adoption is uneven for some teachers and in some subject-matters. Many teachers are not using the laptops as frequently as one might anticipate, and too few of them report using the technology for teaching 21st century skills (Silvernail et al., 2011).

Rogers' (2003) Diffusion of Innovation theory explains the variety in the rate of adopting new technologies by individual differences. The continuum of adopting innovations ranges from innovators and early adopters, to early majority and late majority, and finally laggards. Similar categorization was reported in educational settings (Dori, Tal, & Peled, 2002; Peled, Kali & Dori, 2011). Based on the way of managing the learning process during the implementation of educational technologies, Dori et al. (2002) and more recently Peled et al. (2011) describe four types of teachers: (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 only when he or she is forced to, and (4) “the antagonist” teacher who will not use educational technologies under any circumstances. Shamir-Inbal, Dayan, and Kali (2009) pointed to the fact that Dori et al.'s classification, grounded in the educational field, seems to align with the types of the more general theory of 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. The same matching is true for the findings of Peled et al.'s (2011) follow up study.

The literature highlights the importance of personal characteristics of teachers that implement effectively the technology in their pedagogical practices (Becker, 2000). These characteristics include teaches' openness to change and their attitudes towards ICT that can support pedagogical changes. Some researchers claim that the role of teacher attitudes should be more empirically tested (e.g., McCormick & Scrimshaw, 2001), because deeper understanding of teacher attitudes towards ICT can help avoid obstacles in technology implementation in schools (Hew & Brush, 2007).

In the context of one-to-one classrooms, previous research suggest (Larkin & Finger, 2011; Penuel, 2006) that computer usage in one-to-one environments is strongly correlated with how closely that usage can be aligned with teacher attitudes and beliefs. While some teachers express high enthusiasm towards teaching in one-to-one classrooms, others are concerned about non educational usage of technology during the lessons (Silvernail et al., 2011). To the best of our knowledge, previous research did not explore the role of teachers' openness to changes in one-to-one settings.

Study Goals and Hypotheses

This paper explores the relationships between teachers' openness to change, their attitudes towards ICT, and the use of technology for online communication and information search for both personal and professional purposes. In addition the study compares three groups of participants - teachers working in one-to-one classrooms, teachers who received a laptop from the ministry of education, and teachers working without technology. We hypothesized that:

1. Teacher's openness to change and attitudes towards ICT would positively relate to their online communication and information search;
2. Openness to change and attitudes towards ICT would be higher among teacher in one-to-one program and teachers having laptops compared to teachers working without technology.

Method

Participants

The participants were 97 teachers from three secondary schools (7-12 grades) in Northern Israel. The schools are situated in the same geographical region, under the same type of ministry of education supervision, and very similar in terms of socio-economic status, ethnic origin, organizational structure, and educational values. In the 2010-2011 academic year school A started gradual implementation of the one-to-one laptop program - Israeli "laptop per student" project called "Katom" (the acronym of Class, Student, Computer in Hebrew). During the 2010-2011 academic year all 7th graders (12-13 years old) started the program; at the time of writing this paper - during the 2011-2012 academic year all 7 and 8 graders learn in one-to-one classrooms; during the next academic year (2012-2013) the implementation will be completed and all middle school students will study with laptops. The results presented in this paper refer to the first year of the one-to-one laptop program implementation in school A (2010-2011 academic year). During this initial period of the program, teachers working in one-to-one classrooms volunteered to do so. From this school all 22 teachers who volunteered teaching in the one-to-one model in the first year of the program and 27 teachers who did not volunteer participated in the study. From school B, where all teaching staff received laptops for pedagogical purposes, 25 teachers participated in this study. From school C, where the staff does not have laptops for teaching, 23 teachers participated in the research.

The participants' age was normally distributed (Range: 24-64, Median: 41, Mean: 43.74, SD: 9.82, Skewness - 0.15). Fourteen of the participants (14%) were men. Gender representations in the sample correspond to gender distribution among secondary school teachers in Israel. The participants teach a variety of subject-matter: Math, Hebrew (native) language and Literature, English (as a second language), Sciences, and Humanities. The number of teaching years of the participants was also normally distributed (Range: 1-39, Median: 15, Mean: 15.95, SD: 9.06, Skewness: 0.26).

Teachers in school A who volunteered to participate in the one-to-one model during the first year of implementation were significantly younger in comparison to teachers that did not volunteer: Mean: 41.45 versus 47.22, $t(47)= -2.07$, $p < .05$, Cohen's $d= 0.60$. However, no statistically significant differences were found in the number of teaching years between the two groups ($p > .14$).

Instruments and Procedure

The data was collected among teachers from three schools in the spring of 2011 through an online questionnaire which was administrated using Google Form platform. SPSS 19 statistics software was used to analyze the data. The online questionnaire contained three parts:

Teacher's openness to changes as defined by Blau and Antonovsky (2009) was measured in a six point Likert scale ranging from 1 - very difficult to cope - to 6 - very easy to cope. Confirmatory factor analysis with Varimax rotation revealed two factors. For teacher openness to changes *in professional life* the internal consistency was Cronbach's α=.78. This factor contain three items: Describe your ability to cope with following situations - "Changing a curriculum in your subject-matter", "Changing a subject-matter you teach", and "Changing the age group of your students". For teacher openness to changes in their *personal life*, the internal consistency was α=.81. This factor also was composed of three items: Describe your ability to cope with the following situations - "Changes in your personal life - for example, a separation from you spouse", "Changing your place of residence", and "Dismissal from your job".

Teacher attitudes towards ICT (Blau & Antonovsky, 2009) were measured in a six point Likert scale ranging from 1 - completely disagree - to 6 - completely agree. According to the confirmatory factor analysis with Varimax rotation, three indexes were created: *teacher attitudes towards* ICT (items included in this index are 1, 3, 6, 7, 8, 9, 13 in the Appendix), internal consistency α=.82, *time investment in online information search by teachers* (items 5 and 10), Pearson correlation r=.69, p<.001, and *time investment in online information search by students* (item 15).

Teacher use of online communication and information search for both personal and professional purposes were measured in a four point Likert scale ranging from 1 - not using at all - to 4 - highly using (Blau & Antonovsky, 2009). Confirmatory factor analysis with Varimax rotation revealed two factors. *Online communication* factor included three items: "To what extent do you use online communication for personal needs?", "To what extent do you use online communication with colleagues?", "To what extent do you use online communication with students?" the internal consistency was α=.63. *Online information search* factor also was composed of three items: "To what extent do you use online information search for personal needs?", "To what extent do you use online information search for prepare your lessons", "To what extent do you use online information search working with your students?", Cronbach's α=.68.

Table 1 presents the descriptive statistics for all the indexes created. According to the results of the factor analyses and internal consistency tests presented above, two indexes were composed for teacher openness to changes (professional and personal) and three indexes were created for attitudes towards ICT (attitudes, time invested by teacher, and by time invested by students). These are the independent variables of the study, while the use of online communication and information search are the dependent variables.

Table 1: Descriptive statistics for the study variables

	Independent variables					Dependent variables	
	Openness to profess. changes	Openness to personal changes	Attitudes towards ICT	Time investment by teacher	Time investment by students	Online communication	Online information search
Mean	4.64	3.35	5.34	3.29	3.28	3.04	3.32
Median	4.67	3.67	5.43	3.50	3	3	3.33
Standard deviation	0.68	1.11	0.64	1.34	1.40	0.62	0.62
Skewness	-0.38	-0.14	-1.25	0.19	-0.02	-0.24	-0.63
Minimum	3	1	3.29	1	1	1.67	1.67
Maximum	6	6	6	6	6	4	4

As can be seen from the data presented, teachers' attitudes towards ICT were very positive, and their report of technology use was high.

Results and Discussion

This section contains three parts. First the analysis of all participants in the survey is presented. Following that, the characteristics of teachers from school A that volunteered to teach in the one-to-one program are compared to teachers from the same school that did not volunteer and taught regular classes. We conclude with a comparison between teachers who received laptops from the Ministry of Education and teachers who did not receive a laptop.

The Impact of Openness to Changes and Attitudes towards ICT

Multiple regression analysis revealed that teachers' openness to professional change and their attitudes towards ICT predicted 35% of the variances in online information search for personal and professional purposes, $F(2,94)=25.36$, $p<.001$. The relative impact of each independent variable was also statistically significant: $t=3.99$, $p<.001$, $\beta=.35$ for teacher openness to professional changes and $t=4.56$, $p<.001$, $\beta=.40$ for their attitudes towards ICT.

In addition, multiple regression showed that teachers openness to professional change and their attitudes towards ICT predicts 22.3% of the variance of Internet use for personal and professional communication, $F(2,94)=13.51$, $p<.001$. The relative impact was as well statistically significant - $t=2.40$, $p<.05$, $\beta=.23$ for teacher openness to change in professional life and $t=3.77$, $p<.001$, $\beta=.36$ for their attitudes towards ICT. It seems that both teacher openness to professional change and their attitudes towards ICT impact the use of the Internet for personal and professional communication, as well as online search for personal and pedagogical information. These findings are consistent with the claim presented in the literature regarding the importance of teacher readiness to changes and positive attitudes towards technology implementation in education systems (Becker, 2000; Hew & Brush, 2007; McCormick & Scrimshaw, 2001).

Pearson correlations among independent variables revealed that teachers who are more open to professional change also have a more positive attitudes towards ICT, $r=.28$, $p<.001$. Teachers who claimed that their students invest too much time looking for needed online information also report that they themselves invest too much time in search for relevant information for pedagogical purpose, $r=.37$, $p<.001$, have a worse attitude towards ICT, $r= -.28$, $p<.01$, and search less for

information on the Internet, r= -.25, p<.01. These findings strengthen the importance of developing digital literacy and effective strategies for online information search among teachers. These skills can promote teacher willingness for online information search and can reduce the time needed to find relevant data.

Teachers that Volunteered to Teach in the One-to-one Program

Among teachers from school A, statistically significant differences were found in openness to professional changes between teachers who volunteered and those who did not volunteer to teach in the one-to-one program (Means: 4.89 vs. 4.37, (47)=2.95, p<.01); the effect size was large, (Cohen's d=0.86). In addition, borderline significance was found for openness to changes in personal life (Means: 3.47 vs. 2.94, t(47)=1.83, p=.07); the effect size was medium (Cohen's d=0.53). No statistically significant differences in these variables were found between teachers from school A and participants from other schools. These results regarding the differences in teacher openness to changes in professional and even personal life between teachers who accustom faster to organizational changes and those who rather wait until the technology is well established are in concordance with the general Diffusion of Innovation Theory (Rogers, 2003) as well as with the specific typology of adopting new technology by teacher (Peled et al., 2011).

As expected, teachers who volunteered to teach in the one-to-one classes use online communication for personal and professional purposes more than teachers that did not volunteer to teach in the program (Means: 3.11 vs. 2.65, t (47)= 2.54, p<.05, Cohen's d=0.74) and searched for online information more than teachers who taught in regular classes (Means: 3.55 vs. 3.10, t(47)=2.80, p<.01); the effect size was large (Cohen's d=0.81). Note that based on this results we cannot know its direction: whether teachers participating in the one-to-one program expanded the use of online communication and information search, or vice versa, teachers who volunteered to teach in the one-to-one classrooms already used online information search on a daily basis. We plan to explore this issue in further qualitative investigations.

Teachers from school A that volunteered for the one-to-one program perceived the preparation of digital learning materials as more time consuming compare to teachers that did not volunteer (Means: 3.75 vs. 3.06, t(47)=2.01, p<.05, Cohen's d=0.59). Regarding the perception of the Internet as time consuming for students, no significant difference was found between teachers who volunteered and those that did not volunteer to teach in the one-to-one program (p=.75). Thus, during the first year of participating in the one-to-one program, teachers began to understand that preparing lessons which include digital learning materials is a time consuming process. This finding highlights the importance of providing teachers implementing ICT programs with prepared digital learning objects that enable them to focus on the *delivery* of the enriched curriculum instead of preparing digital materials by themselves.

Mann-Whitney U test revealed borderline significance in attitudes towards ICT between teachers who volunteered and those who did not volunteer to participate in the one-to-one program (Z= -1.85, p=.08); the effect size was medium (Cohen's d=0.50). Note that, as presented in Table 1, teacher attitudes towards ICT were very high (Range: 3.29-6 in scale 1-6, Median: 5.43, Skewness: -1.25). The "ceiling effect", in which most of the cases in both groups are concentrated in the right side of the distribution, makes the possibility of finding a statistically significant difference among the groups difficult, even if these differences indeed exist.

Teachers that Received a Laptop for Professional Use

The comparison between teachers who received and did not receive a laptop from the Ministry of Education for their professional needs revealed that teachers having laptops report a higher openness to professional changes (Means: 4.84 vs. 4.52, t(95)=2.23, p<.05, Cohen's d=0.56). A similar

difference was not found in teacher openness to changes in personal life (p=.63). Thus, receiving laptops affected readiness to professional changes.

In addition, borderline significance was found between the teachers with and without laptops in online communication (Means: 3.19 vs. 2.96, (95)=1.89, p=.06, Cohen's d=0.39) and statistically significant difference in online information search (Means: 3.48 vs. 3.24, t(95)=1.98, p=.05, Cohen's d=0.41). As mentioned above, in school A only teachers who volunteered to participate in the one-to-one program received laptops. Therefore, it was unclear whether the use of the laptops expands online communication and information search or technologically proficient teachers volunteered for the program. In contrast, since all the teachers in school B received the laptop, this result indicates that receiving a personal computer expands the use of online communication and information search by teachers and not vice versa.

No statistically significant differences were found between teachers with and without laptops in attitudes towards ICT (p=.32), perceptions regarding the online communication and information search as a time consuming chore - for teachers (p=.60) or students (p=.21). As mentioned above, the absence of significant difference in teacher attitudes towards ICT can be explained by the "ceiling effect" - very positive attitudes reported by teachers. Thus, the difference in the perception of the Internet as time consuming was found between participants teaching and not teaching in one-to-one program, but was not found between participants teaching with and without laptops. This indicates that using teacher's laptop in the classroom does not require preparations similar to those needs for teaching in one-to-one classrooms.

Conclusions

This study compares teachers participating in a one-to-one program, teachers who received a laptop from the state, and participants teaching without technology. The influence of teachers' openness to change and their attitudes towards ICT on online communication and information search were investigated. We hypothesized that: (1) teacher's openness to change and attitudes towards ICT would positively relate to their online communication and information search; (2) openness to changes and attitudes towards ICT would be higher among teacher in one-to-one program and teachers having laptops compared to teachers working without technology. Both hypotheses were supported.

According to the first hypothesis, teachers' openness to professional changes and attitudes towards ICT shape their use of the Internet for personal and professional communication as well as for personal and pedagogical information search. The higher teacher's openness to changes in professional life and the higher their attitudes towards ICT - the more they use the technology for both personal and professional purposes. Thus, this study contributes to the field of knowledge by providing empirical support to the argument presented in the literature (Becker, 2000; Hew & Brush, 2007; McCormick & Scrimshaw, 2001) regarding the importance of teacher openness to changes and attitudes towards ICT in implementation of new technologies in educational institutions. Based on this finding, for the first stages of implementing new technologies in education system use teachers-volunteers is recommended. To the best of our knowledge, exploring the role of openness to changes in one-to-one settings was not previously investigated and it is recommended to continue exploring this issue in other samples.

According to the second hypothesis, teacher openness to changes was higher and the use of online communication and information searching was more extensive among teacher who volunteered for the one-to-one program compared to teachers who did not volunteer to participate. These results are consistent with individual differences in innovation adoption described by the Diffusion of Innovation Theory (Rogers, 2003). However, the results indicate that teachers in a one-to-one program report that the preparation of digital learning materials for their lessons was more time

consuming than other participants. This finding highlights the importance of providing teachers with appropriate digital recourses for their subject-matter and curriculum.

Teachers who received a laptop from the Ministry of Education showed more readiness for professional changes and used more online communication and information search than teachers without a laptop. Therefore, it is important to continue providing teachers with digital devices. More importantly, these devices should provide teachers a personal environment for online learning and communication.

Limitations and Suggestions for Future Work

The main limitation of this study is its exclusive use of qualitative self-reported data. Future studies should use qualitative methods, such as observations of the actual pedagogical use of ICT in classroom and interviews providing teachers the possibility to voice their perceptions of implementing ICT.

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Appendix

Teacher attitudes towards ICT (Blau & Antonovsky, 2009)

The following sentences contain different attitudes, behaviors, and feelings.
Please report to what extent you agree or disagree with each claim.

	Completely disagree	**Disagree**	**Somewhat disagree**	**Somewhat agree**	**Agree**	**Completely agree**
1. I feel comfortable communicating online with family and friends	1	2	3	4	5	6
2. I believe that using the Internet promotes my communication with family and friends	1	2	3	4	5	6
3. I feel comfortable searching online information for personal or family's needs	1	2	3	4	5	6
4. I believe that online I find updated information for personal or family's needs	1	2	3	4	5	6
5. I invest too much time in finding online information for personal or family's needs	1	2	3	4	5	6
6. I feel comfortable communicating online with colleagues	1	2	3	4	5	6
7. I believe that using the Internet promotes communication with colleagues	1	2	3	4	5	6
8. I feel comfortable searing online information for my lessons	1	2	3	4	5	6
9. I believe that searing online I find updated information for my lessons	1	2	3	4	5	6
10. I invest too much time in finding online information for my lessons	1	2	3	4	5	6
11. I feel comfortable to communicate online with my students	1	2	3	4	5	6
12. I believe that using the Internet promotes my communication with students	1	2	3	4	5	6
13. I feel comfortable to direct my students search for online information	1	2	3	4	5	6
14. I believe directing my students to search online help them find updated information	1	2	3	4	5	6
15. My students invest too much time in finding relevant online information	1	2	3	4	5	6

Biographies

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