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TABLET ADOPTION WITH SMART SCHOOL WEBSITE TECHNOLOGY

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ABSTRACT

Teachers play a key role in adoption of technologies for classroom use. This study surveyed teachers regarding their intention to use tablet technology to interact with students and other teachers through smart school websites technology. The Unified Theory of Acceptance and Use of Technology (UTAUT) served as the theoretical framework for this study, which was then augmented with context-specific determinants of adoption that captured teachers' perceptions of the effects of technology on interactions with students and peers. The results showed no resistance among teachers with regard to trying different ways of working with tablets to achieve better learning, unlike other studies using the UTAUT constructs that have found negative reactions to implementing new technologies in the workplace. This is a crucial finding, since teacher appraisals affect the ways in which this technology can be employed to foster learning through technology facilitated interactions.

Keywords: Tablets, UTAUT, knowledge-sharing, intentions, smart school website

INTRODUCTION

Teachers have demonstrated a growing interest in using school websites to provide students with a technology-rich environment that can help foster learning, as well as improve interactions with students [20]. Extant research has explored teachers' attitudes toward technology in the classroom, grounded in the knowledge that teachers will plan and implement technology practices that reflect their beliefs about teaching and learning [10]. However, technological innovations must be accepted by teachers before they can be adopted and integrated into educational offerings [18]. Educators must first understand how these technologies can be used effectively to support various learning modalities [27]. As individuals adopt mobile technologies that change their daily activities and even their lifestyles, it is inevitable that mobile technologies will be adopted in the educational environment by teachers. Accordingly, it is imperative that we understand teachers' perceptions about innovative technologies, such as tablets, that can be used to interact with the smart school website technology. Teachers play a key role in adopting technologies for classroom use, [12], we therefore seek to understand the factors that drive their intentions to adopt tablet technologies in this study.

Although a relatively new development, tablet technologies include multiple applications that can be adapted to classroom use, with the potential to enhance educational opportunities [18, 36, 46]. Interestingly, the tablet was launched primarily as a platform for audio-visual media including books, movies, music, games, apps, and web content; however, a large number of educational institutions now use tablet technologies [49] and this incorporation of the tablet in education has attracted considerable attention [6, 17]. Unlike laptops and desktop computers, tablets offer the user the advantage of mobility in the workplace, allowing a professional to walk from patient to patient, for example, with a computer in his or her hand [3], or in this case for a teacher to move about the classroom while interacting with students.

Technological Context for This Research: Smart School Technologies

A smart school technology includes a rich and familiar user experience provided by a virtual desktop, which includes icons, a start menu, a sidebar, and multiple gadgets. In Israel, an educational desktop has been implemented, called "Webtop," which looks, feels, and functions just like a desktop of any other computer. *Webtop* was developed to serve as an interoperable platform to link data used by the systems from different vendors, to facilitate an easy, efficient, and entertaining user experience for teachers, students, and parents. In addition to supporting basic capabilities such as file management, smart applications, and personal visual adjustments, *Webtop* also retrieves information, such as grades, disciplinary incidents, matriculation, timetable changes, and examination schedules from the systems and applications deployed by the schools.

Theoretical Model of Technology

The Unified Theory of Acceptance and the Usage of Technology (UTAUT) model [48] is the dominant theoretical foundation for assessing antecedents that lead to individual level (not group or organizational level) adoption of emerging technologies, and has been applied to a plethora of focal phenomena [31, 33, 44]. For example, it was applied to examine the effectiveness of desktop technology [51] online technology [32, 2], and online learning communities [29, 30]. It was also applied to the investigation of preservice teachers' acceptance of IT integration [4].

The UTAUT model suggests four core determinants of intention and usage of technology—Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions. It sheds light on the drivers of acceptance, and is therefore considered to be a useful tool for assessing whether a new technology will be successful. The UTAUT model has been leveraged as a theoretical lens in educational research to determine which constructs impact the acceptance of educational technology.

The theory suggests that three constructs play a significant role as direct determinants of user intention to adopt a new technology, and may thus impact teacher acceptance of tablet technology. Performance Expectancy is the degree to which an individual believes that using the system will help him or her to improve job performance. Effort Expectancy is the perceived degree of ease associated with the use of the system. Social Influence is the degree to which an individual perceives that important others believe that he or she should use the new system. Finally, the dependent variable in the present study is Behavioral Intention, which has been established as a direct antecedent [13] of the focal behavior, which in this case is the adoption and use of a specific technology.

HYPOTHESES DEVELOPMENT

The research model examined in this study is depicted in Figure 1.

Performance Expectancy

In an educational setting, Performance Expectancy can best be understood as perceptions of the usefulness of technology to teachers in terms of completing their tasks faster and providing materials to students. [48] found Performance Expectancy to be the strongest predictor of intention to use new technologies, explaining between 46% and 59% of the variance in the construct across the various models examined. Therefore, we also predict a positive relationship between Performance Expectancy and Intention to use tablet technology in our study:

H1: Performance Expectancy is positively associated with intention to use tablet technology.

Effort Expectancy

This construct captures the expected difficulty of using a tablet to post and update materials with the smart school website technology. Effort expectancy also addresses task complexity, which is the perceived degree of difficulty involved in understanding and using the technology [45]. To the extent that perceptions of the difficulty and effort involved in using the technology are low, it is expected that teachers will be more motivated to use tablet technology to access the smart school web site technologies to update learning materials. Therefore, based on this and past research (e.g., [48], we expect a relationship between Effort Expectancy and Intention to use tablets in our study:

H2: Effort Expectancy is negatively associated with intention to use tablet technology.

Social Influence

Social influence has been shown to impact individual behavior by altering the belief structures of individuals, causing them to respond to social pressure [1]. Though strong especially in the early stages of an experience, when individual beliefs about the behavior are relatively ill-informed, this normative pressure will attenuate over time, as increasing experience provides a more instrumental basis for the individual to use the technology [47]. In this research, we examined whether teachers are influenced by the opinion of other teachers, family, or friends, who use tablet technology in their daily lives, and how far these opinions affect their intention to use the technology themselves in their professional capacity. Based on past research, we expect a relationship between Social Influence and Intention to use the technology.

H3: Social Influence is positively associated with intention to use tablet technology.

Knowledge-Sharing

Previous studies have highlighted the role of technology in affecting the development and conduct of knowledge-sharing interactions involving teachers [11, 16]. We propose that teachers' perceptions about how the adoption of tablet technology for use in the classroom affect teachers' and students' interactions, as well as teachers' interactions with colleagues, will also affect their intention to adopt the technology.

We distinguish between the interactions initiated by teachers and directed to students, interactions initiated by students and directed to teachers, and interactions between teachers themselves, as three distinct forms of communication that occur in an educational

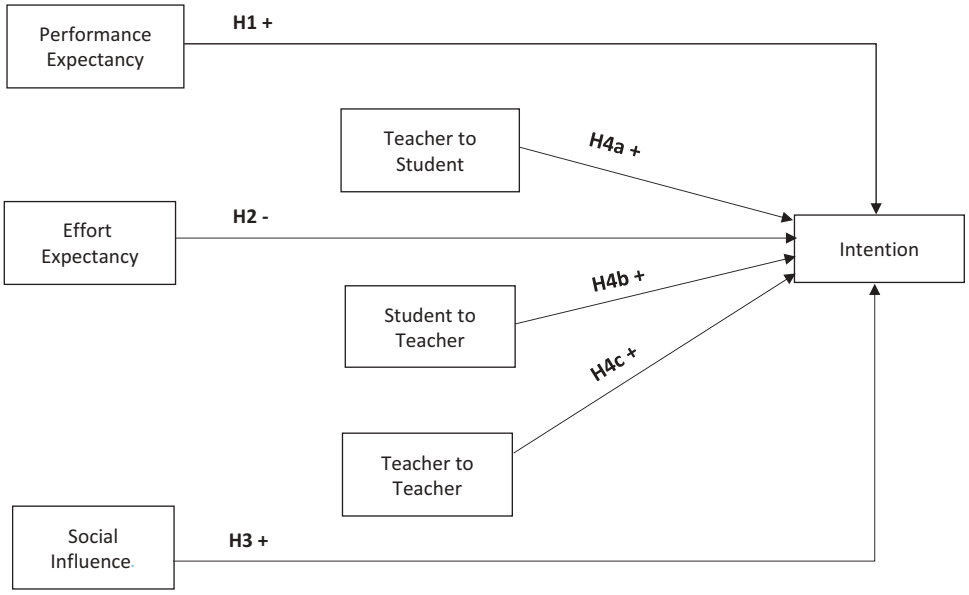

FIGURE 1. Research Model

community. One factor in successful implementation of technology in the classroom is user acceptance [25] and we propose that teachers are more likely to adopt tablet technology for classroom and professional use, because they perceive the adoption of this technology as a means of enhancing these knowledge-sharing interactions. Therefore, we hypothesize the following relationships:

H4a: Knowledge-Sharing Perceptions (Teacher-to-Student) is positively associated with intention to use tablet technology.

H4b: Knowledge-Sharing Perceptions (Student-to-Teacher) is positively associated with intention to use tablet technology.

H4c: Knowledge-Sharing Perceptions (Teacher-to-Teacher) is positively associated with intention to use tablet technology.

SAMPLE AND METHODOLOGY

Data Collection Procedures and Sample

Data were obtained from a sample of 500 primary and secondary school teachers from 20 primary and secondary schools located in central Israel, all of which had implemented the use of smart school website technologies. Before distributing the survey, we obtained approval from the Ministry of Education, as well as from the principal at each school. A total of 247 usable responses were received, yielding a response rate of 49.8%.

The tablet technology under consideration for adoption was the iPad. The participants ranged in age from 21–30 (18.9%), 31-40 (27.7%), 41–50 (32.1%), and 1% over 51. In terms of internet use, 20.9.% of the teachers reported that they used the Internet less than 4 hours a week, 23.7% between 4 and 5 hours a week, 24.1% between 6 and 8 hours a week, 11.2% between 9 and 10 hours a week, and 20.1% reported using the Internet more than 10 hours a week. In the sample, 65% of the teachers had a Bachelor's degree, and 35% a Master's degree or higher. Students taught by the participants ranged in age from 6 years (in primary school) to 18 years (in high school). The teachers reported using the iPad for a number of website tasks: 41.8% sent announcements to the school website, 40.6% sent pictures, 5.2% updated contact details, 9.2% uploaded materials, 2.4% added a link to a site, and 0.8% updated the structure of a site, such as adding a group or category to a website.

Measures

Performance Expectancy, Effort Expectancy, and Social Influence were measured with the [47] UTAUT scales, each measured by multiple five-point Likert items, adapted to fit the context of this study. Knowledge-sharing was assessed using the ESECI scale [21]. Within the original scale, measures existed for two different types of interaction and relationships between students and teachers: (1) teacher to student (i.e., how teachers interact with and relate to students), and (2) student to teacher (i.e., how students interact with and relate to teachers) [5, 22, 23, 41]. The original scale included 38 items which assessed collaboration in an elementary school according to five criteria: respect for autonomy, non-malfeasance, beneficence, justice, and fidelity.

The scale was reviewed by a panel of experts comprising 11 reviewers who are academic subject matter experts, including 4 education officials with national teacher training responsibilities, 2 representatives from the ministry of education, and 3 professors of education. Panelists guided us to include only three items for each type of interaction, to reflect teacher's perceptions of their ability, performance, and motivation to collaborate through knowledge-sharing. A pilot study was conducted using 36 teachers from 36 schools spread over the country.

To assess the fit between the teachers' tasks and knowledge-sharing, we drew on Task-Technology Fit theory [15], which ascribes key importance to the perceived fit between the task that needs to be completed by the information system, and the success of information system implementation. More specifically, for the teacher–student relationship, we focused on relationships in which teachers share knowledge to (a) help students improve their study habits, (b) make students feel safe during the learning process, and (c) encourage cooperation among students. In regard to student–teacher relationships, we included items related to sharing knowledge in the context of the perception of learning environments, cooperation with teachers, and enjoyment of learning from teachers. Furthermore, a third dimension of knowledge-sharing termed "representing knowledge-sharing between teachers" was included, as suggested by [50]. This dimension distinguished between explicit and tacit knowledge-sharing. The scale examined the sharing of formal knowledge, including general teaching material, and also material designed by the teachers themselves. This scale also focused on tacit knowledge captured by items related to knowledge-sharing between teachers based on their experience, practical engagements, and expertise.

Data Analysis Procedures

The data were analyzed using SPSS 20 for the descriptive statistics and the Mplus version 6 [37] for the SEM model, due to its ability to analyze relationships between latent and observed variables [42]. To obtain reliable results in SEM, a sample size of >200 cases is recommended [9]. Our data exceed this recommendation and therefore the results can be relied upon.

RESULTS

Measurement Model Validation

Reliability was assessed with both Cronbach's alpha (included in Table 1) and the composite reliability statistic [14] (included in Table 2). In both cases, all constructs had a reliability as indicated by a Cronbach's alpha greater than 0.70 cutoff value [39]. Convergent validity was also assessed by calculating the Average Variance Extracted (AVE), which represents the average explained variance in the items due to the construct they represent. Results shown in Table 1 indicate that the AVE for all constructs was greater than the 0.50 guideline [14].

Next, the discriminant validity of the constructs was assessed. Table 1 shows, in the leading diagonal, the square root of the AVE for all constructs in the research model, which were in all cases larger than the inter-construct correlations. These results indicate that the constructs employed exhibit appropriate reliability as well as discriminant and convergent validity [7, 14], and hence the measurement model is of sufficient quality to proceed with the testing of the research model, as shown in Figure 1. In addition, we examined the loadings of each item on its construct, reported in Table 2. All loadings were significant at $p < 0.01$ and above the commonly used threshold of 0.7 [39], with only two exceptions, which were nonetheless retained in the model, as the estimated loadings were significant.

Testing the Research Model

A structural model analysis which takes into consideration the goodness of fit and explanatory power of the entire model was conducted following recommendations by [41, 43]. The significance of parameter estimates was assessed by comparing the ratio of the estimate to its standard error to a *t*

TABLE 1. Inter-Construct Correlations, Cronbach's Alpha, and Average Variance Extracted

Construct	Cronbach's alpha	AVE	PE	EE	SI	INT	KS-TS	KS-ST	KS-TT
Performance Expectancy (PE)	0.899	0.724	**0.851**						
Effort Expectancy (EE)	0.939	0.801	0.480**	**0.895**					
Social Influence (SI)	0.796	0.606	0.427**	0.143*	**0.778**				
Intention to Use the Technology (INT)	0.914	0.802	0.525**	0.400**	0.348**	**0.896**			
Knowledge-Sharing—Teacher to Student (KS-TS)	0.913	0.784	0.266**	0.064	0.347**	0.416**	**0.886**		
Knowledge-Sharing—Student to Teacher (KS-ST)	0.941	0.843	0.300**	0.012	0.319**	0.295**	0.769**	**0.918**	
Knowledge-Sharing—Teacher to Teacher (KS-TT)	0.943	0.756	0.199**	0.202**	0.139*	0.366**	0.489**	0.464**	**0.870**

Notes: AVE = Average Variance Extracted. Square root of AVE in the diagonal and bold. *$p < 0.05$, **$p < 0.01$.

distribution. The ratio of the chi-square to its degrees of freedom was 1.78 (should be <3), the Comparative Fit Index (CFI) was 0.968 (recommended values ≥0.9), and the Root Mean Square of Approximation (RMSEA) was 0.056 (recommended values >0.08). Based on these, we conclude that our model shows more than adequate fit to the data (Figure 2)

Table 3 provides a summary of all hypotheses tested in our research.

DISCUSSION, LIMITATIONS, AND CONTRIBUTION

Discussion

A cause and effect relationship is largely demonstrated between the predictor variables and the outcome (intention to adopt tablet technology). Statistical analysis displayed in Tables 1 and 2 show evidence of adequate internal consistency, meaning that the items in our scale did actually measure what they were meant to measure. For example, items 4 and 17 did not load significantly on their intended factors and were therefore deleted [38].

In view of these analyses that indicate adequate model validity and item reliability, the study has adequately and accurately measured what is intended and that the outcomes being observed are truly a function of experimental manipulation of the independent variables [19]; hence our inferences discussed here are validated.

The main goal of this research was to examine the relative importance of various factors in influencing teachers' intention to adopt tablet technologies—more specifically, iPads—for use in primary and secondary school classrooms, for interacting with the smart school website technology. Given that adoption by teachers is a necessary condition for integrating technology into the classroom [18], it is important not only to understand which factors influence that decision, but also their relative importance as determinants in order to foster the adoption of this technology, as well as to appreciate the expected consequences arising from its use. In particular, we viewed teachers' perceptions of knowledge-sharing interaction with students and other teachers as important determinants of the intention to adopt the technologies.

A summary of our hypotheses test results is provided in Table 3. These results show that in this setting and technology, expectations about performance improvement to be derived from its adoption (H1), as well as expected improvements in teacher-to-student knowledge-sharing interactions (H4a), are the most important drivers of adoption. Of similar but relatively less importance are expectations about the amount of effort involved in adopting and using tablet technology (H2) and the expected improvements in teacher-to-teacher knowledge-sharing interactions (H4c) that would be facilitated by the adoption of the technology.

In this research context, neither social influence (H3), which captures perceptions about what others who are important to the respondent believe she should, nor changes in student-to-teacher knowledge-sharing interactions (H4b), were significant predictors of intention to adopt.

While we can only speculate on the reasons underlying the lack of significant relationships for these two constructs, it is noteworthy that the path coefficient for student-to-teacher interactions was negative, and close to being significant. This may be indicative of reservations on the part of teachers about how the adoption of tablets in the classroom may negatively impact student-initiated interactions toward them. It might also be that teachers could not adequately address students' perception of the student–teacher interaction because they were not the initiators. Extant research indicates that students' attitude influences technology acceptance [34,8]. At the same time the teachers could have been comparing their assessment of student–teacher interaction to teacher–student relation which the teachers initiate. An empirical study would be necessary to elucidate the plausible cause of the unexpected relationship. To the extent that this is the case, more careful examination of these issues appears to be a worthwhile area for future research.

Limitations

This study is not without limitations. The effect of contextual factors such as school policies can vary at different educational levels. Hence, these results may have limited generalizability. In addition, this study assumed the independence of individuals in their computer behaviors, whereas teachers are probably influenced not only by individual factors, but also by factors that are related to the school where they work, such as policy planning, infrastructure, and leadership. On the other hand, individual resistance to technology adoption has been shown to be an important issue in these endeavors [35, 28], which indicates that users retain some degree of leeway in their behavior, even when adoption is, at first sight, mandated.

The researchers acknowledge that multilevel analysis is a powerful technique to analyze factors that are subject to different levels of effects, both at the individual level and the organizational (school) level [26, 24, 43]. Future research could analyze both the impact of individual determinants and school-level factors on teachers' professional usage of iPads. Further, it is important to examine this model at different times during the same school year, to assess improvement and the dynamic processes of iPad adoption in the school. This can be done in schools that are starting to implement iPad technology.

All constructs employed in this research were measured with items captured by means of surveys obtained from primary and secondary school teachers, raising concerns about common

TABLE 2. Confirmatory Factor Analysis Results

Scale items	Mean	Std. dev.	Std. loading	Std. error
Performance Expectancy (CR = 0.802, AVE = 0.724)				
I would find the iPad useful in my job	4.17	1.026	0.698	*
Using the iPad would enable me to accomplish tasks more quickly	4.13	1.097	0.880	0.086
Using the iPad would increase my productivity	4.06	1.118	0.954	0.123
Effort Expectancy (CR = 0.942, AVE = 0.801)				
My interaction with the iPad seems clear and understandable	4.12	1.013	0.845	*
It would be easy for me to become skillful at using the iPad	4.02	1.122	0.851	0.064
I would find the iPad easy to use	4.08	1.075	0.950	0.055
Learning to operate the iPad would be easy for me	4.10	1.087	0.930	0.057
Social Influence (CR = 0.817, AVE = 0.606)				
People who influence my behavior think that I should use the iPad	3.51	1.242	0.567	0.085
People who are important to me think that I should use the iPad	3.98	1.104	0.838	*
The senior management of this school has been helpful in the use of the iPad	3.99	1.099	0.891	0.083
Knowledge-Sharing Teacher to Student (CR = 0.916, AVE = 0.784)				
Teachers help students improve their study habits.	3.60	1.315	0.827	*
Teachers make students feel safe on the site.	3.56	1.280	0.925	0.083
Teachers encourage cooperation among students using the site.	3.64	1.320	0.902	0.082
Knowledge-Sharing Student to Teacher (CR = 0.942, AVE = 0.844)				
Students enjoy learning from the site	3.73	1.238	0.877	*
Students cooperate with their teachers through the site	3.78	1.221	0.951	0.046
Students pay more attention to activities on the site	3.68	1.268	0.925	0.049
Knowledge-Sharing Teacher to Teacher (CR = 0.939, AVE = 0.756)				
I associate documents and books with school teams on the site.	3.35	1.356	0.780	*
I provide materials and instructions to run the school through the website	3.26	1.349	0.828	0.053
I associate my experience with school teams on the site	3.21	1.362	0.886	0.072
I provide knowledge to all those who request it through the site	3.26	1.398	0.899	0.073
I try to benefit from the expertise that the school staff has acquired through the website	3.28	1.382	0.946	0.072
Intention to Use the School Website (CR = 0.923, AVE = 0.802)				
I intend to use the iPad on the school website to update e-learning material in the near future	3.60	1.315	0.738	*
I predict that I will use the iPad on the school website to update e-learning material in the near future	3.56	1.280	0.984	0.083
I plan to use the iPad on the school web site to update e-learning material in the near future	3.64	1.320	0.945	0.082

Note: AVE = average variance explained, CR = composite reliability, all loadings significant at $p < 0.01$, *loading fixed at one for identification purposes.

method variance affecting the relationships tested in this research. This is a common concern in survey-based research, and shared with many other technology adoption studies that have employed similar methodologies. We assessed the magnitude of common method variance (CMV) by performing the Harman's one factor test [40], which did not result in one single factor emerging as dominant or accounting for the majority of the variance (the first factor emerging from the analysis accounted for only 35% of the overall variance in the measures). This is an indication that there was no significant CMV among the reflective scales.

Contribution and Future Research Directions

Despite its limitations, the current study contributes to the literature on technology adoption in different ways. Different constructs impacted intentions toward using tablets, such as teachers' frequent needs to update materials on school websites. Further refinement of the constructs drawn from the Unified Theory of Acceptance and Usage of Technology Model (UTAUT) should be explored in future research from the students' point of view in order to determine directions that need to be developed on school websites for higher quality interactions. In this research, we consider adoption of tablets from the perspective of teachers, whose perception of the technology and the educational and instructional benefits that could arise from its use in the classroom is a major determinant of the extent to which the technology will be deployed. However, once technology has crossed this threshold, successful classroom adoption cannot occur without the engagement of students. Therefore, a better understanding of this adoption process requires an examination of the student perspective as well, like in [8]. A natural extension of, and complement to, this research would be to investigate the factors that drive students to accept and adopt tablet technologies for educational purposes.

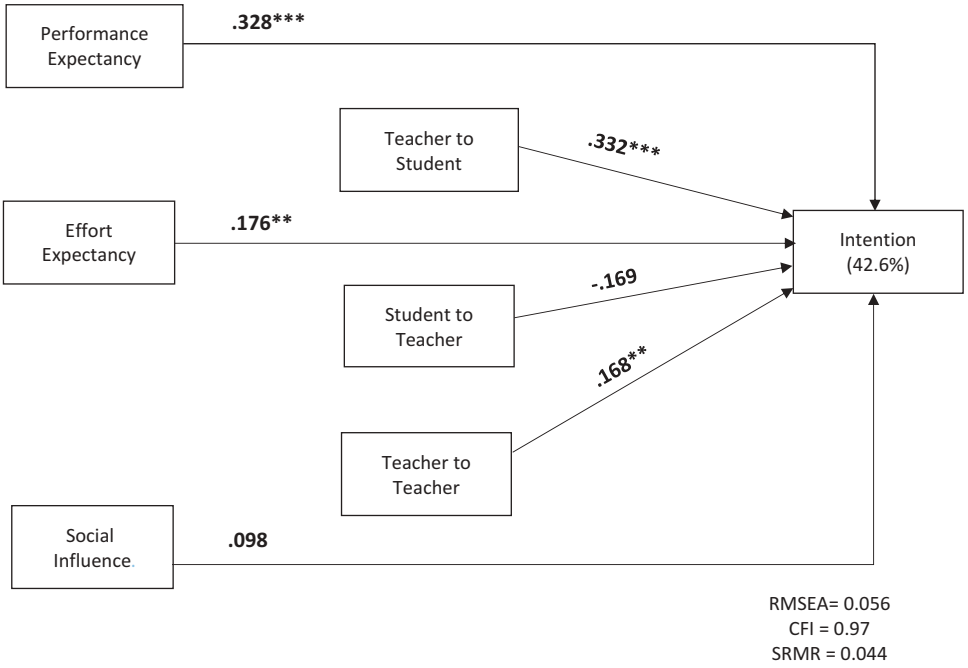

FIGURE 2. Results from SEM Analysis

Note: All paths standardized, explained variance within parentheses where appropriate; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

TABLE 3. Hypotheses Testing Summary

H#	Hypothesis	Testing	Support
1	Performance Expectancy will positively affect Intention to use tablet technology	β = 0.328, $p < 0.001$	Supported
2	Effort Expectancy will negatively affect Intention to use tablet technology	β = 0.176, $p < 0.01$	Supported
3	Social Influence will positively affect Intention to use tablet technology	β = 0.098, p = ns	Not supported
4 (a)	Teacher-to-Student knowledge-sharing will positively affect Intention to use tablet technology	β = 0.176, $p < 0.01$	Supported
4 (b)	Student-to-Teacher knowledge-sharing will positively affect Intention to use tablet technology	β = –0.169, p = ns	Not supported
4 (c)	Teacher-to-Teacher knowledge-sharing will positively affect Intention to use tablet technology	β = 0.168, $p < 0.01$	Supported

Student are the consumers of services provided by teachers. As such, the effects of student-to-student sharing on teachers' intentions to adopt new technology should be explored. The current generation and maybe future generations of students are technology savvy and are bound to use different technologies in diverse contexts. Because they might engage in discussion comparing these contexts, future research should assess the impact of such students-to-student sharing on technology adoption.

Furthermore, because tablet technology is spreading rapidly, it is of interest to include facilitating conditions or the belief that the school system and the technological infrastructure support knowledge-sharing and intention to use school websites. For large school systems, the adoption of a tablet technology can easily range over hundreds of devices that need to be supported and managed.

From an educational and governmental point of view, the results of this study highlight the potential contribution of iPad technology to the specific context of the educational system in Israel. Recently, a decision was made to implement the use of tablets in several schools in Israel; hence future research will be able to conduct longitudinal studies, which are important for the generalizability of the findings and any inferences of causality that may be drawn from them.

In conclusion, this study found that the UTAUT model of technology acceptance, augmented with context-specific constructs such as knowledge-sharing interactions between teachers and students, is a useful tool for analyzing and understanding the acceptance of educational mobile technologies. This research model provides a framework for analyzing the focal phenomenon, and will enable greater improvements in the adoption and use of this emerging technology.

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