Teachers' Technology Acceptance in a One-to-One Tablet PC Integration Across Cities: Three-year surveys

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Abstract: In this research, the authors clarified how school teachers have been using tablet PCs (TPC) with students across the region for over three years. The authors have continued the investigation of Terashima *et al* (2016), which was carried out for one year, for the next two years. The following data was analyzed: 1) changes in impressions about TPC use 2) the characteristics of both user and non-user groups from 87 elementary school teachers. As a result, 1) usage situation and class image improved. The time sensation also improved in the long term, but the anxiety related to troubles with TPCs did not improve. 2) Although there were no differences in teachers' beliefs between the user and the non-user groups, the user group thinks about the possibility of using ICT and student's individualization.

Keywords: Tablet PC, One-to-one Computing, Technology Integration, Technology Acceptance

INTRODUCTION

Information and communication technology (ICT) is widely recognized as important for, and a powerful tool to change, teaching and learning (Valtonen *et al*, 2015). Many ICT facilities like interactive white boards were integrated into education and many teachers challenge the practices (Tosunta *et al*, 2015; Holmes, 2009).

The implementation of one-to-one computing—with a tablet PC (TPC) for each pupil—is currently being promoted by the Japanese government (MEXT 2016), as it is in countries all over the world (Vrasidas 2014; Reichert 2018). Practical research conducted in pilot schools has shown that one-to-one computing is effective for improving pupils' academic achievement. In Japan, the Learning Innovation Project with ICT reported effectiveness in pilot school trials (MEXT 2014). After this project, many local governments tried to integrate tablet PCs, but progress was hindered due to budget problems; the trials depend on each city's budget. Few cities have installed tablet PCs for pupils. Educators must think about future plans based on these city trials.

Under such circumstances, Terashima *et al*.(2016) investigated a technological integration that advanced the introduction of each tablet PC by each student. As a result, the use of TPC was improved in one year, and the impression on it did not improve or worsen. Research on technology integration is sometimes not clarified by short-term studies, and follow-up surveys are necessary.

In this research, the authors investigated the studies of Terashima *et al*.(2016) thoroughly over a year and analyzed 1) changes in impressions about using TPCs and 2) comparison between the characteristics of users of TPCs and those of non-users, in the case of elementary school teachers. By doing this, it is possible to obtain basic materials about how the teacher actually uses TPC and how it can be introduced in many areas and used for reference.

LITERATURE REVIEW

Although information communication technology is considered as indispensable by teachers for education and learning, several studies have revealed that there are not many teachers trying to utilize ICT in teaching activities (Ertmer 1999, 2005; Ertmer *et al* 2010; Ottenbreit-leftwich *et al* 2015; Sang *et al* 2010; Vanderlinde *et al* 2010).

As ICT became widespread, the concept of TPACK was discussed with regard to the knowledge required for teachers. TPACK attempts to identify the nature of knowledge required of teachers for integrating technology in their teaching practices, while addressing the complex, multifaceted, and situated nature of teacher knowledge (Mishra & Koehler 2006; Koehler & Mishra 2008; Voogt *et al*

2013). This concept is enhanced by Pedagogical Content Knowledge (Shulman 1987). Many recent studies have focused on TPACK, especially in the U.S. Terashima (2011) reviewed 65 peer review studies on TPACK and found three types: studies that (1) identify the factors of TPACK for the purpose of its evaluation (Schmidt 2009), (2) propose a design for teaching TPACK to teachers and pre-service students (Jang et al, 2010), and (3) develop a technology integration model using TPACK.

Some studies have provided models of TPACK use for when teachers and students use ICT in schools. For example, Guerrero (2010) developed work lists for mathematics teaching. In the Japanese research context, many researchers have introduced typical learning designs using ICT; however, these methods are focused on general teaching, not on specific subjects.

Research on teachers' ICT acceptance is proceeded. Several technology acceptance models (TAM) show how teachers accept ICT. The Unified Theory of Acceptance and Use of Technology (UTAUT) was developed (Venkatesh *et al*., 2003) based on a TAM developed and improved by Venkatesh and his fellow researchers (Venkatesh, V., & Davis, F. D., 2000; Venkatesh, V., & Balal, 2008).

METHODLOGY

Research questions

1. How has the one-to-one use of TPC been incorporated in three years?

2. Has the teacher's impression on tablet usage changed? This question focuses on and analyzes three issues (lesson creation, anxiety about time, anxiety due to equipment troubles) raised by Terashima (2016).

3. What kind of characteristics does the teacher using TPC have in comparison to the teacher who does not use it?

Research Context

Teachers from 13 elementary schools and five junior high schools in City A were surveyed (population: about 37,000 people). Windows OS tablet PCs had been introduced for each student in this city at the end of 2014. Note that there was a training operation for the teacher before the survey. However, training simulating the use of tablet PCs, was not a common practice for lesson studies in each school.

The survey was conducted four times. The first survey began at the same time as the new fiscal and teaching year and took place over half a month, from mid-May to early June 2015, which seems to be familiar to some extent. The survey was conducted via Web site; respondents entered their data during the specified period of time. The same survey was conducted Februarys, 2016, 2017,2018.

Research data and analysis

Data for both surveys were collected and compared.

1. Possible responses regarding tablet PC usage were "almost every day," "about one to three times a month," "about one to three times a week," and "do not use"; they were measured on a 4-point Likert scale.

2. Regarding anxiety about TPCs, we conducted a questionnaire survey that addressed the image of using in TPCs in the classes (three items), the time of use of TPCs (two items), and the anxiety related to troubles with TPCs (three items).

3. Among the four surveys, responses from 87 elementary school teachers who responded in the third survey were extracted. The third survey of elementary school teachers was targeted for the fact that the number of respondents was the largest in the second to fourth surveys, that the number of respondents was the largest among the groups ("almost every day," "about one to three times a month." There were no unilateral differences in statistical comparison between 39 people and 48 unused groups ("about one to three times a week," and "do not use") .

In the survey, we asked questions about 1) belief in the class, 2) expectation of the students' ability in dairy lessons, 3) possibility of using ICT in lessons. With regard to the conviction concerning class, using Benesse's work (2014), we presented the ideas (A, B) for the two conflicting classes over nine items and chose which way of thinking is close to the six likert-scale. Regarding the conscious expectation in the lessons, 12 items were defined using the same 12 items of the survey (Benesse 2014) that used the 21st century skills emphasized in the world to date. Regarding the possibility of using ICT in lessons, the 15 items of Benesse (2014) were presented over multiple choices comprising the expected responses.

RESULTS

Frequency of tablet PC usage

The frequency of TPC usage by teachers improved in the first year (Terashima, 2016), but there was not much improvement after that (Table. 1). For the whole data, the improvement was significant (t= 3.80, df = 311, p <0.01) after the first year (comparison between the first and second surveys). However, when we look at the data as a whole after that, we can see that it is constant after the second year. Compared to junior high school, elementary school has a higher utilization rate. However, there was an improvement in the second year in elementary school, while in junior high school there were no changes.

Table 1. How to make students use tablet PCs? (4-point Likert scale).

	2015.6	2016.2	2017.2	2018.2
Whole	1.72	2.05	2.09	2.09
Elementary	1.97	2.35	2.47	2.38
Junior High	1.33	1.55	1.56	1.43

Teachers' assessment of TPC use

Evaluation on the use of TPC showed improvements every year over the three years, although there was a little improvement in the first year.

Regarding concerns about teaching using TPCs (Table 2), there was improvement in all the years. Improvements were verified over a year (comparison of the first with the second survey). For example, items "I cannot imagine making the students use a tablet PC in class" and "I do not understand the class design to make the students use tablet PCs" (t = 3.80, df = 311, p <0.01) (Terashima, *et al* 2016). These was improvement even after two surveys and the anxiety decreased. Although these improvements are explained in Terashima *et al* (2016), it can be said that they occurred because several training programs were enhanced, continued, and established.

As for the time of use of TPCs, we found that there would be a slight improvement over the long term. Initially, there were no improvement during the first year (Terashima *et al* 2016). However, it was found that anxiety decreased from the second to the third year (Table 2). While using this, it can be said that teachers and students have gotten used to each other, judgment that part of utilization of TPC in learning time is partly started, and so on.

Regarding anxiety related to troubles with TPCs, there were no improvements during the three-year survey. According to the results, things became worse in the first year (Terashima *et al* 2016). In this regard, there were no further changes after that (Table 2). If children use TPCs simultaneously, the greater the number of people, the greater the possibility of problems. In addition, the more the number of years since the introduction, the more obsolete the equipment becomes. Through investigations, it has become clear that certain problems are inevitable.

Table 2. Teachers' Concerns about using Tablet PCs (4-point Likert scale).

	Image of the Class Design			Out of Order			Time	
	I cannot imagine making the students use a tablet PC in class.	I do not understand the class design to make the students use tablet PCs.	I do not understand how one-to-one tablet PC learning increases students' academic achievement.	The tablet PCs for students froze.	The tablet PC(s) for students ran out of battery.	When the tablet terminal for students is causing problems, there is a possibility that class cannot proceed.	It takes a long time to use a tablet PC in class.	It takes a long time to prepare to use a tablet PC in class.
2015.4	2.83	2.94	2.88	3.09	2.84	3.36	3.07	3.22
2016.2	2.43	2.60	2.70	3.30	3.01	3.40	3.08	3.22
2017.2	2.41	2.50	2.53	3.32	3.04	3.44	2.96	3.17
2018.2	2.30	2.38	2.41	3.23	3.00	3.34	2.86	2.98

Characteristics possessed by a teacher utilizing TPC

When comparing the data on teacher's belief in both TPC user and non-user groups, there was not much difference in beliefs but there was a difference in the ability to nurture regular education regarding what they expect for ICT utilization.

For both users and non-users of TPCs, there was not much difference in relation to teacher's belief (Table 3). The median value was 3.5 and there was nothing close to B's opinion in both user and non-user groups. Of the nine items, only two showed

significant differences or trends. Items that presented differences are better for the TPC user group than for the non-user group “Build academic skills from the weak subjects and areas” and “Support children to learn voluntarily on their own.” It presented a slight close result. For these reasons, there was a tendency for teachers in the user group to focus somewhat on children’s goodness and spontaneity, although they did not show a different tendency from the non-user group.

From the point of view of the power that the teacher seeks to give the child through usual education, the TPC user group revealed to be more conscious about the development of this force in more points than the non-user group (Table 4). Regarding the ability to utilize ICT equipment, some abilities are expected, such as problem-solving, creating new ideas, communicating with friends, conveying opinion, and being active. On the other hand, there was no difference between the two groups regarding the basic knowledge and skills acquisition, thinking ability, and

Table 3. Teachers' Beliefs of Education

	Near to 1	Near to 6	User (N=39)	SD	Non User (N=48)	SD	F-Score	
1	Handle the content from textbooks and instructional guidelines to the end in any way	Even if you can not finish everything, have a basic idea	2.33	1.27	2.23	1.19	0.15	
2	Build academic skills from weak subjects and areas	Increase academic ability of subjects and areas of specialty	3.18	1.22	2.69	0.85	4.81	*
3	Fair evaluation of children using objective standards	Even though it is intuitive, evaluating it with emphasiemphasizes on the children's individuality of children	2.49	1.08	2.65	1.03	0.48	
4	Encourage all children to develop as much academic ability as possible	For children who are not good at studying, providedoing another extension	2.36	1.19	2.40	0.93	0.03	
5	To support the flowering of children's possibilities of children	Teaching and training what you needis needed to become an adult	3.41	1.45	3.46	1.02	0.03	
6	Become a master by training children to read or write	Learn intuitively and easily using images (charts) and images	3.10	1.24	3.35	1.16	0.93	
7	Even though it takes time, provide classes that where children can learn from experience	In class, share as much knowledge as possible more efficiently	2.74	1.06	2.85	1.00	0.24	
8	Support children to learn voluntarily on their own	Teach basic knowledge and skills to children even if they are compelled	2.72	1.24	3.23	1.16	3.84	+
9	Children learn from each other	Teach knowledge and skills properly	2.77	1.23	3.13	0.86	2.46	

Table 4. Teachers' Usual Action in Education

		User (N=39)	*SD*	Non User (N=48)	*SD*	F-Score	
1	Learning basic knowledge / skills	3.64	0.53	3.58	0.61	0.21	
2	Fostering the ability to utilize ICT equipment	3.18	0.59	2.56	0.61	22.06	**
3	Fostering the ability to discover tasks	3.00	0.60	2.71	0.76	3.71	*
4	Fostering the ability to solve problems	3.28	0.64	2.92	0.70	6.17	*
5	Fostering the ability to select necessary information	2.97	0.62	2.71	0.79	2.88	+
6	Training the ability to think logically	2.85	0.70	2.73	0.70	0.59	
7	Training the ability to judge based on grounds	3.05	0.71	2.83	0.77	1.79	
8	Fostering the ability to create new ideas	2.87	0.65	2.54	0.68	5.21	*
9	Fostering the ability to recall yourselfon your own	3.36	0.70	3.27	0.78	0.29	
10	Fostering the ability to act activelybe more active	3.23	0.62	2.98	0.69	3.05	+
11	Fostering the ability to convey your opinion	3.49	0.67	3.23	0.71	2.88	+
12	Fostering the ability to collaborate with friends	3.46	0.55	3.13	0.73	5.61	*
13	Fostering the ability to be interested in Society	3.13	0.69	2.73	0.67	7.31	**

Table 5. Teachers' Expectation of ICT Use in Education

		User (N=39)	*Rate*	Non User (N=48)	*Rate*	x2(1)	Chi-squared residuals	
1	Child"s interest and motivation to learnning increases	38	97.4%	45	93.8%	0.091		
2	Child"s understanding deepens	24	61.5%	26	54.2%	0.024		
3	Increase children's concentration of children	14	35.9%	17	35.4%	0.019		
4	Children"s own awareness and discovery increases	11	28.2%	13	27.1%	0.016		
5	Increase your ability to utilize knowledge	10	25.6%	4	8.3%	3.578	2.185	*
6	Time to acquire knowledge can be shortened	12	30.8%	11	22.9%	0.338		
7	The opportunity for children to think in class increases	10	25.6%	5	10.4%	2.51		
8	The opportunity for children to present in lessons increases	14	35.9%	9	18.8%	2.431		
9	Opportunities to share opinions and discuss in classes will increase	12	30.8%	12	25.0%	0.128		
10	Childrens will actively speak	9	23.1%	4	8.3%	2.611		
11	Children will act be more actively from themselveson their own	8	20.5%	5	10.4%	1.023		
12	Learning oOpportunities for learning tailored to each individual"s abilities will increase	26	66.7%	21	43.8%	3.674	2.133	*
13	Children will be able to learn freely about their interests	18	46.2%	12	25.0%	3.377	2.064	*
14	Teaching and learning among children increases	9	23.1%	8	16.7%	0.229		
15	The students will acquire the ICT skills necessary for the society of the future	24	61.5%	19	39.6%	3.317	2.037	*

reflection ability. In many respects, the TPC user group was more conscious of the development of this power, although there were items that both groups emphasized.

Regarding the possibility of using ICT, many people, especially from the user group, expected that the use of ICT could increase the individualization of the child (Table 5). This will appear in the items "Children use their knowledge," "Learning opportunities tailored to each individual's abilities will increase," and "Children will be able to learn freely about their interests." There was also an expectation that it would be desirable to expand ICT skills using TPCs.

As a result, teachers' beliefs were similar, but it became clear that the user group is expecting the individualization of children's learning. It seemed that there were differences between attitudes regarding taking ICT to problem-based learning by the user group, expectation to learn through knowledge, and children's learning.

CONCLUSION

In this research, the authors clarified how school teachers use tablet PCs (TPCs) with students across the region for over three years.

As a result, it became clear that the use of TPC is improved. In addition, we can clarify at what stage it would improve by conducting long-term investigation.

Moreover, in this research, we also clarified what kinds of features teachers using TPC have in comparison with non-users. As a result, although teacher's belief does not change much, there is a tendency for the user group to have expectations about learning through individuality for both regular education and ICT-based learning.

The results of this research show which points should be studied simultaneously in the future for the advancement of technological integration research in Japan. There is a particular concern about the improvement of TPC environment and teacher training. For example, it is said that it is difficult to change teacher's belief in general in how to eliminate anxiety about environmental improvement based on these results. However, through training, it is said that the teacher It is a useful research in considering whether we need to be conscious of it.

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