

Technology Integration Changes over Three Years: Teacher Technology Acceptance in a One-to-One Tablet PC Integration Across Cities

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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 following data were analyzed: 1) changes in TPC use, 2) impressions of TPC use, and 3) the characteristics of both user and non-user groups. The following results were obtained: 1) the utilization rate of TPC improved in the beginning, but did not subsequently improve, 2) teachers' feelings of "usefulness" improved, but "ease of use" may take a longer time to show improvement, and 3) the user group had expectations about individualization of the student learning experience for both regular education and ICT-based learning.

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

Introduction

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

The implementation of one-to-one computing—with a tablet PC (TPC) for each pupil—is currently being promoted by the Japanese government (Ministry of Education, Culture, Sports, Science and Technology [MEXT], 2014), as it is in countries all over the world (Vrasidas, 2014; Reichert & Mouza, 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 TPCs, but progress was hindered due to budget problems; the trials depend on each city's budget. Few cities have installed TPCs for pupils. Educators must think about future plans based on these city trials.

The subject of research in ICT integration is not a survey targeting a small number of individual teachers. In some countries such as Japan, it is better to target teachers working in the local government. Although the introduction of ICT is recommended, financial problems are affecting the spread of ICT use in Japanese schools. In Japan, there is a belief that the learning environment of each school should be the same. However, it is difficult to establish an environment that makes full use of the facilities of each school, and the budget that a school's management can utilize is limited. The local government has a budget for disseminating ICT. However, the educational committee of each city has to make the learning environments of all the schools in that area equivalent. It is therefore difficult to integrate many ICT facilities at once. From this, it is desirable to investigate the ICT use for the local government.

Under such circumstances, it is important to analyze how technology is used at each school and what impression the

teacher has when ICT is integrated into a local government simultaneously. It is the students who use technology in one-to-one computing, but it is up to the teacher to decide whether to employ these technologies in school. Therefore, it is important to consider how teachers accept classroom technology.

It takes a long time for teachers to accept and use TPCs in the classroom. Although many studies have reported on the possibility of using TPCs and their subsequent technology acceptance (Falloon, 2015; Haßler, Major, & Hennessy, 2016), it is difficult to practice effectively if teachers possess only fragmented knowledge, or if teachers are confused. Kopcha (2012) attempts to clarify how to overcome the barriers of utilization for 18 teachers, but also states that it will take time, and that long-term follow-up is necessary.

In this study, a three-year follow-up survey was conducted to determine how all of the teachers in the study from a certain city will receive and accept TPCs in their classrooms. In the past, research had only been conducted on how teachers accept the use of TPCs over a short period (Terashima, Nakagawa, & Murai, 2016). Terashima, et al. (2016) investigated a technological integration that advanced the introduction of each TPC 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. A questionnaire was administered twice (one and a half months after the start of a new semester and then nine months after the first survey) to 195 teachers. The teachers represented thirteen elementary schools and five lower secondary schools in City A, where TPCs had been issued to all Grade 1-9 students. The survey results revealed that it is difficult for teachers to use ICT with children, which is a primary feature of one-to-one computing, and that while TPC use is an advanced teaching technique, teachers still feel a great deal of resistance to using TPCs. It is necessary to clarify how teachers were integrating technology by studying its long term classroom use, and tracking what happened after that.

In addition to the previous survey (Terashima et al., 2016), in this study, the authors want to discuss how to advance technology acceptance by teachers. Based on prior survey data, it is expected that there will be teachers who use TPCs continuously, and teachers who do not. In this study, we analyze each variable to identify what attitudes or decision-making determines whether a teacher will choose to utilize a TPC in the classroom or not.

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 ICT 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, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Ottenbreit-leftwich, Ertmer, & Tondeur, 2015; Sang, Valcke, Braak, & Tondeur, 2010; Vanderlinde, & Braak, 2010).

In order to accept a new classroom technology, it is necessary for a teacher to have knowledge and a positive attitude toward the new technical tool. There are various barriers to using technology (Ertmer, 1999), and it is necessary for teachers to take time to acquire knowledge about each technical tool. But before that, unless the teacher who uses the technology as a good attitude toward it, they generally will not begin or continue to use it in the classroom. Therefore, it is important to identify how teachers accept technology.

It is important to have knowledge of TPACK (Technological Pedagogical Content Knowledge) in order to utilize technology (Figure 1) (Mishra & Koehler, 2006). Some studies have provided models of TPACK use for when teachers and students use ICT in schools. 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, Fisser, Roblin, Tondeur, & Braak, 2013). This concept is enhanced by Pedagogical Content Knowledge (Shulman, 1987).

In this model, there are three main components of knowledge—content, pedagogy, and technology. As shown in Figure 1, not only the knowledge of each component, but also the importance of the knowledge of the complex area is claimed. 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, Baran, Thompson, Mishra, Koehler, & Shin, 2009), 2) propose a design for teaching TPACK to teachers and pre-service students (Jang & Chen, 2010), and 3) develop a technology integration model using TPACK. 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.

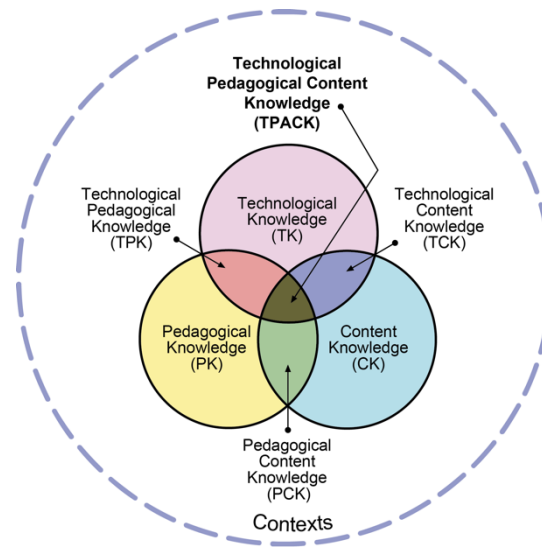


Figure 1. Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006)
(<http://www.tpack.org/>)

It is important for teachers to accept technology before they gain knowledge. The Technology Acceptance Model (TAM) is a theory of how to obtain teacher acceptance (Davis, Bagozzi, & Warshaw, 1989). TAM is specifically tailored for modeling users' acceptance of information systems or technologies (Lai, 2017). TAM explains the general determinants of computer acceptance that lead to user behaviors across a broad range of end-user computing technologies and user populations (Davis, 1989; Lai, 2017). The basic TAM model included and tested two specific beliefs: Perceived Usefulness (PU) and Perceived Ease of Use (PEU) (See Figure 2.). "Perceived Usefulness" is defined as the subjective likelihood that a potential user will use a certain system, or that they will improve their action (Davis, 1989; Lai, 2017). "Perceived Ease of Use" refers to the degree to which a potential user expects the target system to be effortless (Davis, 1989; Lai, 2017).

The basic theory of TAM has not entirely changed but has evolved through several models. The Unified Theory of Acceptance and Use of Technology (UTAUT) was developed (Venkatesh, Morris, Davis, & Davis, 2003) based on a TAM developed and improved by Venkatesh and his fellow researchers (Venkatesh & Davis, 2000; Venkatesh & Balal, 2008). UTAUT identifies four key factors (performance expectancy, effort expectancy, social influence, and facilitating conditions) and four moderating factors (age, gender, experience, and voluntariness) that are related to predicting behavioral intention to use a technology, as well as actual technology use, primarily within an organizational context (Venkatesh, Thong, & Xu, 2016). According to UTAUT, performance expectancy, effort expectancy, and social influence were theorized and found to influence behavioral intention to use a technology, while behavioral intention and facilitating conditions determine technology use (Venkatesh et al., 2016).

TAM and UTAUT are models for human technology acceptance, but not models specifically designed for school education and teachers; however research in this area field is rapidly advancing. Deng & Tavares (2013) used TAM as an indicator in clarifying student participation factors in online discussions. Sang et al. (2010) sought to clarify how student teachers think about integrating technology into schools. Based on the findings of Sang, et al., a review paper examining the link between teachers' educational beliefs and their educational use of technology has also clarified that perspectives toward technology acceptance are also important (Tondeur, Braak, Ertmer, & Ottenbreit-Leftwich, 2017).

In this research, the authors examined the teacher technology acceptance of one-to-one computing by the students in the classroom, which is the attitude required before the acquisition of knowledge by the teacher, and investigated how this acceptance changed over a long-term period. Research on how to introduce technology in schools is important but limited (Ifenthaler & Schweinbenz, 2013; Karaca, Can, & Yildirim, 2013). Moreover, the existing research includes short-term surveys (e.g. Karaca et al., 2013); the long-term considerations have not been taken into account. Therefore, in this research, we decided to clarify the long-term tolerance of technology use among teachers, and also aimed to better clarify the characteristics of teachers who implement technology use successfully and consistently in their classrooms, based on the resulting data.

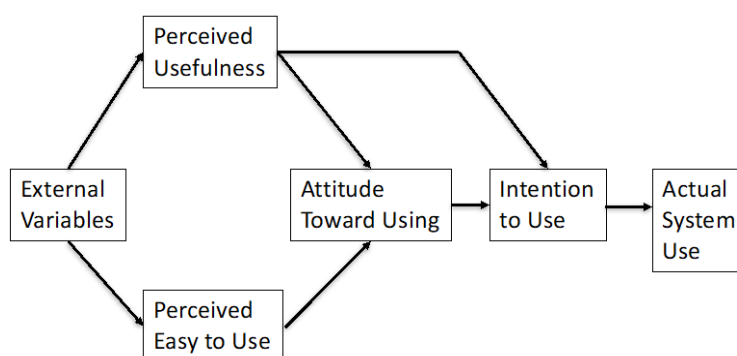


Figure 2. Technology Acceptance Model (TAM) (Davis, Bagozzi, & Warshaw, 1989)

Methodology

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).
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 in Japan were surveyed (population: about 37,000 people). Windows OS TPCs 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 TPCs, 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 TPC 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 also 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.

The authors asked about two specific TAM beliefs, namely, Perceived Usefulness (PU) and Perceived Ease of Use (PEU) in regard to technology acceptance, that is, the teacher's attitude toward the technology. That is because the item at TAM is not an item at the actual educational community. Items developed for TAM in the educational field include Karaca et al. (2013), but they were not developed to measure teacher acceptance of technology when one student has a TPC. For this reason, the authors decided to use items developed with regard to a Japanese setting, in order to better assess Japanese teacher attitudes toward new technology use in their classrooms.

Results

Frequency of TPC usage

The frequency of TPC usage by teachers improved in the first year, but there was not much improvement after two years (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 TPCs? (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 TPC in class" and "I do not understand the class design to make the students use TPCs" ($t = 3.80$, $df = 311$, $p < 0.01$). 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 three years. 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.

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 TPCs (4-point Likert scale).

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

Table 3

Teachers' Beliefs of Education

Near to A's opinion	Near to B's opinion	User (N=39) SD	Non User (N=48) SD	F-Score
Handle the content from textbooks and instructional guidelines to the end in 1 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 emphasis 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, provided doing 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 need is 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

*p<.05 +p<.10

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	
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 yourself on your own	3.36	0.70	3.27	0.78	0.29
10 Fostering the ability to act actively be 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 **

**p<.01 *p<.05 +p<.10

Table 5

Teachers' Expectation of ICT Use in Education

	User (N=39)		Non User (N=48)		Chi-squared x2(1) residuals
	Rate	Rate	Rate	Rate	
1 Child's interest and motivation to learning increases	38	97.4%	45	93.8%	0.09
2 Child's understanding deepens	24	61.5%	26	54.2%	0.02
3 Increase children's concentration of children	14	35.9%	17	35.4%	0.02
4 Children's own awareness and discovery increases	11	28.2%	13	27.1%	0.02
5 Increase your ability to utilize knowledge	10	25.6%	4	8.3%	3.58 2.185 *
6 Time to acquire knowledge can be shortened	12	30.8%	11	22.9%	0.34
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%	2.43
9 Opportunities to share opinions and discuss in classes will increase	12	30.8%	12	25.0%	0.13
10 Children will actively speak	9	23.1%	4	8.3%	2.61
11 Children will act be more actively from themselves on their own	8	20.5%	5	10.4%	1.02
12 Learning oOpportunities for learning tailored to each individual's abilities will increase	26	66.7%	21	43.8%	3.67 2.133 *
13 Children will be able to learn freely about their interests	18	46.2%	12	25.0%	3.38 2.064 *
14 Teaching and learning among children increases	9	23.1%	8	16.7%	0.23
15 The students will acquire the ICT skills necessary for the society of the future	24	61.5%	19	39.6%	3.32 2.037 *

*p<.05

Discussion

Based on the above research results, teacher technology acceptance of TPC is clarified and can be understood in new ways.

First, advancing the development of the TPC environment does not mean that the technology acceptance of teachers will increase. According to the results of this survey, while the utilization rate of TPCs improves in the beginning, it does plateau and does not continue to increase in the long term. Until now, it has been considered that the ICT use of teachers does not progress due to a lack of an ICT environment (Mext, 2014). On the other hand, if the ICT environment is enhanced by policy, ICT use of teachers could be promoted or improved. However, from the results of the survey conducted in the area where the environment was improved as in this research, it cannot be considered optimistically. Japan's ICT environment, which was targeted in this research, could be greatly improved by appropriate policy-making in the future; however, only improving the ICT environment cannot guarantee an increase in TPC use by teachers.

In order to promote teacher technology acceptance, in addition to maintaining an ICT environment, human resources professionals should encourage ICT education. It is also necessary to nurture teachers, who use TPC through training, the leadership of school principals, and coordinators who provide technical support on the use of ICT by teachers. It is necessary to discuss not only the development of the ICT environment, but also how to create a teacher-centered learning community.

Second, regarding teachers' use of TPCs in classes, their feeling of "usefulness" is improved, but "ease of use" may take a longer time to show improvement. In this respect, this study demonstrates that teacher technology acceptance did not progress according to the low rate of "ease of use". From the results of this survey, it was shown that in terms of "usefulness," teachers were able to estimate classroom use as they progressed to the end of the second and third years of the study. From the viewpoint of "ease of use," teacher anxiety over preparing and using a TPC tended to improve over time, but the fear that the "TPC causes problems so it cannot be used" showed no improvement over time. It is also clear from this result that according to the TAM model, both "usefulness" and "ease of use" are important for technology acceptance and progression in its classroom use.

From now on, in order to improve teacher technology acceptance, it is necessary to increase feelings of "ease of use." Improvement is seen when the teacher gets used to handling TPCs, but it is necessary to speed up this process. Regarding the operation of the TPCs, it is required to take a typical example and create opportunities to master it. As preparation is limited, it is helpful to create a manual after patterning the current success case. Since it is difficult to charge the TPC itself to be introduced, it is the reason that it is of low spec. Although it will improve as ICT innovation and the high performance of ICT in the future improve, one person has been introduced currently, but it is better to think a little more about the style of using one at a time. In addition, it is necessary to create an environment that supports teachers when and if a technical problem should occur. In order to do that, it is important to consider providing live human technical support, replacement TPCs for TPCs that have problems or malfunctions, and promoting continuing education classes for teachers and staff involved in TPC implementation.

Third, although teacher's belief does not change much between TPC users and non-users, there is a tendency for the user group to have expectations about learning through individuality for both regular education and ICT-based learning. Since we cannot show causal relationships from this survey, there is a limit to generalize the survey results. However, as we encourage the use of TPCs as well as the importance of new skills, such as 21st century skills, it will be necessary to explain the necessity of learning tailored to each learner.

As for teacher technology acceptance of TPCs, what has become clearer through this research is that it is necessary to consider more detailed measures for "ease of use." For example, with regard to "ease of use," Ifenthaler & Schweinbenz (2013) define it as the "degree to which participants can be attributed that he / she could easily use TPC in classroom instruction," but the improvement does not go beyond at once. It is better to assume that "ease of use" consists of several factors, and that it improves in stages. Kopcha (2012) also identified "lack of time" as a factor of "usefulness," and although there is evidence to support this result, Kopcha did not investigate the quality of the attitudes and beliefs of teachers. Therefore, this study shows that there is a possibility that teacher perceptions, particularly in regard to individualization of learning and orientation to new academic ability, may lead to technology acceptance of TPC.

Conclusion

In this research, the authors clarified how school teachers use tablet PCs (TPCs) with students across the region for IJEMT, Vol. 13, No. 1, 2019, pp.17-26, ISSN 1882-2290

over three years from the view point of technology acceptance by teachers.

As a result, it is clarified what changes continuously about teacher technology acceptance of one-to-one computing using TPCs. While the usage improves in the initial stage, there is no long-term change in use after that. In addition, this research clarifies the stages of improvement by conducting a long-term investigation from the viewpoint of technology acceptance. The results show that while “usefulness” is improved, some of the perceptions of “ease of use” take more time to improve, and may not improve at all in some cases. Further, unlike the non-use control group, the researchers found that the user test group had high expectations for individualized education.

The results of this research show which points should be studied simultaneously in the future for the advancement of technological integration research in Japan and other countries. 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.

In the future, international comparative studies are expected to be forthcoming, due to different policy decision-making on the introduction of technology in schools from country to country. In Japan, it is difficult for individual teachers to make decisions because fiscal measures are decided especially in relation to policy. The technology acceptance of teachers can be quite different based on country or policy context. However, in terms of overall technology acceptance by teachers, this study has clarified some factors for individual teachers in Japan, but it will be necessary to conduct further comparative research that also reviews the technology education policies of other countries to determine if these research findings can be applied in further contexts.

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