

A Pilot Study on the Technology Readiness for 1:1 Mathematics Intervention

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Abstract: With the advance of technology, the price drop and the increasing reliance of personal computers showed possibilities on transforming our current education. As mentioned in Bloom's 2-sigma problem (Bloom, 1984), one-to-one classroom learning proved a significant learning outcome compared to the conventional. Therefore, with the assist of technology, applying 1:1 learning in the regular practice might be the ultimate goal for the educational transform. In this study, we explored the experiences and showed encountered problems for 1:1 learning in Taiwan. The experience was categorized into users and technology, followed by the analysis of criteria that based on empirical observations. As a result, the observation provided a guideline for the technology readiness, which consisted of the perception of users (teachers & administrators, students & parents) and the stability of pedagogical and hardware integration (pedagogy/software and devices). The result of this study also suggested that further attention should be addressed on the hardware infrastructure and the teacher's professional training, because there were over 50% of encountered problems that were mainly the problems for stability of computer hardware (54.41%). Most problems encountered by teachers & administrators could be solved by effective professional trainings and flexible school assessments (31.00%). Nevertheless, neither students nor parents showed a high participation ratio in this study (14.59%).

Keywords: one-to-one, technology adoption, technology acceptance, technology readiness

1. Introduction

In recent years, WWW or Internet accelerated the growth of information. Not only the adolescents or adults, but also the children received external stimulations passively or actively by the common use of technology. 21st century is believed as the age of information explosives, and the rapid growth of technology easefulness strengthened the connection between the useful information and the human mind. Although some studies described the technology adoption in the classroom learning (Macmillan, Liu, & Timmons, 1997; Schrum, 1994, 1997), the use of technology was limited to a shallow application for the regular practice (Cuban, 1986; Tyack & Cuban, 1995). Nevertheless, the pedagogy in classroom learning remained unchanged regardless the power or possibilities by technology. Therefore, additional efforts should be offered for the integration with technology (Gülbahar, 2007). Therefore, two possible explanations for the aforementioned problems might be the technology readiness and the pedagogical effectiveness for technology application.

In this study, technology readiness involved the technology acceptance or experience by users (teachers, school administrators, students and parents) and the stability of pedagogical and hardware integration (network devices, laptops, or software). The effectiveness of technology readiness affected the success for 1:1 learning. Therefore, in exploring the technology readiness, this study focuses on:

- **The experience of teachers and school administrators:** this was vital for the success of 1:1 learning in the classroom (Collis, 1996). Transforming education needed supports by the teachers and school administrators. Without teachers' or school administrators' assistance or tolerance, they would easily suspend or reject the application of 1:1 learning into their classrooms. Therefore, professional trainings for teachers were a must for the educational transformation (Joyce & Showers, 1983, 1995).
- **The perception of students and parents:** compares to the experience of teachers and school administrators, the perception of both students and parents was a challenging task. Most students

were not eager to learn autonomously, or even some of them were being forced to go to the elementary school. Therefore, students' motivation became the first priority, and the smoothness of self-paced learning pedagogy was important for enhancing students' willingness. On the other hand, the support from parents was also important because it would help both students and teachers consolidate the concept of 1:1 learning.

- **The stability of pedagogical and hardware integration:** it involves how the seamless integration between the learning pedagogy and the infrastructure. The way of integration between devices and pedagogy was important; therefore, the stability and the reliable of the devices played an important role for 1:1 learning. The learning activity would be unstable when the computer network was unreliable, and the users (teachers and students) would be frustrated for the partial information that they had received.

In order to overcome the problem, this study designed a 3-cycle model for exploring the experience on adopting 1:1 into the regular practice. Therefore, this study intended to find out:

1. Would the 3-cycle play a certain role between users and researchers?
2. What would be the key factor(s) that affecting the technology readiness in 1:1 learning?

2. Related Work

2.1 *Technology acceptance*

Many studies discussed the technology acceptance for our current education. Venkatesh, Morris, Davis, & Davis (2003) defined the technology acceptance as a means of explaining the intention for the usage of information systems. Therefore, in order to understand the perception of one's willingness/intention to doing something, a previous study by Ajzen & Fishbein (1980) described the theory of reasoned action (TRA) for the prediction of behaviour intention, attitude and subjective norm. Then, the technology acceptance model (TAM) was derived from TRA model, in which Davis (1989, 1993) believed that the investigation for users acceptance was also crucial for describing one's behavior. He suggested that the key factors that affecting the use of technology were the perceived usefulness and the perceived ease of use.

2.1.1 *Perceived Usefulness*

The meaning of perceived usefulness implied whether the technology was feasible by the user's perception and the job performance after applying technology. A system with high degree of perceived usefulness would reinforce the relationship between the user's belief and performance. In other words, if the user thought that the technology was helpful, s/he would be more engaged to use the technology (Davis, 1989) and therefore s/he would reach a higher achievement at work (Venkatesh & Davis, 2000). A similar study by Moore & Benbasat (1991) also showed that the innovative technology would strengthen the user's social status, and they believed that the usage of technology was perceivable, observable and communicable.

2.1.2 *Perceived Ease of Use*

The meaning of perceived ease of use implied the user's perception on the naturalness of using technology. It referred the user's belief when s/he was using the technology without extra cognitive loads. An easier system would be more likely accepted by the user. For that reason, it would also raise the intention by using technology. The other studies described the perceived ease of use as the degree of user's beliefs on accomplishing the jobs by using technology (Compeau & Higgins, 1995), the degree of anxiety and enjoyment by technology, and the objective usability for the comparison of actual effort to complete specific jobs (Venkatesh, 2000).

2.2 *Assessing criteria*

User's perceptions and the system's usefulness are crucial in the technology acceptance model (TAM). Liu, Chen, Sun, Wible, & Kuo (2010) discussed the technology acceptance to understand the feasibility of technology-enhanced learning. Liu et al. extended TAM for exploring the factors that affecting the usage of online courses. They also described the technology acceptance based on the perception of human (learners & teachers) and system (hardware connections, online content & software platform). Liu's evidence showed that the perceived variables (usefulness, ease of use, intention to use an online community) could help predict the usage of online learning community. Therefore, in this study, human's perceptions (teachers & administrators, students & parents) and the stability of pedagogical and hardware integration (Wireless conditions, hardware or software issues, content development) will be considered as foundations for exploring the factors in 1:1 learning.

3. Method

3.1 School background & data collection

In this study, 1:1 learning was applied in a public elementary school, which was located in the countryside of Taiwan. In this school, although some families were economic disadvantages, most parents agreed to buy laptops for their children to learn in school (BYOD, bring your own device). This study followed the 1:1 learning model by Chen, Liao, Chien, & Chan (2011) that students would learn by math missions in most regular math classes.

The data was collected from September 20, 2012 to April 30, 2013. All classes in Grade 2 and Grade 3 (16 classes in total, with 27-29 students in each class) were applied 1:1 learning pedagogy. 438 elementary school students (229 Grade 2 students, 209 Grade 3 students) and 16 teachers were involved in this study. The empirical data was collected by consultation and observations, which was mainly based on user's experiences, and the data was categorized into users' perceptions (teachers & administrator, students & parents) and the stability of pedagogical and hardware integration (hardware or software) (to be discussed in 3.3), in a form of online spreadsheet with the information such as categories (device problems, suggestions, or special needs), comments/problems, data/time ... etc.

3.2 Design

In order to apply 1:1 learning into classrooms, there needs to have an effective design for the sake of sustainability. Therefore, this study follows Design-based Research (Brown, 1992), for the capture of empirical data to refining the current pedagogy. Another goal of this model is to test whether this model will play a certain role between researchers and users. Furthermore, we believe that this will be helpful for the further design in 1:1 learning. The 3-cycle model is composed of Refine, User Acceptance Questioning (UAQ) and Feedback:

1. Refine: Researchers designed and/or tuned the system for the needs in 1:1 learning. Every new function or modification would be simulated for predicting the real situation, and the new system was self-evaluated for minimizing the negative effect on the usage.

2. UAQ: The term UAQ was derived from UAT (User Acceptance Testing). Rather than providing tests for teachers to evaluate the 1:1 learning pedagogy, this study helped the teachers to reflect the situation by asking every teacher for the usage problem. Once the teachers or students encountered a problem, teachers would immediately record the situation, which consisted of the condition of usage, date and time, and optional information.

3. Feedback: Every afternoon in the school day, the interviewee would visit every teacher. The goal of the visit was to understand the perception of the system, encountered problems, and the interviewee would record teachers' comments/complaints. Later, the interviewee would discuss the problem with the researcher for further follow-ups or make additional system tuning.

4. Result and Analysis

For the first research question, the 3-cycle model played a certain role between users and researchers. After months of usage, both users and researchers were familiar with the 3-cycle model. From the

researcher's observation, this model provided not only a bridge for communicating with each other, but also an opportunity for helping researchers and teachers resolving the technical or conceptual problems collaboratively. Consequently, this 3-cycle model showed a 'joint-venture' phenomenon that brought teachers as one of the researcher (Cole & Knowles, 1993) because most teachers would sometimes have suggestions or would argue with the researcher about the pedagogical design of the pedagogy. This kind of partnership would possibly increase the success of technology adoption, because teachers owned the expert knowledge and authentic experiences in education. For the second research question, the encountered events during the 1:1 learning were recorded and categorized by the criteria listed in Table 1, 2, & 3, for the acceptance of teachers & administrators, the acceptance of students & parents, and the stability of pedagogical and hardware integration, respectively. Also, a summary for the frequency of encountered events in 3 categories was listed in Table 4.

4.1.1 The experience of teachers & administrators

Table 1 described the experience by teachers and school administrators. The number in the parentheses implied the total amount of corresponding events. Most problems appeared in this category were mainly the usage problem (40 times), which could be solved by professional trainings. For example, some teachers received the usage training before the 1:1 learning pedagogy was applied, but they would easily forget what they had learned, and they would ask about the application of the system once again. Besides, some other teachers would provide suggestions (16 times) for the application of 1:1 learning pedagogy, and most suggestions were related to the conflicts between the traditional practice and 1:1 learning pedagogy. Almost every teacher in the 1:1 learning class worried about the individual difference and the assessment for students (3 & 17 times), because the formal assessment was designed for average students. Teachers might need time for overcoming the new challenges in 1:1 learning, and a flexible/negotiable assessment was suggested to free the limits of traditional education.

Table 1: Observed criteria for the experience of teachers & administrators.

The experience of teachers & administrators (101 events in total)	
1. Professional training & application (40)	5. Interface suggestion (14)
2. Pedagogical suggestion (15)	6. Class arrangement (3)
3. Individual difference (3)	7. Special care for students (9)
4. Assessment (17)	

4.1.2 The perception of students & parents

Table 2 described the encountered problem for the perception of students & parents. Since students learned by math missions, most problems were mainly students' perception for the status of math missions. The response of math mission implied the feedback or output by the learning missions or material, such as the results by unexpected usage by children, the usage of specific input methods, or the rewards for mission accomplishments. The solution to the response problem could be the additional training for students or a simplified design for math missions. Besides, the duplicates of math mission status stated the insufficient variety of math missions, where students were easily confused with the similar design for different math missions. It was suggested that additional decorations or rearrangement for math learning missions should be considered in future content development. On the other hand, there seldom existed the problems or suggestion raised by parents. The reason to this phenomenon might due to the financial background of families, because a lot of student's families are two-incomes. Only a few of parents got involved in the design or pedagogical application.

Table 2: Observed criteria for the perception of students & parents.

The perception of students & parents (47 events in total)	
1. Status of math mission (42)	2. Requirement for learning after-class (1)
1.1 Length (4)	3. Parent's perception (4)
1.2 Duplicated missions (10)	3.1 status enquiry (1)
1.3 Response (26)	3.2 reject due to health problem (1)
1.4 Learning effectiveness (2)	3.3 content & interface (2)

4.1.3 The stability of pedagogical and hardware integration

Table 3 showed that the most common problem for the stability of pedagogical and hardware integration. Although the software usage reached the highest amount of events in this category. Most software usage problem was caused by the unstable of wireless networks. As a result, we doubted the reliability of computer software, and even 1% of data loss might result fatal errors on learning. Even if this problem seemed minor in 1:1 learning, it might refer to the contingencies caused by either human or computer hardware. Therefore, it was suggested that there should be a guarantee for ensuring the stability of the network communications.

Table 3: Observed criteria for the stability of pedagogical and hardware integration.

The stability of pedagogical and hardware integration (179 events in total)	
1. Infrastructure (11)	4. Platform (39)
2. Networks (40)	5. Software usage (62)
3. Content design (16)	6. Student's PC hardware (11)

4.1.4 The frequency of the encountered events in 1:1 learning

Table 4 showed the summary for the frequency of encountered problems in 1:1 learning. The stability of pedagogical and hardware integration held over 50% of problems in 1:1 learning. The reliability of pedagogical and hardware integration remained the most challenging part among those categories. It was suggested that a fine-tuned software platform or powerful hardware was needed and should be carefully evaluated before applying 1:1 learning pedagogy in the regular practice. Besides, the number of problems in experience of teachers & administrators showed that teachers & administrators were more eager to comment on the events or problems in 1:1 learning. Two reasons might be able to explain the situation. First, teachers held the responsibilities on the pedagogy, and the 1:1 learning pedagogy challenged their expertise in the classroom. Second, as mentioned in 3.1, teachers received training before the 1:1 learning was applied. They understood the concept or pedagogy well, so that they would be able to point out more problems in 1:1 learning.

Table 4: The frequency of the encountered events in 1:1 learning.

Date/Category	Teachers & administrators	Students & parents	Pedagogical and hardware integration
Sept, 2012	3 (21.43%)	3 (21.43%)	8 (57.14%)
Oct, 2012	14 (29.17%)	14 (29.17%)	20 (41.67%)
Nov, 2012	29 (35.80%)	8 (9.88%)	44 (54.32%)
Dec, 2012	17 (26.98%)	4 (6.35%)	42 (66.67%)
Jan, 2013	15 (50.00%)	2 (6.67%)	13 (43.33%)
Mar, 2013	17 (30.36%)	11 (19.64%)	28 (50.00%)
Apr, 2013	7 (18.92%)	6 (16.22%)	24 (64.86%)
Total (100%)	101 (31.00%)	49 (14.59%)	179 (54.41%)

5. Conclusion

This study showed the experience on the adoption of 1:1 learning into public schools. In this study, the experience was recorded and addressed in different categories, which included user's perceptions (teachers & administrators, students & parents) and the stability of pedagogical and hardware integration (hardware & software). Although the empirical data was collected and discussed in this study, further experimental assessments and statistical analysis should be carefully applied for the perception of users and the integration of technology. By applying the 3-cycle model (Refine->UAQ->Feedback) between researchers and users, the interaction phenomenon implicitly showed a partnership for transforming teachers into one of the researchers. In addition, this study provided a guideline for further development in 1:1 learning, as the empirical data showed that the stability of infrastructure (including network problems) and more effective professional trainings should be taken into further considerations.

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