The mathematics class using the tablet PCs: Why do not Japanese Teachers use them?

Tsutomu Ishii1,*

1Department of Education, Bunkyo University, Japan
*benishii@koshigaya.bunkyo.ac.jp

Abstract. In this paper, we will consider about the reason of using Tablet PCs. Japanese teachers do not use Tablet PCs so much. The reason is the research question. Japanese Government is supporting financially for teachers to use the projectors and computers in the classroom. Recently, teachers using Tablet PCs are increasing, but there are teachers who do not use Tablet PCs, too. In the 1st step, several studies were considered. And we checked its educational possibility and expectation of Tablet PCs. For example, in early childhood showed that teaching with Tablet PCs contributed significantly to the development of children’s mathematical ability. In the 2nd step, we analyzed the mathematics class using Tablet PCs about the percentage of the elementary school 5th grade in Japan. We analysed carefully about understandings of children and instructions of teacher. In the 3rd step, as the case study, we considered whether instruction by Tablet PCs was proper in detail and we argued the result based on several studies. In this paper, at the end, we pointed out 2 points. First, children's understanding deepens by Tablet PCs. Next, there is little contribution to bring the flexibility and creativity up.

1. Introduction
This paper is a report of our consideration about classroom using tablet PCs. Previously, in [1], we considered the digital technology is disappointing and the grand visions of the 1980s are not being realized. Japanese government is supporting it financially for schools and teachers to use technology. Recently, teachers using Tablet PCs are increasing. But there are the teachers who don't try to use all ICT as well as Tablet PCs. We have studied Tablet PCs about the effect used at mathematics class for it. In [2], the use of tablet PCs in teaching has two of the most important features. First, the annotation feature allows the user to write on almost any document much as one would annotate a printout of the same document. Second, the wireless communication feature allows tablet PCs to share information with one another.

Much effect is pointed out more by the research which targeted young children. In [3], technical issues in learning using tablet PCs were encountered, children were interested and persisted without frustration. It seems to matter for children’s learning is the ways teachers choose to implement this technology. There is also a study to which the effect of Tablet PCs is being reduced systematically in
the study these days advanced. For example, we knew the goodness using Tablet PCs were Find, Apply, Construct, Order, Calculate, Play, Evaluate and Argue [4].

We, any more effect, survey, even if, I notice that we were conquered by technologies intuitively. In [5], computers, Tablet PCs and smartphones are now part of the lives of this new generation of students, so it's only natural that they are used for educational purposes as well. Young children can also use Tablet PCs well like this. Young children at Greece showed that teaching using Tablet PCs compared to teaching with computers contributed significantly to the development of children’s mathematical ability [6]. We understand the merit using Tablet PCs. But there aren't few teachers who avoid using those in Japan. We would like to find the reason. In this paper, we analyze about a mathematics class at Japanese elementary school.

2. Methods

After we grasp the global image of the classroom, we select symbolic episode. About the details of the episode, we examine classroom qualitatively. We consider the cognitive understanding by communication in the classroom. Therefore, we are observing argumentative discussion in the classroom. The discussion without warrant is not appropriate as the argumentation in the classroom.

Argumentative discussion in the classroom is the purpose for learning mathematics. And we ought to judge the quality of the lesson by carrying out based on it. This contributes to the improvement of the lesson study indirectly. Because lesson study aims at the improvement of the lesson, and suitable evaluation of the lesson is indispensable to the improvement of the lesson. Argumentative discussion leads to the interaction in the classroom. In [7], we paid attention to “travel of ideas; the interaction between each idea of the student and the whole class community”. Surely, mathematical communication is convenient method to describe the mathematical discussion, but is not often appropriate to describe the nature of mathematics [8]. On the other hand, argumentative discussion is good for describing it [9][10]. As mentioned above, we are observing document collective activity (DCA). In [11], they developed a methodological approach to DCA that focuses on how mathematical ideas or ways of reasoning become normative in the whole class discussion [12][13].

DCA methodology uses Toulmin’s model of argumentation as an empirical tool [11]. In [14], we were pointed claim(C), data(D), warrant(W), qualifier(Q), rebuttal(R), and backing(B). Data(D) causes qualifier(Q) by warrant(W). Qualifier(Q) causes conclusion (C). Warrant(W) causes rebuttal(R) by backing(B). Toulmin claims that arguments typically consist of six parts. A typical Toulmin diagram to describe an argument may look as follows [15]. So we are using Toulmin diagram and DCA methodology as seen in the figure 1 [16].

![Toulmin diagram](image)

This paper is the report of our consideration about classroom using tablet PCs. So, we analyzed the mathematics class using Tablet PCs about the percentage of the elementary school 5th grade in Japan. It was carried out in the board school in Tokyo on 6th September 2017. It was the lesson which solves the following problem. “The 66 lots are contained in the box. The ratio of the hit and its blank is 4:7. Find the value of the hit and its blank in the box.” This is the problem plain for Japanese children.
However, study of the rate is difficult. Because, if children do not understand the more than relation of two, the problem of the rate is unsolvable. Then, Japanese teachers carry out activity as which children express the more than relation of two to the figure.

And this lesson is that lesson that used Tablet PCs. There are few mathematics lessons which used Tablet PCs in Japan. Although clear statistics do not exist, it is only 3\% or less of the whole. This lesson was carried out by the 2nd times in the class which uses Tablet PCs. Therefore, elementary operation is possible although children are not proficient in use of Tablet PCs.

3. Result

It was the lesson which solves the following problem, “The 66 lots are contained in the box. The ratio of the hit and its blank is 4:7. Find the value of the hit and its blank in the box.”

T: The 66 lots are contained in the box. The ratio of the hit and its blank is 4:7. Find the value of the hit and its blank in the box. We need to consider this problem in that lesson.

T: Log in by Tablet PCs.
C: (Children log in.)
T: (The teacher shows a big-screen TV the entry page of Tablet PCs.)
T: Are you OK?
C: …
T: Is it OK? I prepared the page of this note.

![Figure 2. Page 2 of the screen](image1)

T: The 1st page and the 2nd page are the same pages as this. Please write in as usual what was considered freely as the note at these pages.

T: (The picture of the big-screen TV is changed.)

![Figure 3. Page 3 of the screen](image2)

T: Those notes are the different page.

T: (The picture of the big-screen TV is changed again.)
Figure 4. Page 4 of the screen

T: It is a page for drawing such a figure on the 4th page.
C: It is wonderful!
T: There are four hints in the 5th page. (The picture of the big-screen TV is changed entry of hint page.)

Figure 5. Page 5 of the screen

C: Hint?
T: Please see this, if you would like to see the hint. By carrying out the double-tap of the hint, you can see a hint.
T: (The picture of the big-screen TV is changed page of the hint 1. Having been indicated as the hint is as follows. “Was it The ratio of the hit and its blank is 4:7?”)
T: (Having been indicated is as follows when the double-tap of this is carried out.“Find the ratio of the whole to the hit.”)
T: (Having been indicated is as follows when the double-tap of this is carried out.“All: Hit=11:4.”)
T: (Having been indicated is as follows when the double-tap of this is carried out.“All: Hit=66:x.”)

Figure 6. Page 5 of the screen

T: The problem for practice is in the 6th page. This problem is easy. It is that problem for the person whom this problem finished solving.
T: (The picture of the big-screen TV is changed the page in easy practice problem.)
T: And the special problem is in the 7th page. This is a difficult problem. Although this is difficult, this is also the problem for practice.
T: (The picture of the big-screen TV is changed the page in especially problem.)

T: Do you have a question?
T: Mr. S, please.
S: Can I use the 1st page only?
T: Yes, of course, you can do it. However, if the 1st page finishes, describe other views to the 2nd page and the 3rd page. I am going to order presentation later.
T: Mr. J, please.
J: Even when I do not have an idea, can I see a hint?
C: You cannot do it.
T: Yes, you can do it. But I will give the person not using the hint in you a high score. Those who want to solve by themselves had better not look at a hint.
C: I would like to solve by myself.
T: You can begin to solve a problem freely.
The above is details of episode. After this, the problem was individually solved in about 10 minutes, and 30 children of the whole class discussed. The solution by the children whom the teacher took up in it is as follows.
4. Discussion

This paper is a report of our consideration about classroom using tablet PCs. In order to analyze this lesson, there are two important viewpoints. It is the first of an important viewpoint how the teacher was using Tablet PCs in the mathematics lesson. It is the second of an important viewpoint what kind of image the teacher has to Tablet PCs. Although we conduct some analysis below, it is important to stand on these two viewpoints and to return.

The teacher introduced with "I prepared the page of this note." And the teacher explained it as "Please write in as usual what was considered freely as the note." This explanation guaranteed the function of Tablet PCs as a note, and referring to other solutions freely. Therefore, children's understanding deepens by Tablet PCs. Moreover, there is little contribution to bring the flexibility and creativity up.

However, the above analysis is only the whole half. We should observe in how the teacher used Tablet PCs in the end of episode. This is the first important viewpoint. And the image about Tablet PCs has determined that teacher's intention in this scene. Therefore, it is as follows when Toulmin Diagram expresses this scene. The teacher in Backing "you can do it." is separated from his real intention. So, the teacher was not able to answer exactly to the question of "Even when I do not have an idea, can I see a hint?" of J in Qualifier. Nobody can say this educationally. As a result, the Conclusion here settled in "I would like to solve by myself." by child.

Figure 9. The solution by the children

Figure 10. The process of the ending episode by the Toulmin Diagram

This paper is a report of our consideration about classroom using tablet PCs. Next, we analyze episode by DCA. It began from the question by J. J asked the question "Even when I do not have an idea and can I see a hint?" According to it, the one child murmured "You cannot do it." A teacher answers "Yes , you can do it" promptly. And it continues with "But I will give the person not using the hint in you a high score." Moreover, the teacher confessed real intention, saying, "Those who want to solve by themselves had better not look at a hint." From the exchange so far, the one child murmured "I would like to solve by myself." This is a child's real intention and was shared by the whole class. The figure which arranged the interaction by the teacher here and child J, and two children by DCA is
as follows. Becoming remarkable by this arrangement is having changed ignited by the unexpected utterance by child J. And two children's remark backed up this change. The image about Tablet PCs appears in the teacher's remark here. That a child can use the hint freely was the image of interfering with the child's problem-solving capability.

![Figure 11. DCA in data (Episode)](image)

5. Conclusion
In this paper, we'll consider about the reason of using Tablet PCs. We considered several studies. And we checked its educational possibility and expectation of Tablet PCs. Next, we analyzed the mathematics class using Tablet PCs about the percentage of the elementary school 5th grade in Japan. Finally, we considered the case study.

In this discussion, we pointed out 2 points. First, children's understanding deepens by Tablet PCs. Next there is little contribution to bring the flexibility and creativity up. According to these, Tablet PCs was used how or the image which the teacher has was analyzed from the viewpoint of something. As a result, we pointed out that using the hint freely had the image of interfering with the children's problem-solving capability. We think that there are not few teachers with the image.

References
[1] Ozel, S., Yetkiner, Z.E., and Capraro, R. M. 2008 Technology in K-12 Mathematics Classrooms J. of Sch. Sci. and Math. 108(2) pp. 80-85
[2] Fister, K. R., and McCarthy, M. L. 2008 Mathematics Instruction and the Tablet PC Int. J. of Math. Educ. in Sci. and Technol. 39(3) pp.285-292
[3] Couse, L. J., and Chen, D. W. 2010 A Tablet computer for young children? Exploring its viability for early childhood education J. of Res. on Technol. in Educ. 43(1) pp.75-98
[4] Haapasalo, L., and Zimmermann, B. 2011 Redefining school as pit stop: It is the free time that counts. In Integration of technology into mathematics education: past, present and future Proc. of the 16th ATCM pp. 19-23
[5] Korenova, L. 2015 What to Use for Mathematics in High School: PC, Tablet or Graphing Calculator? Int. J. for Technol. in Math. Educ. pp. 59-64
[6] Papadakis, S., Kalogiannakis, M. and Zaranis, N 2016 Comparing tablets and PCs in teaching mathematics: An attempt to improve mathematics competence in early childhood education Preschool & Primary Educ. 4(2) pp. 241-253
[7] Saxe, G. B., Gearhart, M., Shaughnessy, M., Earnest, D., Cremer, S., Sitabkhan, Y., Platas, L., & Young, A. 2009 A methodological framework and empirical techniques for studying the travel of ideas in classroom communities. In B. B. Schwarz, T. Dreyfus & R. Hershkowitz (Eds.) Transformation of knowledge through classroom interaction pp. 203-222 (London: Routledge)

[8] Ishii, T. 2013 Research using the studied-mutually-model about the discussion in the mathematics lesson Proc. of the 6th ICMI-East Asia Regional Conference on Mathematics Education 657-6

[9] Ishii, T. 2015 Research on the teaching methods which deepen the argument in problem solving Proc. of the 7th ICMI-East Asia Regional Conference on Mathematics Education 657-664

[10] Ishii, T. 2015 Considerations on teaching methods to deepen student argumentation through problem solving activities Proc. of the 9th Congress of the European Society for Research in Mathematics Education 222-223

[11] Rasmussen, C., & Stephan, M. 2008 A methodology for documenting collective activity. In A. E. Kelly, R. A. Lesh, & J. Y. Baek (Eds.) Handbook of design research methods in education: Innovation in science, technology, engineering, and mathematics learning and teaching 195-215 (New York: Routledge)

[12] Tabach. M., Hershkowitz. M., Rasmussen. C., Dreyfus. T. 2014 Knowledge shifts and knowledge in the classroom J. of Math. Behavior 33 192-208 DOI:10.1016/j.jmathb. 2013.12.001

[13] Ofri, O., Tabach. M. 2017 The spread of mathematical ideas in argumentative classroom discussions: Overt and covert participation. In Kaur. B., Ho, W.K., Toh, T.L., & Choy, B. H. (Eds) Proc. of the 41th Conf. of the Int. Group for the Psy. of Math. Educ. 3 329-336 (Singapore: PME)

[14] Toulmin, S. E. 1969 The uses of argument (Cambridge: Cambridge University)

[15] Hitchcock D., & Verheij, B. 2006 Introduction. In D. Hitchcock & B. Verheij (Eds.) Arguing on the Toulmin model: New essays in argument analysis and evaluation 1-23 (Dordrecht: Springer)

[16] Ishii, T. 2018 The focus in argumentative classroom discussions Proc. of the 8th ICMI-East Asia Regional Conference on Mathematics Education 478-483

Acknowledgements
I am thankful to you who gave the opportunity of printing of this full paper. I expect that this full paper is helpful to Indonesian. I can offer the data of the education of Japan if necessary. Please do not hesitate for you who wish to have data to contact me. I wish research of you and cooperation. A curriculum, lesson research, etc. are waiting for the proposal from the Indonesian teachers.