A Study on Building Capacity for Pre-service Teacher Regarding to Technological Pedagogical Content Knowledge (TPACK)

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ABSTRACT

It has been thought that "Pedagogical Content Knowledge (PCK)"is important to acquire and improve teaching skills. However, recently, teachers are required to improve students learning skills through ICT, too. When designing such learning that recognizes its quality and deepening including use of ICT, etc., for example, a wider range of skills will be required of teachers.Thus, teachers are also required for enhancement of "Technological Pedagogical Content Knowledge (TPACK)". Therefore, it is believed that it is necessary for preservice teacher students to get opportunities to learn TPACK in the period of the teacher training.

This presentation reports that we explored the way for analyzing and assessing changes of TPACK of preservice teacher students during practicum by using MindMap. And this study aimed at expressing clearly the terms and environment which would benefit having TPACK in the guidance programs for preservice teacher students.

The trial program then aims to obtain clues to program preparation related to the process of pedagogical content knowledge concerning technology during actual student practice in the training process (practicum) through analysis of the details of these changes and the conditions and the environment that caused them..

Keyword: Preservice Teacher Education, PCK, TPACK, Practicum

1. Introduction

The ability to learn the importance of sharpening "Pedagogical Content Knowledge" has been pointed out. However, for teachers to have an image of learning including ICT use, in addition to "Technological Knowledge" , there are calls to approach such matters as development and training through "Technological Pedagogical Knowledge", "Technological Content Knowledge" and "Technological Pedagogical Content Knowledge" and clarification of what the issues are in acquisition of this knowledge.

This research therefore designs opportunities for learning concerning pedagogical content knowledge related to technology during the period of practicum in the training process and then focuses on analysis of what kinds of changes occur by using "MindMap". The research then aims to obtain clues to program preparation related to the process of pedagogical content knowledge concerning technology during practicum through analysis of the details of these changes and the conditions and the environment that caused them.

2. Research Design and Methods

2.1. Technological Pedagogical Content Knowledge and Practicum

The pedagogical content knowledge related to technology addressed here means Technological Pedagogical Content Knowledge (It was firstly expressed at TPCK without the "A," but recently in many cases it has been represented as TPACK; Total Package regarding to Technological Pedagogical Content Knowledge, as above). This does not just mean using ICT in educational activities such as the classroom. It is an expression that attempts to grasp the relationships in knowledge of teaching, subject matter and technology and their compound nature, which is the mindset put forth by Mishra and Koehler (2006). Also, this TPACK can be said to be an issue of focus in recent educational technology research (Archambault and Barnett, 2010; Jang, 2010; Jimoyiann, 2010; Kramarsky and Michalsky, 2010).

In the TPACK which is the focus of this report, teacher knowledge of technology makes learning effective and efficient and is thought of as one more closely related component. PCK is included above in response to the situation and is also understood as knowledge which structures it.

As shown in Figure 1(Koehler & Mishra 2009), in the TPACK idea, Technical Content Knowledge (TCK), Technical Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPACK) make learning effective and efficient, may be closely tied to PCK, and are shown as those three potential abilities and additional components.

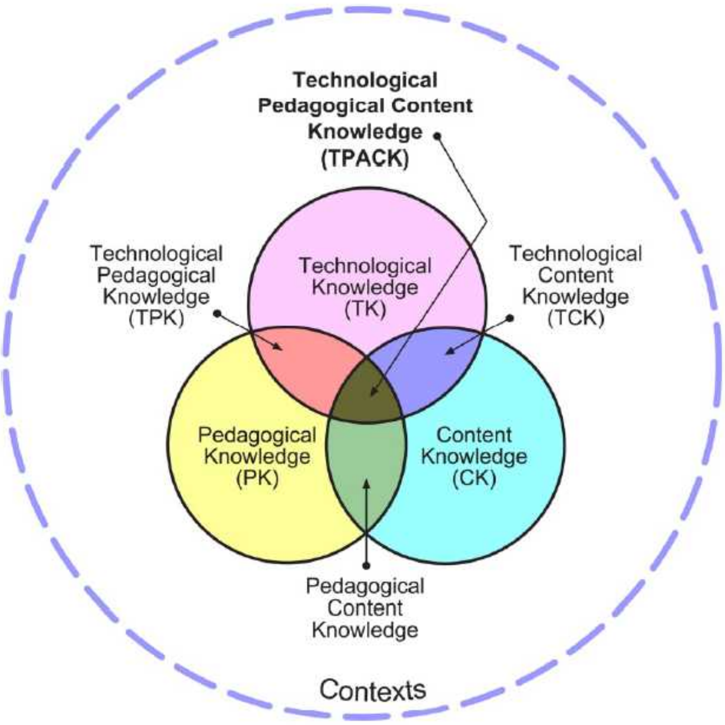

Figure 1. The TPACK framework and its knowledge

However, when conducting actual teacher development and training, etc., TPACK elements showing each overlap have points that are difficult to understand, and there are calls to further clarify the definition and framework. Schmidt, Baran, Thompson, Mishra and Koehler (2009) therefore pursue this framework through further investigation concerning TPACK regarding how students in the development process perceive these.

Also, although there is not a great deal of prior research on TPACK at all, 2 trends are seen here. One of these is research into preservice teacher students in the development stage and the instructional ability of current instructors (Angeli and Valanidies, 2009; Chai, Koh, and Tsai, 2010; Kramarsky and Michalsky, 2010; Niess, 2005), and the other is research into preservice teacher student perception regarding university teacher TPACK-related instructional ability. (Jang and Chen, 2010; Tuan, Chang, Wang and Treagust, 2000).

In terms of these research trends, this research falls into the first one. It focuses on the developmental stage, especially the relationship between practicum in the teacher training period and the transformation in preservice teacher students. The research does not focus on confirming the perception of each TPACK component among students themselves, rather attention is placed on analyzing from the actions of students themselves what type of learning of components are seen as transformation.

2.2 Research Purpose and Methods

Up to now, practicum in science classrooms at school in Japan has focused on such matters as thinking of what materials to use, what to teach students and what abilities to impart as well as instilling practical skills to enable educational planning, preparation and implementation suited to the actual situations of students. However, provision of instruction tailored to individual student teachers in a limited timeframe and developing skills for goal-oriented ICT use in teaching and problem solving with coworkers as well as the ability to continue learning while conducting appropriate self-evaluation is difficult and is becoming an issue.

To respond to these issues, the purpose of this research in relation to student TPK is therefore to deepen discussion for the purpose of instruction tailored to individual student teachers as well as problem solving by the student teachers using mindmaps, and also to verify its effects by practicing this on an experimental basis considering that it is effective in student self-evaluation. Also, such matters as usage conditions for mindmaps in practice instruction that leads to transformation of that knowledge and the entire program of practice instruction were considered.

Furthermore, for this to also be basic experience using mindmaps that employ ICT in class, preparation of mindmaps using ICT as a tool for students themselves to repeat their experience was also included after that, and such possibility was considered.

Mindmaps are a thinking tool advocated by Tony Buzan. Their characteristics enable visualization of what one is thinking. The theme is expressed as a central image, and from there a branch widens in radial fashion. The first branch is called a main branch (1st level), and basic ideas are entered as keywords above this. From here, associations are widened by developing a 2nd level, 3rd level and sub-branches. This is how mindmaps express the widening of thoughts on a certain theme in a layered form.

Accordingly, with preservice teacher students designing classes focused on mindmaps, in this research the mindmaps were used as tools to grasp changes in what is considered important and to what level deep thought is possible. This isn't just a case of making mindmaps before and after the student training period for the instructor to use for evaluation and instruction, but also for the student teachers themselves to understand their own growth through self-comparison. Also, the groups made group mindmaps about topics of their choice with the goal of deepening discussion toward problem solving. Furthermore, we loaned out iPads (iMindMap HD mindmap drawing software) for situational awareness using ICT to make class observation more efficient and for smoother progress in educational critique meetings.

3. Results

The results of individual pre and post mindmaps made by preservice teacher students are summarized in. Figure 2 is a graph of individual student teachers using the results of classification by TPACK components of mindmap branches. Focusing on the pre mindmaps, we see types where branches including CK predominate, as in those of student teachers a, b, c, d, g, h, j, k, l, m, and types where branches including PK predominate, as in those of student teachers e, f and i. These indicate a separation between types where student teachers before teaching practical training had a strong awareness of the details of scientific study and types where there was a strong awareness of teaching method. In classes in the beginning of practical training, there were cases in which the details of science were taught to the best of the teacher's ability, and there were classes heavy on explanation or those in which learning wasn't deep although the teaching method went following procedures since there were few scientific details. This is in line with the realization of practical training instruction that instructors have had up to now.

Comparing pre and post mindmaps, while there were differences among individuals, among all student teachers the number of branches including PCK increased (Figure 3). This can be said to be the result of a transition from not being able to think by linking teaching methods to the details of scientific learning that must be taught before practical training to being able to think linking to how to teach the details of scientific learning after practical training.

Concerning what kind of relationship exists between the increase in the number of branches including PCK in the post mindmap and preservice teacher student's practical ability, we analyzed the correlation with preservice teacher student's evaluations conducted by instructors (Figure 3). Evaluation of student teachers at the school was conducted by an overall score of a ten stage evaluation of a variety of items in practical instruction concerning teaching subjects. In this analysis, from these items we extracted the status of educational materials research, instructional plan drafting, development of the lesson and instructional technology and the use of questioning, writing on whiteboards, teaching tools, teaching materials and texts, all of which are directly related to teaching, and analyzed the total score. As a result of graphing, since a somewhat positive

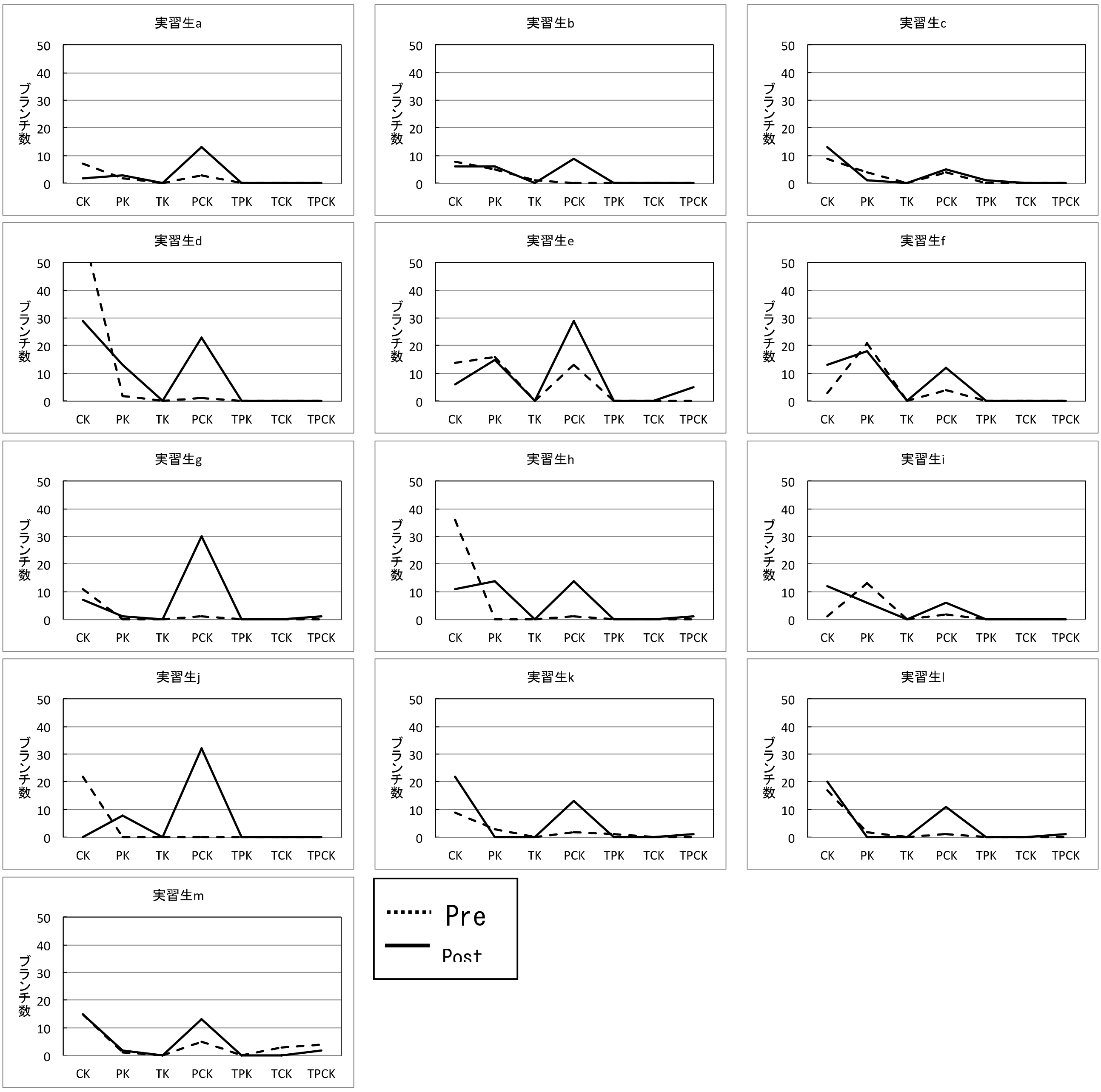

Figure 2. The Number of Branch of TPACK by student

correlation was seen between instructor evaluation of student teachers and the number of branches including PCK in the post mindmap, additional examination was conducted using the Spearman rank order correlation coefficient. Due to the examination results, a positive correlation was inferred between instructor evaluation of student teachers and the number of branches including PCK in the post mindmap (rs = 0.57, $p < 0.05$). What can therefore be understood from analysis using mindmaps of PCK transformations is that they assist in grasping the changes in the practical ability of student teachers.

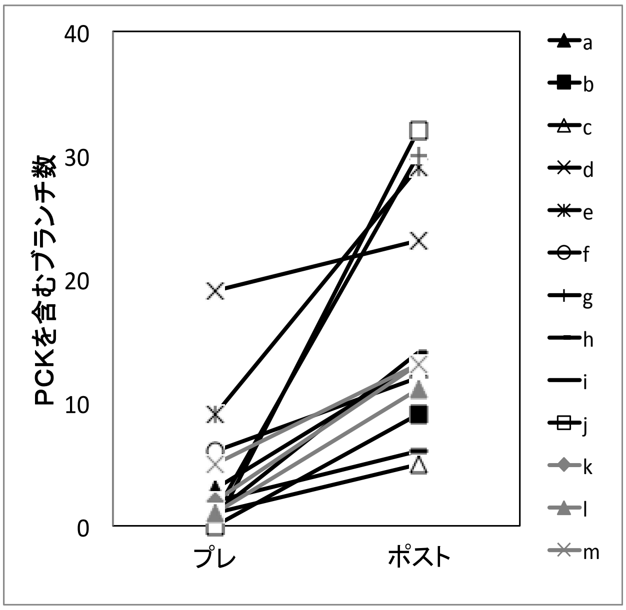

Figure 3. Result of Pre-Post by students

Branches including TCK, TPK and TPACK were detected in student teachers b, c, e, g, h, k, l, and m, and tended to increase in the post mindmap compared to the pre mindmap. In practical application, all student teachers observed or implemented classes using document cameras, electronic blackboards and iPads. However, branches including TCK, TPK and TPACK could not be detected in mindmaps for all student teachers. For that reason, student teacher e taught how to use gas burners in the final class while confirming it with a document camera, student teacher g in the final class used a document camera to teach a calculation method that the students were having difficulty with in an easy to understand fashion, student teacher h showed an actual item with a document camera to arouse interest among students in the final class, and since the subject of the last class was the human body, student teachers k – m used a large amount of images as teaching materials. In other words, the results strongly depended on the details of the final class. However, since there is a trend for the detected number of branches including TPACK to increase in post mindmaps, if this is observed linked to the increase in PCK, there are changes enabling consideration of how and for what purpose to use ICT among student teachers thinking how to teach science.

4. Findings

The below four points are raised as results of this research.

1) There is instruction recognizing the TPACK framework for ICT use as well in the practical instruction class preparation cycle. As a result, as stated before, more

branches including TCK, TPK and TPACK were detected in post mindmaps than pre mindmaps. However, as seen in figure 2, examining the process of knowledge transformation overall many changes are seen in PCK. Since they are affected by such factors as the purpose and details of the managed classes, it was understood that it is difficult for TK, TCK and TPK to appear independently (it is difficult to be aware of the use of this knowledge). Rather, when they appear they do so in the form of a mixed TPACK. What is interesting is that, as preservice teacher student m indicates, even if there is greater awareness of TCK, TPK and TPACK at the time of the pre mindmap, through practical experience transformation enabling consideration of when and for what purpose to use ICT is seen. In other words, if TPACK is deliberately taught in practical instruction it became clear that what was previously learned in some form (lecture, etc.) about TPACK was further examined in practice.

2) In mindmaps, since words are connected to branches in the order of thinking from main branches, tracing words from main branches to sub branches enables reading of the context in which the words appear. Using these characteristics to conduct analysis using mindmaps and quantify fitting the TPACK components, it was possible to grasp the transformation in the student teachers. In other words, when giving instruction recognizing the TPACK framework, it became clear that mindmaps recognize TPACK and can be a tool to visualize changes, even for instructors and student teachers.

3) During practicum, the student teachers drew pre, group and post mindmaps. Making group mindmaps expresses mutual thinking concerning an image of teaching and is effective in recognizing required knowledge. Namely, if mentioned in the conditions and environment causing transformation, it became clear that opportunities through such groups to encourage visualization of knowledge and thinking are important. Results of using mindmaps to understand changes in student teachers will in the future be reflected in the formative evaluation and instruction of preservice teacher students.

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Note

This report, while referring to the following report, by adding to findings of research, summarizes the results. Satake,Y did this practicum and analysed preservice teacher student's transoformation.

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