

# Development and Evaluation of Case Method Teaching Materials using Manga on Tablet PCs *A Trial with Pointing Type Annotations*

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Abstract: The purpose of this research was to develop and evaluate a system that could be used to support university students and graduate school students desiring to become teachers by providing the knowledge and skills necessary for them to provide instructions for scientific experiments; the system involved sharing awareness of issues using easy to use tablet PCs. The system required learners to perform touch operations by pointing at locations with pins of four colors, at which time they became aware of issues within the scenes of the experiments involving the pupils depicted in the manga displayed on the screen. The learners mutually shared the things they noticed using the sharing function. The manga displayed on the screen is a case method learning material, developed for the purpose of educating teachers. It is embedded with a diverse amount of knowledge and skills necessary to become a science teacher, while enabling learners to acquire the observation skills of teachers. The sharing function and the color-sorted frame advancing function of this system were rated positively by the students. Furthermore, learners suggested that the system could be improved by adding a memo function as well as a function for an overall view and for viewing arbitrary pages.

## 1 INTRODUCTION

Currently, the greatest challenge for teacher education in Japan is nurturing the qualifications and abilities of teachers in order to increase their degree of specialization. The concept of pedagogical content knowledge (PCK) is widely known with regard to the qualifications and abilities of teachers (e.g., Gess-Newsome and Lederman, 1999; Mishra and Koehler, 2006). PCK is quite simply the knowledge that links directly to the abilities and levels of a teacher's specialty. The understanding of knowledge pertaining to experimental tools and educational materials, as well as experimental skills, is essential for teachers, particularly in the field of science education. Teaching materials for teacher education designed to nurture such power of execution, however, are lacking.

Technologies, including information and communication technologies (ICT) and digital content, on the other hand, have been widely

implemented in the field of education, right from elementary schools to universities. Tablet PCs, such as iPads and Androids, are starting to become popular as tools for learning, particularly in recent years. Many of the methods employed for such uses are knowledge communication types of multimedia educational materials or drill and tutorial type systems, developed with consideration for individualized support in an environment with simultaneous instructions (e.g., Ostaszewski and Reid, 2010; O'Loughlin, 2011).

Each individual learner, however, can handle a tablet PC and communicate with others, as well as share information, regardless of whether they are linked by Bluetooth or are configured into a server-client setup. This is the reason tablet PCs have been utilized as tools to promote sharing and externalizing and building knowledge in learning communities (e.g., Kim et al., 2009; Reid and Ostaszewski, 2011).

The biggest feature of tablet PCs, however, is the convenient operations involving touching and

gesturing. This aspect must therefore be fully considered when tablet PCs are utilized as tools for learning, through such means as keeping the entry of text to a minimum. A learning system intended for nurturing the practical instructional abilities of teachers who teach science was developed by utilizing the features of tablet PCs, such as touching and gesturing, to create a collaborative learning environment intended for teachers of elementary schools, university students and graduate school students desiring to become teachers.

The specific educational materials utilize manga as a communication tool with the aim of enabling effective interaction with tablet PCs. This is because students can read and interpret manga stories in relatively short periods of time; moreover, it is possible to provide information that is focused on the portions that should be read by the students. This characteristic of manga can be displayed effectively on tablet PCs and awareness of the students can be easily displayed and shared by performing touching or gesturing operations. These educational materials were case method educational materials developed by Daikoku and his associates (2010), which use manga that depicts scenes of learning actually occurring in experiments by pupils. The acquisition of situational decision-making abilities is supported by integrating the learners into the stories as the main characters in charge of solving problems. These case method educational materials were developed and evaluated as paper-based materials and their effectiveness has already been confirmed (e.g., Daikoku et al.,2011).

Learners in the community can use this system to share pins indicating their awareness from images representing scenes from science experiments in their elementary school and their thoughts. The pins represent what the students in the community thought about and what they became aware of.

The idea was to utilize these more effectively on tablet PCs. A system for visualizing and sharing locations, which learners notice in manga educational materials for the case method by inserting annotations through touch operations, was therefore developed and its effectiveness was examined for the purpose of this research.

## 2 OUTLINE OF SYSTEM

### 2.1 Development Environment

The development environment for tablet PCs was Adobe Flash CS5.5. It was therefore possible to release publications as applications for iOS and Android, respectively. The development environment on the server side comprised Windows 7 (Professional), Apache 2.2, PHP 5.3 and MySQL 5.5. As long as the same level of service can be provided, it will also be possible to create an environment on other operating systems.

### 2.2 System Configuration

Figure 1 shows the configuration of this system.

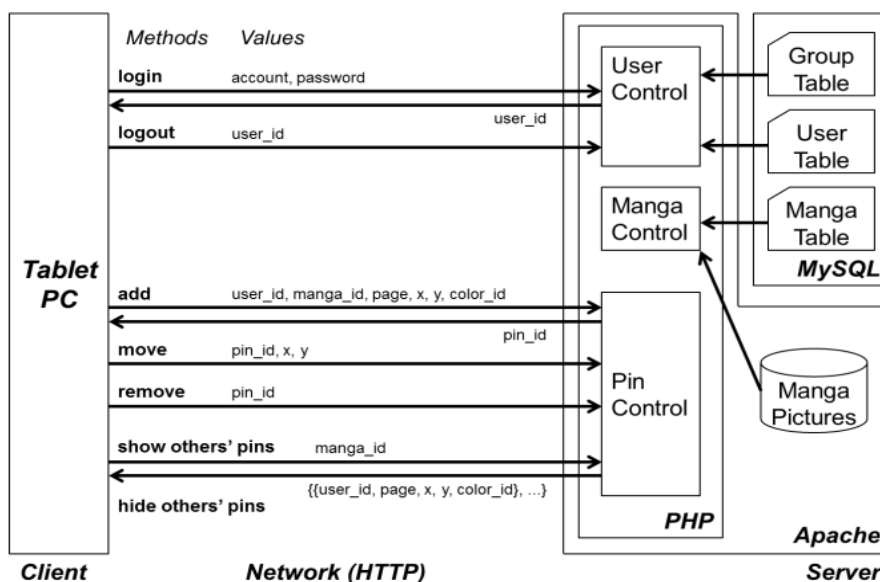


Figure 1 : The configuration of this system.

Although only one tablet PC is depicted here, multiple tablet PCs were actually connected to the server, making it possible to share data, for instance, with placed pins. Once logged into the system, clients are able to browse any arbitrary page of manga and operate a variety of functions, primarily the pin placement function on any arbitrary location in the frames—wherever they feel problems exist. Information of such operations is sent to the server via the network and then stored in the MySQL database via the Control unit on PHP. Once the “show others’ pins” command is sent from a tablet PC, the information on all pins placed on the manga being viewed is read from the MySQL database and loaded onto the tablet PC. Those pins are then displayed on the tablet PC. The sharing of pins that represent awareness locations among the learners becomes possible in this manner.

## 2.3 User Interface and Functions

Figure 2 shows the condition of how locations where individuals have become aware of issues are represented by the positioning of pins using the user interface (for iPads) of this system. The operation section for various functions located in the upper section of the interface is shown in Figure 3.

### 2.3.1 Pin Placement Function

Pins of four colors, blue, green, yellow, and red, are arranged as shown in Figure 3. These pins are dragged and dropped onto the manga to add



Figure 2: User interface after pin placement.

annotations. Pins in four colors were developed to allow learners to use them according to their arbitrary observation points. Blue has been assigned to lesson instructions; green, to experimental skills; yellow, to lesson environments; and red, to others for the purpose of facilitating a common understanding on the observation points in our practical implementation.

Assigning such meanings to pins clarifies the observation points that led to the placement of pins on locations.

### 2.3.2 Pin Relocation and Deletion Functions

Pins that have been placed can be relocated. Furthermore, pins can be dragged and dropped into a trash bin located in the operating section, shown in Figure 3b, when they have to be deleted.

### 2.3.3 Manga Page Manipulation Function

Users can flip forward through the manga by swiping a page to the right and move backward by swiping pages to the left (Figure 3d). No buttons have been specially set up for these purposes.

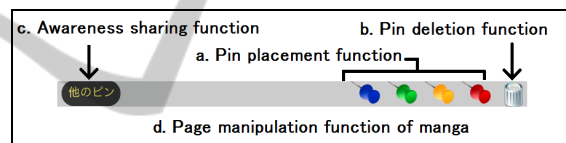


Figure 3: Operating section for various functions.

### 2.3.4 Awareness Sharing Function

Touching the “Other pins” button, shown in Figure 3c, displays pins placed by other learners on the same page as semi-transparent pins (Figure 4). This operation enables learners to share annotations using pins. Conversational activities can be promoted by focusing on the relocations and colors of pins.

The locations of the focus and their categories can be represented using pins of four colors and shared through touching and gesturing operations of this system, which can be considered to be fully utilizing the conveniences of tablet PCs.

## 3 EVALUATION OF THE SYSTEM

### 3.1 Evaluation Subjects and Period

The study involved a total of six subjects from 4 university students and 2 graduate school students



Figure 4: User interface after sharing.

desiring to become teachers, a national university located in Japan. None of the subjects had any experience using this system or the case method educational materials that use manga. The study conducted in October 2012.

### 3.2 Procedure of the Experiment

Operations were explained to the learners before the relationship between the colors of pins and observation points was explained. They were then instructed to read through the manga once, swiping pages to flip through it. Next, learners were given 10 minutes to perform the task of placing the pins at locations in the frames of the manga where they became aware of issues. Discussions were held by having learners mutually share the pin placements. A discussion that focused on different locations selected for the awareness of issues, as well as how pins of different colors were placed even in the same frames, was held for about 30 minutes. Figure 5 shows the evaluation of the experiment. All the subjects were interviewed immediately after the experiment.

### 3.3 Procedure of the Survey

An interview survey was conducted in order to clarify the validity of the system, focusing primarily on the functions of the system, from the perspective of the learners. The duration of the interview was about 10 minutes per person. The responses were video-taped and then transcribed.



Figure 5: Evaluation of experiments.

## 4 RESULTS AND DISCUSSION

The results of the study are discussed from the perspective of the advantages and improvements for learners.

### 4.1 Advantages of the System

The trends of responses pertaining to the advantages of the functions of this system, from the perspective of the learners, are summarized by the following three aspects. They are individually examined, with a typical interview protocol cited in Table 1.

#### 4.1.1 Ease of Sharing Awareness of Issues

Six subjects all cited the ease of sharing pins for indicating awareness of issues. A in Table 1 depicts a typical protocol relating to the ease of becoming aware of the issues indicated by pins in frames. Regarding the use of sharing functions for the awareness of issues, KI, YA, HI, AN, IN, and KE positively evaluated the aspects of ease of gaining knowledge differences in the awareness of issues in frames indicated by pins, as well as differences in observation points. On the other hand, AN cited the benefits of having a comprehensive overview of others' awareness of issues at a glance, which made it possible to improve efficiency in discussions, along with the ease for specifying particular frames.

#### 4.1.2 Color-coded Pins Placed in Frames Facilitated Easy Identification of Observation Points

Two people positively evaluated the color coding of pins placed in frames. B in Table 1 depicts a typical protocol relating to the ease of seeing the

observation points, due to the color coding of the pins used in frames. AN and IN both evaluated the clarification of observation points using color-coded pins in frames to be a positive aspect that made it easier to determine the differences in frames.

#### 4.1.3 Several Pins can be Placed on Locations of Concern

Two people evaluated the fact that a lot of pins can be placed on a location positively. C in Table 1 depicts a typical protocol relating to the fact that many pins can easily be placed on locations of concern. AN and IN both positively evaluated the fact there is no limit on the number of pins that can be placed on locations where an awareness of issues exists.

## 4.2 System Improvements

Trends of the responses pertaining to improvements

Table 1: Advantages of this system from the perspective of learners.

### A. Ease of sharing

KI: I thought it was very interesting how I could share my observations with the people around me. I noticed how other people placed their pins at locations different from mine or they noticed things different from me and when I became aware of them, I could often figure out what they must have been thinking when they placed their pins, just by looking at those pins.

YA: There were a few places that I overlooked, so I think it was very good.

HI: I thought it was good that I could clearly see how other people used different color codes from mine on the same locations or where others also placed their pins on the same locations as me.

AN: The fact that things can be clearly seen and that the system allows you to see the opinions of other people all at once, I believe, shortens the time of discussion in comparison with ordinary debates. It was good that the details could be pointed out properly and clearly simply by referring to specific pins in particular frames.

IN: It was good because viewpoints and opinions of other people could be seen at a glance and be very easily understood.

KE: When you notice that other people have placed their pins at locations different from yours, you wonder why, which leads you to have a new awareness of issues.

### B. Ease of seeing observation points with color-coded pins in frames

AN: Simply put, I think you can become develop a completely different awareness of issues, even in the same frame, by clarifying them using pins, since they are color coded blue, green, yellow, red, and so on.

IN: What I thought was good about the system is that since four colors were available for the pins, even when multiple pins were placed on the same frame, it was clear to see the differences in perspective, which led to the placing of those pins.

### C. Ability to place many pins on locations of concern

AN: There is a benefit in the fact that many pins can be used to cover places where concerns exist.

IN: Since pins can be placed many times, it allowed me to place pins at many locations and also allowed other people to place their pins in many places. Thus, it was not about one place or the other on any given page, but we were able to place our pins for a variety of reasons.

\* The two alphabetical characters placed in front of the protocols represent the initials of the names of the test subjects. (The same applies hereinafter.)

in the functions provided by this system, from the perspective of learners, are summarized into the following three aspects. They are individually examined, with a typical interview protocol cited in Table 2.

#### 4.2.1 Memo or Sticky Note Function is Desirable

Three people cited the necessity of adding a new memo or sticky note function to the pin placement function of this system. A in Table 2 shows a typical protocol for such a memo or sticky note function. HI and KE both cited the necessity of retaining details of awareness on issues in frames as memos. This can be interpreted as an indication that issues can be forgotten with the current specification of noting observation points using only pins with four color codes.

Table 2: Improvements to this system suggested by learners.

**A. Memo or sticky note function**

HI: I think it would have been better to have some kind of sticky note, on which you can enter memos, rather than pins. When you have so many pins placed on a frame, you may forget why you placed your own pins, so it would be handy to have a memo when sharing with other people later on.

KE: It would probably be useful if memos could be entered, especially for people who tend to be a bit forgetful.

**B. Ability to viewing all pages and select particular pages**

HI: It would have been good if we were able to have an overview of all the pages and then select particular pages, but instead we had to flip one page at a time, which made the task quite cumbersome.

KI: I would like a function that makes it possible to view a previous page.

**C. Function to change colors of pins.**

KE: It would be good if it was possible to select a desired frame in a similar fashion as right clicking on a computer or selecting colors with right click, etc.

IN: When I was performing the task, I actually experienced situations where I thought and did change colors of particular pins; these changes were reflected on my own display but not on my neighbor's display.

**4.2.2 Functions for Viewing All Pages and Selecting Particular Pages**

Two people mentioned the need to add new functions for viewing pages in their entirety to the system. B in Table 2 shows a typical protocol for adding the option of displaying an overall view of all the pages to the manga page manipulation functions. HI stated that it was cumbersome to flip pages, whereas KI cited the need to view previous pages immediately. Thus, a function that allows users to jump to a page or to open an arbitrary page across the entire file and improve efficiency is needed, since at the present time the page manipulation functions for the manga only allow learners to flip one page at a time.

**4.2.3 Function to Facilitate the Changing of Colors of Pins**

Two people stated that they would like to be able to

change the color of pins while performing their tasks. C in Table 2 shows a typical protocol for changing the colors of pins after placing pins and also while sharing them. KE requested a function that enables the changing of colors instantly whenever a need to do so arises, whereas IN cited that the changing of colors while sharing awareness on the issues should be reflected on the screen shared with other people. This feedback points to poor efficiency of the system, due to the fact that in order to modify the color of a pin, it must first be deleted and a new pin then be placed. Moreover, once sharing starts, it is not possible to alter the colors of the pins in frames.

**5 CONCLUSIONS**

A system that displays case method educational materials in the form of manga on tablet PCs and allows users to add annotations on the points of observations using pins placed on frames to be shared via a network was developed in this study. The system was evaluated from the perspectives of learners and all test subjects validated the utility of the function for sharing awareness on issues. Furthermore, other features, such as clear indication of points of observations by placing color-coded pins on frames and having an unlimited number of pins that can be placed onto frames, were also positively evaluated.

Suggestions for improvement included requests for additional functions, such as a function for providing an overview of all the pages at a glance and for displaying a particular page, as well as a function for easily changing the colors of the pins placed in frames. We would like to refer to incorporate these opinions by making relevant additions and improvements to the system.

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