Using Technology in Mathematics Classrooms with U-Learning: A Story from South Korea

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ABSTRACT— ***This articles details the self-study of an elementary teacher in her experience in teaching mathematics with technology. The practical use of technology in a mathematics instruction and its influences on students' learning was explored based on the framework of Ubiquitous Learning Providing specific procedures of developing and performing mathematics instruction with Ubiquitous Learning, this paper aims to broaden the understanding of using an educational technology. In particular, the paper provides implications for the elementary teachers, researchers, and policy makers in the United States as well as those in South Korea, from the case of a South Korean elementary teacher's mathematics instruction***

Keywords— Educational Technology, U-learning, Mathematics Instruction, South Korea

1. INTRODUCTION

The emphasis of using technology in mathematics classroom is not unique to the U.S. educational system [1]. In particular, South Korea, as one of the leading nations in technology, has been investigated in using technology in elementary mathematics education by developing Digital Mathematics Textbook (DMT) with a dedicated tablet PC since 2006 (See Figure 1).

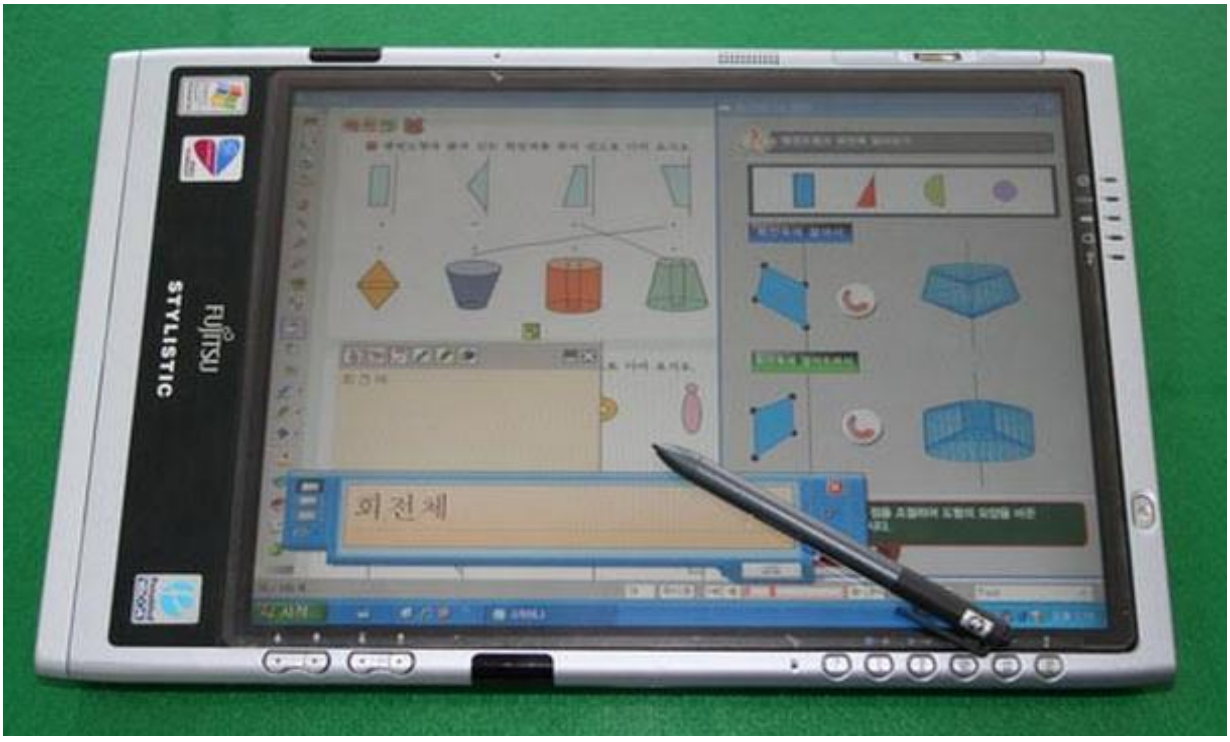

Figure 1: Digital Mathematics Textbook and Tablet PC

DMT includes 3D-animation for diverse shapes and executable cyber-manipulatives programs such cyber-geoboard. In addition, the table PC supports online-chat and data search service. The South Korean Government selects about one hundred elementary schools over the country and supports them to use DMT and tablet PC in their school every year.

KERIS (2005) acknowledges that the introduction of the educational technology in South Korea classroom should be understood in the context of Ubiquitous-Learning (U-Learning) [2]. U-Learning is the education system that supports the students learning regardless to physical limitations such as time, locations based on ubiquitous technology environment [3]. In particular, Ogata and Yan (2003) assert that U-Learning should support the students' authentic learning that relates to their real-life problems based on the interactivity and communication to the teachers, friends and expertise in cyber space [3].

In this context, this self-study describes my teaching experiences with DMT based on the framework of U-Learning. As an elementary teacher who works at the designated elementary school, I had to prepare to use technology including DMT in my fifth grade mathematics classroom in incoming academic year of 2010. During developing instructional process, I explored how technology might influence the work of planning and teaching mathematics. In designing my mathematics class, I was guided by four benchmark ideas, which will be discussed in the following section. With this focus, I set out to answer the following questions.

(1) How technology may support elementary students' mathematics learning at both inside and outside of a classroom in anytime based on the framework of U-Learning?

(2) How technology may support student to be introduced to rich mathematical tasks in daily-lives?

To answer my questions was significant because I needed to understand the strength of using technology in order to provide better mathematics instruction to my students than when we used traditional mathematics textbooks and manipulatives. The starting point of answering the questions was to see introduction backgrounds of technology.

2. UBIQUITOUS-LEARNING AND MODELING THE LESSON

Exploring the concept of U-learning, I realized that the technology should take a role more than just presenting abstract mathematics concepts with specified computer programs. Rather, the technology should support students to get the exact information that they need for at the moments. Based on my understanding of the definition of U-learning, I set up my instructional goals; all my students to be introduced to rich mathematical tasks in daily-lives and attempt to develop understanding of mathematics concepts in the task with technology in the context of U-Learning.

2.1.Modeling the Lesson based on the Framework of U-Learning

To develop lesson plans based on my understanding of U-Learning, I addressed four important benchmark ideas for U-Learning mathematics instruction according to the major characteristics of U-Learning described as shown in Figure 2.

- Accessibility: U-Learning supports the students to access to data for learning at any places based on their requests. It supports leaner's self-directed learning.
- Immediacy: U-Learning supports learns to record their ideas or questions on online-database system.
- Interactivity: U-Learning support students' both synchronous and asynchronous interactions with expertise, teachers or students.
- Situating of instructional activities: With U-Learning, learning tasks are presented as authentic forms that relate to daily-life problems.

Figure 2: Characteristics of U-Learning (Adapted from Ogata and Yano, 2003)

With the benchmark, I analyzed the 5^{th} grade mathematics curriculum and chose mathematics topics that closely relate to students' daily-lives. Among selected topics, I examined the possibility of improving students' mathematical understandings when they might use technology according to the benchmark.

All things considered, I developed at least one mathematics projects for each chapter of the textbook in which my students may improve their mathematical understandings with technology. The following project is one of the projects that my students performed during the semester. Before I introduced the project, I would acknowledge that I spent several days introducing how to use DMT, as well as to communicate with each other using the tablet PC to my students at the beginning of the semester. After my students were familiar with using functions and tools of both DMT and the

tablet PC, I started to use technology in my mathematics instruction.

2.2.The Mathematics Projects with U-Learning

The objectives of the project is to support my students to understand the concepts of 1 square centimeter (cm^2) and 1 square meter (m^2) and to apply their knowledge about area-units on their real life mathematics problems. In order to manage the project efficiently, I set up the plan for schedule (See Table 1).

Table 1: Plan for the Project

Major Topic of the Students' Learning	Understanding Given Problems	Designing Plans for Solving Problems	Performing Plans for Solving Problems	Presenting and Discussing about their answers for the problem
Students' Learning Place	Inside of the classroom	Inside of the classroom	Outside of the classroom	Inside of the classroom
Students' Learning Time	40 Minutes* (One Class)		Three days	80 Minutes (Two Classes)
Required Technology	Internet Bulletin Board Connected to Online Database	Internet Bulletin Board Connected to Online Database	DMT/Internet Bulletin Board Connected to Online Database /Online Chatting Program	Online Voting Program

* Note. In South Korea, the duration of one lesson is usually 40 minutes.

On the first day of the project, I presented the problem to my students, "From previous lessons, we learned about area units such as cm^2 and m^2. Now, we are going to solve a mathematics problem based on what we learned. Here's a square-shaped tile. The length of each side is 50 centimeters. Our school is planning to cover all walls, floors, and ceilings with this tile inside of the school building excluding basement and hallways. However, we do not know how many tiles needed. How can we calculate the number of tiles? Do you have any idea?" I decided to start conversation with whole class, because I wanted to make sure that all students understood the purpose of the project clearly. Also, I believed that my students might get some clues from the classroom conversation.

NaYoung (All names are pseudonyms) rose up her hand and answered, "I'm going to cover the walls, floors, and

ceilings in one classroom. Then, I can multiply the number of tiles for one classroom by the number of the classrooms in a school, because the size of all the classroom is same." JaeHyuk replied, "But some classrooms look different. The computer lab is bigger than our classroom. So we cannot simply multiple one size of the classroom by the number of the classrooms in the school." JunHo also argued, "I think we don't need to cover all the spaces with tiles in a classroom. The classroom looks like a rectangular parallelepiped. So, the sizes of area of spaces, which face to each other, are same."

While my students were discussing, I recorded their conversation and uploaded the video-clip to the classroom the Bulletin Board System (BBS), and I said, "During the discussion, several things you need to consider emerged. Now, you are going to develop a plan for calculating the number of tiles with your own group. For three days from tomorrow, each group should find the answer based on the plan. On the fourth day, you are going to present how you find the answer with your group members. I already posted the problem, classroom discussions and the other things you need to consider such as safety considerations on BBS. Also, each group will have own BBS. I need you to upload the process of performing this project. You can take pictures or video-clips. You may discuss using chatting programs or BBS. If you have any question, you can email to me or the other expertise on Internet. You may also use DMT when you need to check mathematics concepts." After announcement, I divide my thirty-two 5^{th} grade students into six groups. Reviewing the classroom conversation uploaded just before, each group developed their own plans. My role was to monitor their conversation and to remind them what they needed to consider such as different size of the classrooms. I also encouraged my students to record their conversation or to leave notes about their decisions on the group BBS.

For following three days, I could check students' progress via group BBS. A few students emailed me about their difficulties. I did not provide the right answer for them. Rather, I suggested several options that they could choose. On fourth day, each group had ten-minutes for their presentation. The following two examples of Group and B are representative cases of students' presentations.

DaeSik from Group A started the presentation, "The school building has four floors excluding basement. From the observations, we found that there are fifty-four general classrooms, which have same size to each other. Also, there are four restrooms on each floor, and their sizes were same to each other." SoYoen added, "We also found that there are nine classrooms, which have their own unique size such as the principal's office and the computer lap." WonJae said, "Therefore, there were eleven rooms that we need to measure the area. So, each member of our group had taken a responsibility for measuring areas of two or three rooms." BoKyoung explained, "Before we visited the classroom, we had sent emails to the teachers in order to get permissions to measure the room. After making an appointment, we measured sizes of each room and took pictures and recorded our activities as we uploaded on the group BBS. We used a tapeline to measure the room. After measuring, we calculated the sizes of classroom as an individual and uploaded own answers to BBS, and then we crosschecked the answers. The answers were not same at the first. So, we discussed about our answers using Internet chatting program. The area of a tile was equal to $250cm^2$, which is $0.25m^2$. The total area of spaces of every room in our school was equal to approximately $20{,}945m^2$. Finally, we found that we need 83,780 tiles." The other four groups solved the problem in a similar way with Group A. However, Group B had a different approach.

JinHo from Group B started the presentation stating, "My uncle is an architect. So, I already knew that there needed a blueprint in order to build a school, because I had seen my uncle had worked with a blueprint." Yuna explained, "We decided to use a blueprint rather than measuring the sizes by ourselves. But, we did not know where we could get the blueprint. So, we emailed to the school custodian. After he received conformation letter from the teacher, the school custodian sent us a copy of a blueprint via email to us." JongHak said, "However, we did not know how to read the blue print. So, we decided to send the copy to Jinho's uncle via email. We wanted to visit his office, but we did not have enough time. Thankfully, he sent us a video-clip, which included his explanation about how to read a blueprint. At first, there were some parts that we could not understand. We emailed to him again, and finally we could find the lengths that we needed for calculating the area of spaces." HyunJin added, "After that, we calculated the number of tiles like the other groups did."

During the presentation, I did not provide any comments on their works, because I wanted to listen students' onions about the project. After finishing presentations of all group, I asked students to vote the best presentation group using online voting system. I also encourage them to write down what they learned from the project as well as the other group's presentation. Most of the students said that they were impressed by the Group B's presentation. In particular, MyungSook wrote, "It was interesting for me to communicate with my group members in the cyber space. The best part was that I did not need to worry about scheduling group meetings. We could use chatting program or BBS. I also could get help from the teacher via Internet and checked what we learned from DMT at any time. Particularly, I learned that I could get help from everyone in the Internet from Group B's presentation. It was brilliant! They got the correct answer with less effort than mine. They also had a chance to learn about a blueprint, which I did not learn from the lesson. If I have a question when I study, I would like to ask it to expertise via email like Group B did."

3. A LOOK INTO THE USE OF TECHNOLOGY IN THE MATHEMATICS CLASSROOM

Before using this lesson, I was not sure that how the technology may improve students' mathematics learning. I was also worried about my students' ability to use technology in their learning. However, I realized that my fears were unfounded after finishing projects. My students' proficiency in using technology is more than I just expected. Also, I learned that using technology with the concept of U-Learning was helpful to both the students and me.

To use of technology stimulate my students' interest in mathematics learning. All my students participated in the project enthusiastically. Also, they had a chance to apply their mathematical understanding of area units on their real life problems. The best part of the project was that it was helpful to improve students' mathematical communication ability. Usually, some students dominated mathematics discussion in the classroom. Also, because of the time limitation, sometimes I did not provide equal chances to speak their ideas to my students in the classroom. When my students used chatting programs or BBS, all students had an equal chance to present their opinions at any time. I could observe my students' in-depth discussion to find the answer of the project from the chatting program or BBS.

The use of technology in the mathematics classroom was also assistance to me in managing the project and assessing my students. I could observe students' participation in the project, although I was not being there with them. From updated pictures, movie-clips and discussions on Internet, I could check each group's progress and provide proper feedbacks to them. In addition, the data from the students' works was helpful when I assessed the projects. I could see each student's participating degree, understanding on the mathematics concepts including misconceptions and mathematical communication abilities from the data.

After finishing project, I realized that teachers should make efforts to innovate their mathematics classroom in order to support their students to improve their mathematical understanding. I also learned that to use technology based on the concept of U-Learning might helpful to expand students' learning infinitely breaking barriers of limitation of time and space. Although my experiences was about South Korean mathematics classroom, I expect that the U.S educators and teachers get some ideas of using technology in their mathematics instruction. The teaching case in this paper shows that to use technology based on the concepts of U-Learning may improve students' conceptual understandings, capacity to think logically about the relationships among concepts and situations, and abilities of solving mathematics problems that the Common Core State Standards for mathematics emphasizes.

4. REFERENCES

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