

An Investigation into Students' Writing Process Using Digital Pens in Exercises During Lessons

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Abstract: Many university classes nowadays have adopted the active learning (AL) style. AL is conducted through various techniques. In this report, we focus on exercises during lessons in class. We propose that teachers should know how students work on exercises in order to be able to give more effective support to students on these lessons. In order to investigate how students work on exercises, we used digital pens to collect data on their writing process using those pens and analyzed the data. The results showed that the students' writing process had two important features: making attempts at exercises during explanation of the theme by the teacher, and adding other answers during group-work or explanation by the teacher after answering.

Keywords: Digital pens, writing process, active learning, lesson study, higher education

1. Introduction

Recently, many university classes have adopted the active learning (AL) style. AL involves various techniques, for instance, project-based learning, learning through educational games, and learning by completing exercises during lessons. In this study, we focused on exercises during lessons.

Many studies focus on exercises during lessons in higher education. For example, Crouch and Mazur (2001) present the peer instruction method, which gets students more involved in their own learning during lessons and focuses their attention on underlying concepts. However, it is important that teachers not merely design AL classes but also assess students' performance or process in AL environments. This allows teachers to find ways to provide more and better support to students in AL classes and to better assess their performance.

In the present study, we used digital pens to collect data on students' writing process while they completed exercises on worksheets during classroom lessons. Digital pen technology has been used previously in educational settings, for example to share notes or memo between students (Steimle, Brdiczka, and Mühlhäuser, 2009), or to assess students' writing performance or process (e.g., Ikegami and Ohsawa, 2015). The purpose of the present study is to investigate how university students work on writing exercises during their class lessons.

2. Research Objects

The Course Design

The course in which this research took place was conducted at a university in 2015. About 180 students participated in each lesson. The course theme was "learning environmental design." Lectures on knowledge creation, study support, and educational assessment were provided over the course of the semester. In each lesson, the teacher repeated two or three cycles of the following activities: (1) lecture by the teacher; (2) exercises related to the lecture; and (3) group-work to share students' answers among them. The teacher distributed the worksheets in each lesson, one by one, and students filled them in.

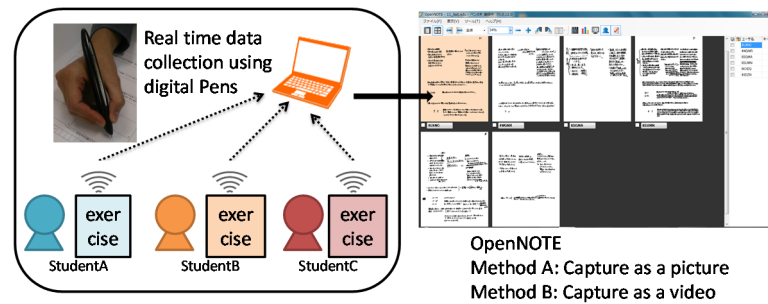


Figure 1. Methods of Data Collection.

Students started using digital pens in the 5th lesson. However, we could not analyze the data for the 6th, 12th, and 13th lessons because of malfunctions of the digital pens and Bluetooth receiver. We also excluded the 10th lesson because there was a guest lecturer.

Methods of Data Collection: Using Digital Pens

We used the Anoto Digital Pen (DP-401) to collect students' writing data. The special paper used with this pen has a microdot pattern surface, and the pen camera reads these dots to identify the pattern of the writing. The data were transferred to PC via Bluetooth. Using OpneNOTE, the data for all students were displayed with pictures onscreen, and could be managed there (Figure 1).

Since this study is a pilot for future work, we had only six students use digital pens when they wrote exercise answers, all semester. The participants were students who expressed their own interest in taking part or who were recommended by the teacher (Table 1).

3. Research Methods and Resources

We examined the students' writing process of exercises during lessons using two methods.

The first way was by capturing students' exercise answers as pictures at different stages (we called this approach "Method A"). We used this method from 5th to 11th lessons. We captured data five times per exercise, respectively when the students were (1) presented with exercise content, (2) started the exercise, (3) finished the exercise (started the group-work), and (4) finished the group-work (that is, at the beginning of the explanation by the teacher), and also (5) at the end of the explanation by the teacher.

The second approach was by capturing students' answers as videos in order to examine how early or late students started and finished to write (we called this "Method B"). We used this method on the 14th lesson.

4. Results

Method A: As Students Write Answers

Table 1 shows the timing with which students wrote answers to the exercises during the lessons. In the table, "1" means that the student started writing when first presented with exercise content by the teacher, while "3" means that the student added further material to the answer during group-work, and "4" means that students added to their answers during the explanation by the teacher after answering time was over.

The results suggest that students C, D, E, and F often started writing at "1." On the other hand, students A and B often began writing in the answering time, from "2" to "3." In 5th lesson E2 (C, D, E), 7th lesson E3 (A, C, E), and 8th lesson E3 (C, D, E), three students started at "1" each exercises. We considered these findings to relate to the theme of the exercises. For example, 8th lesson E3 asked students to "Consider learning support to students themselves by other people: teachers, parents, other learners." The themes they responded with focused on students' own

experiences. We consider on this basis that themes related to student' experiences are relatively easy for students to absorb.

Table 1: Results for Method A by Participant

Student(year)	5 th lesson		7 th lesson			8 th lesson			9 th lesson			11 th lesson		
	E1	E2	E1	E2	E3	E1	E2	E3	E1	E2	E3	E1	E2	E3
A (3)					1									
B (3)						3								
C (2)		1			1			1		1		1		1
D (2)		1	1				4	1	3	4		3		
E (2)		1	1		1			1						1
F (2)				1	4	Absent			Absent					

*E = Exercise; thus, E1 = Exercise 1, etc.

Method B: When Students Write Answers

We examined when students started writing answers using video that captured students' writing process. The 14th lesson had two exercises. The first involved gathering information from a reading, instead of a lecture. Students did the exercise after the reading the handout. In the second exercise, the teacher presented the exercise theme at the opening of a lecture (lecture 2 in Figure 2 below).

In the 14th lesson, almost all students answered the both exercises on time. However, student D added additional answers after and during group-works. We focused on student D because she also tried exercises early or added to the Method A analysis. Figure 2 shows the lesson plan for the 14th lesson and student D's writing process for exercises. She stopped writing during group-work and wrote after group-work (Exercise 1). This result suggests that she engaged in group-work and got some information or advanced knowledge from it, which she added.

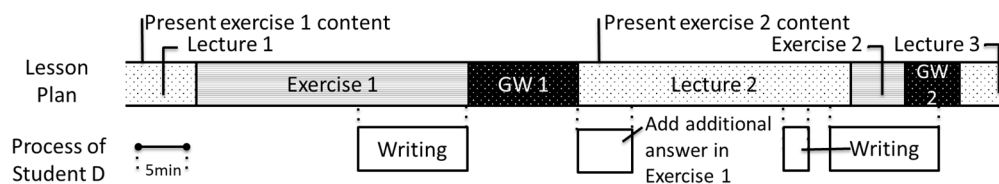


Figure 2. Compare the Lesson Plan and Student D's Writing Process in the 14th Lesson.

5. Conclusion and Future Work

In this study, we investigated how students worked on exercises during lessons on the basis of data on their writing process collected with digital pens. As a result of the analysis, we identified two important features of their process: trying exercises during explanation of content by the teacher, and adding more material during explanation of the exercise by the teacher or during group-work after the answering time was finished.

The next step in our project is to look for any relationships between students' writing process and learning outcomes. To do so, we will examine the exercise-writing process during lessons and exercise outcomes for a larger number of students.

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