A Peer-Assessment System Connecting On-line and a Face-to-face Smart Classroom

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Abstract: Peer assessment can enhance students' learning effect by comparing their learning outcome with their peers' outcome and by benchmarking them. It also helps students to increase their responsibility and autonomy. However, the peer assessment has usually been adapted in e-learning environment because of the easy use on the Web. On the other hand, many Education Collages in Universities encourage students to give presentations as one of class activities because the students can have confidence and build up their practical experience by their presentations. The peer assessment is a good way to use in presentation-based learning. Due to the advent of smart learning environment, students can learn anywhere and anytime. It means that smart learning eliminates the distinctions between on-line and off-line classes by using smart technologies. However, some instructional methods still have difficulties in performing in face-to-face classrooms because there is no system that keeps the class activities happened in our classroom like e-learning systems. In this paper, we design and implement a prototype of the peer-assessment system for students and teachers that can assess the peers and the students respectively. In addition, the proposed system stores the assessment result in a database and feedback the result to the students and the teachers for smart learning.

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1. Introduction

IT has changed our education paradigm these days. Since the Korean Education Department announced the smart learning strategies and plans in 2011, the research works related to the development of smart classrooms, digital textbooks, and class supporting tools have been performed (Cheon, 2013). Like many other countries such as England, Singapore, and Japan, Korea is also interested in the development of class-supporting tools for smart learning (Gye, 2013). In this research (Gye, 2013), the state-of-the-art of the class-supporting tools has been summarized by promising instructional models in the 21st century. As the promising instructional models, there are situated learning, problem-based learning, project-based learning, and collaboration learning (Gye, 2013). However, we hardly found the research that connects the class-supporting tools with students' assessment.

On the other hand, when teachers evaluate the academic achievements of secondary school students, learning process has been treated more important than learning outcome recently. At the same time, performance assessment has been regarded as a good method for measuring students' academic achievement. Due to the advent of e-learning systems, performance assessment becomes easier to adopt because the e-learning systems can monitor students' activities automatically. By archiving the students' activities in the system, the teachers can analyze their students' learning process systematically and easily.

Recently, the peer assessment has been adopted as a good class activity in e-learning environment (Lai et al., 2006) (Gentile et al, 2003) because it is easily performed in on-line environment. The positive learning effects of peer-assessment have announced in many research works (Topping, 1998) (Dochy et al., 1999) (A'ali, 2007). It enhances students' learning achievement as well as their meta-cognitive skills (Sadler et al., 2006). According to Kim's work, learners' peer-assessment scores are acceptable to use when teachers grade the learners (Kim, 2007). In (Ahn, 2008), the author presented a case study that showed where the peer-assessment is more efficient to apply to classes. According to the paper, hard courses are more suitable to apply peer-assessment than basic courses.

In 2011, the Ministry of Education, Science, and Technology in Korea announced the necessity of smart education in secondary schools. Currently, most schools are interested in digital textbooks and the use of smart devices. However, we need more useful tools for our smart learning environment. In other words, it is difficult to find smart class support tools that work well on-line and off-line at the same time. If students' class activities happened in face-to-face classrooms can be stored in a certain system like e-learning environment, teachers can analyze their students' learning process more in detail and feedback more accurately for students' reflection.

In this paper, in order to satisfy the previous need, we design a peer assessment system that works well in team-based presentation classes. The team-based presentation learning is a type of collaboration-based learning. Also, this learning method enhances meta-cognitive skill, which helps to monitors students' own learning processes (Noguchi, 2010). Our system consists of two parts; one is a web-based tool for teachers and the other is an app for students and teachers. The teachers' tool helps to register team information and assessment items, to assess the presentation of each team, and feedback the results of their presentations. The app can assess the peers' presentations in a real-time manner. The presenters can confirm their assessment results immediately after presentations. Also, the students can read the feedback from the teachers after the teachers send messages to the students later.

Our paper is composed as follows. In the following section 2, we summarize the background related to our system. In section 3, we present the functions of the components of our system. In section 4, we show the implemented functions of our App and the web-based tool. Finally, we conclude our paper in section 5.

2. Background

Korean Ministry of Education, Science, and Technology defined the Smart education as the intelligent teaching and learning support system for changing overall education system such as pedagogy, curriculum, assessment, and teachers in Korea (Korea Ministry of Education, Science, and Technology, 2011). Smart stands for Self-directed, Motivated, Adaptive, Resource enriched, and Technology embedded. By performing the Smart education, we can expect the changes in our classrooms. The changes include educational content (digital textbook), instruction method and evaluation (on/off-line evaluation system), education environment (information ethics and laws), teachers' competency (smart teacher training program), and cloud-based education (standardization of education platforms).

The Design of the learning activity for fulfilling our Smart education has been performed by Cho's work (Cho, 2013). According to (Cho, 2013), ITL Research (http://www.itlresearch.com) developed an index for enhancing learners' core learning abilities in the 21st Century. The desirable learning activities are collaboration, knowledge construction, self-control, practical problem solving and innovation, ICT literacy, and communication. Thus, for the desirable learning activities, in (Lee, 2005), project-based learning and collaborative learning are expected to be the most promising instructional learning model as shown in Table 1.

Table 1. Instruction Learning Model for 21st Century

Model	Frequency	Percentage
Goal-based Scenario	51	11.1%
Case-based learning	61	13.3%
Situated learning	63	13.7%
Problem-based learning	74	16.1%
Project-based learning	101	22.0%
Collaborative learning	81	17.6%
Cognitive Apprenticeship	29	6.3%
Total	460	100%

From the existing research works about smart education, the desirable learning activities and learning methods have been defined well, but the assessment methods and tools for smart education have rarely been proposed. One thing for the future student evaluation methods is that performance assessment is suitable because it considers not only students' achievement outcomes but also their learning processes. However, a new method for the performance assessment for smart education has not been proposed (See also Figure 1 below).

Face-to-face classroom Class activities	**On-line, web-based, or e-learning**
▪ Main education ▪ Most of the class activities happen. ▪ Various types of learning methods can be applied. ▪ There is no chance to store students' activity data automatically.	▪ Easy to accumulate data related to students' class activities. ▪ Restricted learning method for interaction ▪ Blogs, messaging, chatting are main tools for interaction. ▪ Assistant education
↓	↓
Performance assessment	**Performance assessment**
▪ Teacher's discretion ▪ A lot of efforts to assess ▪ A lot of time for analysis ▪ Existence of missing data ▪ Hard to continue to monitor students' activities	▪ Automatic assessment result generation for students' activities in the learning system ▪ Continuous student monitoring ▪ Depends on the functions of the given learning system

Figure 1. Comparison in performance assessment between face-to-face classrooms and on-line learning

3. Design of the proposed system

We divide the proposed system into two parts such as tools for teachers and tools for students. Firstly, there are 5 functions for teachers as follows:

- the team registration for the courses where teachers want to adopt peer-assessment
- the assessment items registration
- evaluation (grade)
- examining the result of the peer-assessment
- feedback sending to team (each of team members)

On the other hands, there are 3 functions for students as follows:

- peer-assessment
- examining the result of the peer-assessment in a real-time manner
- reflection with the feedback from teachers in the teachers tool

There are a few assumptions of our system. Firstly, we assume that the maximum number of evaluation items is 10 and the maximum number of team members is 3 because the average number of students in secondary school of Korea is 35 ~ 40. Flexible team size and the variable number of assessment items are not allowed at this time.

Next, we design our databases as shown in Figure 2. There are 8 tables for our system. The Teacher table contains the information of professors such as professor IDs, professor names, passwords, and the department codes of the professors. The Student table is similar to the Teacher table. The Course table contains a set of the year and the semester of a course besides an id, a course name, and a professor in charge. In the Team table, a team name and its members are included. Thus, teachers can send feedbacks to students by using the team ID in the Team table. We only keep the feedback message for teams as shown in Figure 2(h).

PID	PNAME	PASSWORD	DEPTCODE

•PID : professor ID •PASSWORD : professor's password
•PNAME : professor name •DEPTCODE : professor's department code

(a)Teacher table

SID	SNAME	PASSWORD	DEPTCODE	year

•SID : student number •SNAME : student name

(b)Student table

CID	CNAME	PID	DEPTCODE	year	SEMESTER

•CID : course number •CNAME : course name

(c)Course table

TID	TNAME	PID	CID	SID_1	SID_2	SID_3	YEAR

•TID : team ID •TNAME : team name

(d)Team table

CID	PID	QID	QUESTION	POINT	YEAR

•QID : question ID (actually number)

(e)Item table

CID	PID	QID	GRADE

(f)Grade table

PID	SID	CID	GRADE	YEAR

(g)Enrollment table

TID	TNAME	PID	CID	MESSAGE

(h)Feedback message

Figure 2. Database design for our system

4. Implementation of the proposed system

In this Section, we explain how we implement and show some of the Figures we implement. We implemented our system with the following environment. The MIT's App Inventor (http://appinventor.mit.edu) is a programming tool for developing applications for Android with its simulator or smart-phones. The App Inventor is composed of 2 parts such as the Designer for designing user interfaces and the Blocks Editor for combining programming blocks for application functions.

When we developed the first version, we used Google web engine. But there were some limitations when we managed data. Thus, in the second version, we use MySQL for storing data, and then we use JSON (JavaScript Object Notation) when we exchange data between the server (MySQL) and our App. In Figure 3, we show a snapshot representing data exchanging function by using the Blocks editor of the App Inventor as an example. Our system was based on the system proposed in (Park et al., 2014). However, we expand our development based on the previous work.

- OS : Windows7
- Web server : Apache2
- Host language : PHP
- DBMS : MySQL5.6
- App tool : MIT's App Inventor (http:// appinventor.mit.edu)

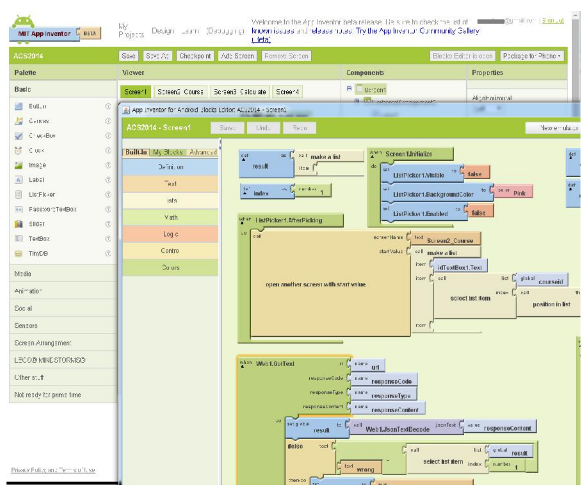


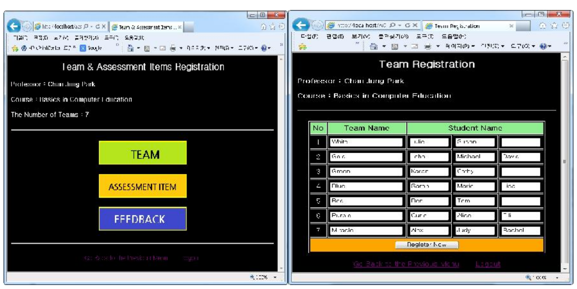
Figure 3. An example use of the Blocks editor

Figure 4 shows the web-based tool for teachers to register team information. When a teacher logs in the proposed system, then the teacher can see the list of the courses he or she is currently in charge (Figure 4(a)). When the teacher chooses a course among his or her subjects, he or she can determine the number of teams of the subject as shown in Figure 4(b).

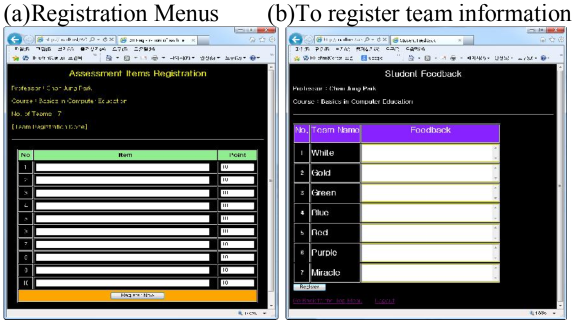
(a)List of courses to teach (b)To enter the no. of teams

Figure 4. To list the lectures of a professor and to enter the number of teams

Then, the teacher can have three alternatives: (i) team information registration, (ii) assessment items registration, and (iii) feedback. Since 7 teams are determined in Figure 4(b), 7 rows are given as shown in Figure 5(b). By our assumption, at most three students' IDs will be entered in fields. In Figure 5(c), the teacher enters the assessment items as many as he or she wants. If the number of items is less than 20, then the exact number of items will be stored in our database. Figure 5(d) shows the method of giving feedback to teams.



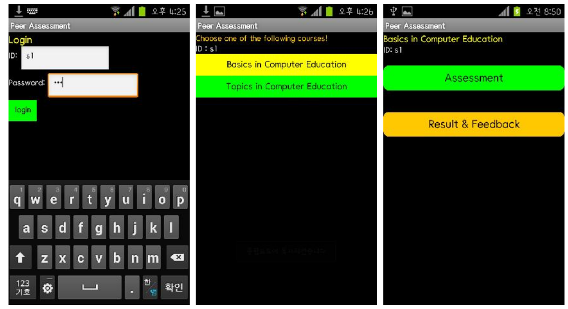
(a)Registration Menus (b)To register team information



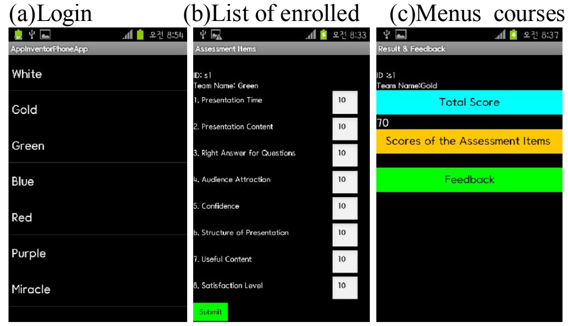
(c) To register assessment (d) Feedback items

Figure 5. Team, assessment items, and feedback registration

Next, we developed an Android-based app for assessment. Most functions are the same for teachers and students. The feedback function is different. In Figure 6, we describe how to use the App we developed. When we select one team to evaluate in Figure 6(c) and (d), the assessment items are displayed as shown in Figure 6(e). Now, we are currently implementing the feedback functions.



(a)Login (b)List of enrolled (c)Menus courses



(d)Team list (e)Assessment items (f) Total score

Figure 6. Android-based App for assessment

4. Discussions and Future Works

This paper aimed to extend the automatic students' class activity pattern analysis to the face-to-face classroom by using smart technology. In other words, this paper helps to keep the class activities happened in the off-line classroom by smart devices for enhancing students' meta-cognitive skills and helping their reflection. In order to achieve this goal, we proposed an assessment model and a prototype for a peer-assessment system for teachers and students.

If our tools are used in the real classes, we can expect a few positive results. Firstly, by gathering the patterns of students' class activities, teachers can evaluate their students more accurately and easily. Secondly, by using the data, the teachers can give more detailed feedbacks to their students and parents.

In the near future, we will apply this system to the real classes, and then analyze how this system works. Also, we will experiment how much students enhance their skills by using this App. Finally, we will analyze teachers' response about this system after using this system.

In this paper, we did not include the various type of analysis about students' activities yet. We can expand our tool to provide various kinds of assessment contents about students. Recently, education fields also begin to adopt big data technology in order to achieve the actual positive effects on the smart education (http://www.bicdata.com). The related research area is educational data mining (EDM).

EDM is one of the hot issues in multi-disciplinary research for developing meaningful educational data by using the advanced IT (Romeo and Ventura, 2010). EDM is different from the traditional data mining because the data generated in education area is hard to quantify unlike conventional field. For EDM, there are statistical and visualization information, clustering, association rules, sequential pattern, and text mining (Romeo and Ventura, 2007). Besides, the classification methods by Baker (Baker and Yacef, 2009) include correlation mining and distillation method.

From the existing research works about EDM (Madhyastha and Hunt, 2009) (Bresfelean et al., 2008), (Nissen, 2003), we propose 4 analysis functions to define the meaningful educational data from students' class activities as follows:

- Generation of the basic statistical data and visualization information about students' grade
- Learning contents recommendation for students based on the cumulative presentation grades and peer-assessment.
- Feedback generation for teachers
- Prediction about students' learning performance for teachers by comparing students' class activity patterns with the past data.

In the near future, we will provide 4 analysis functions for better assessment.

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