



Designing and Applying a Pedagogical Interaction Model in the Smart Cloud Platform

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ABSTRACT

Many researchers are trying to teach in the Smart Cloud Platform(SCP), but most of them either describe it on the conceptual level or realize it on the technical level. The development of the Pedagogical Interaction Model(PIM) has important educational significance and provides guidance for teaching in the emerging cloud learning environment. This study designs the PIM based on the SCP and further applies it in the class teaching of a junior high school. A total of 94 subjects from two classes were selected. One class was taught in SCP, and the other was taught in the traditional class. The pre-test shows both classes have little statistical significance in physics scores. After treating in the SCP for half a semester, the score of the treatment group was significantly higher than that of the control group which means the use of the PIM proposed in this paper can improve students' academic performance. The PIM has promising outlook in improving deep collaboration, communication, and personalized learning.

Keywords: smart cloud platform, pedagogical interaction model, connectivism, teaching support system

INTRODUCTION

The traditional classes often use the expository teaching method. The dull instructional mode lacks adequate interaction between teachers and students. Currently, the new curriculum standards propose to use diversified teaching and collaborative inquiry (Gao & Wang, 2014). The deep integration of information technology with teaching provides a strong technical support which has a promising opportunity to realize the curriculum reform. With the rapid development of the cloud computing, big data analytics, mobile Internet applications, the patterns of learning are undergoing significant changes (Chang, Chen, Yu, Chu, & Chien, 2015). The class is no longer confined to the single interaction between humans but advances toward multidimensionality. The smart cloud platform (SCP) is a positive attempt in this regard and has gradually become a hot research topic (Lee, 2015; M. Wang, Chen, & Khan, 2014). The SCP can be defined as the next generation of the intelligent classroom that integrates

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State of the literature

- Using the smart cloud platform as the teaching environment is becoming a hot research topic. However, little literature presents an integrated solution regarding cloud service and human interaction.
- Most of researchers either describe the cloud-based teaching on the conceptual level or realize it on the technical level. The study of the pedagogical application regarding the smart cloud teaching is not experienced.
- Most literature did not mention how to design the effective pedagogical activity and use the technology-enhanced tools when they are in the cloud-based platform, which makes students not engaged.

Contribution of this paper to the literature

- This paper designs and implements a smart cloud platform by taking the cloud service and human interaction into account, which presents a useful solution to the current smart classroom.
- This paper presents a proper pedagogical interaction model(PIM) in the SCP, which will guide teachers to effectively manipulate the SCP environment and motivate potentials of knowledge discovering and creating.
- The pedagogical activity based on the PIM is developed which uses the SCP to provide sufficient interactions between teachers and students. The pedagogical activity can significantly improve students' academic performance.

the cloud, internet of things and other new technologies. It forms an intelligent learning space by combining the hardware and software resources such as the computer, smart terminal, whiteboard, physical booth in the interactive teaching system. The SCP provides a technology-enhanced learning environment that characterizes as pluralistic interactions (Recupero et al., 2016). In addition to the traditional paper and pen, students can use the tablets with resources provided by the cloud to perform the self-regulated and collaborative learning (Su, Tzeng, & Hu, 2016). Then the smart classroom becomes an integrated learning environment with cloud services, digital materials, and discipline teaching tools whenever a user uses a learning terminal.

Many researchers are trying to teach in the cloud environment. For example, some researchers use the cloud computing, Internet and other technologies to build a smart teaching environment for developing student reflection abilities (Lin, Wen, Jou, & Wu, 2014). They use the cloud platform to provide supports for personalized learning in class teaching. Some researchers analyze the big learning data to develop online learning resources to support pervasive education (Anshari, Alas, & Guan, 2016). Some researchers try to decompose the elements of the learning process and design the learning model based on the smart cloud to promote the integration of technology and learning (Kumar & Daniel, 2016; Sevimli, 2016). However, most of them either describe it on the conceptual level or realize it on the technical level. The study of the pedagogical application regarding the smart cloud teaching is not experienced. The new curriculum standard suggests that successful SCP education

applications should fully realize the interaction between teachers and students in the new technical environment so as to improve the students' academic performance. To achieve this goal, it involves developing a proper pedagogical interaction model (PIM) in the SCP, which will guide teachers to effectively manipulate the SCP environment and motivate potentials of knowledge discovering and creating. Therefore, the development of the PIM has important educational significance and provides guidance for teaching in the emerging cloud learning environment. Regrettably, the existing literature regarding this work is not yet sufficient.

RATIONALE

The aim of SCP is to provide personalized services that will increase interaction between students and teachers by sharing a pool of experiences and knowledge available in the cloud and suggest structured courses that match learners' preferences (Chang et al., 2015; Hew & Kadir, 2016). SCP offers many possibilities for enhanced distant collaboration, instant availability to the web through a variety of devices, wide accessibility to information of different types, and increased personalization through combinations of services, tools, and services (Pireva, Kefalas, Dranidis, Hatziapostolou, & Cowling, 2014).

The interactive teaching in SCP uses multimedia, network, cloud computing in the standard classroom to establish a networking learning environment, so as to provide learners with channels of discussion, communication and information sharing (Ding, Xiong, & Liu, 2015; Donlan, 2014). This enhances the student collaboration and makes them complete the learning tasks more effectively (Liao, Wang, Ran, & Yang, 2014). It incorporates web-based learning in the traditional class so that the learning content, media, environment, and resources can make their respective advantages (Su et al., 2016). The collaboration between students linking by the technologies makes them learn more convenient, interactive and innovative (Junco, Elavsky, & Heiberger, 2013).

This new learning pattern can be well explained by the Connectivism (Goldie, 2016). In the digital era, the amount, update speed and complexity of information exceed human's processing ability. The way learners acquire knowledge is more important than what they have currently known. The Connectivism in the creation of a personal learning environment allows anyone to access a distributed environment containing people, services, and resources (Reese, 2015). The environment supports diversified and autonomous participations to generate new knowledge through multiple levels of interaction (Kizito, 2016). The Connectivism allows individuals rather than institutions to manage learning processes. The individuals have more controls in learning so that they manage learning resources, learning activities, and learning outcomes (Clarà & Barberà, 2013). Learning in the SCP depends on the remote servers, and student's accessing resources and tools of these servers is just what we called learning. The individuals in this environment not only consume learning resources but also produce new ones. In other words, learning is a process of both the knowledge dissemination and production (Barnett, McPherson, & Sandieson, 2013; Reese, 2015).

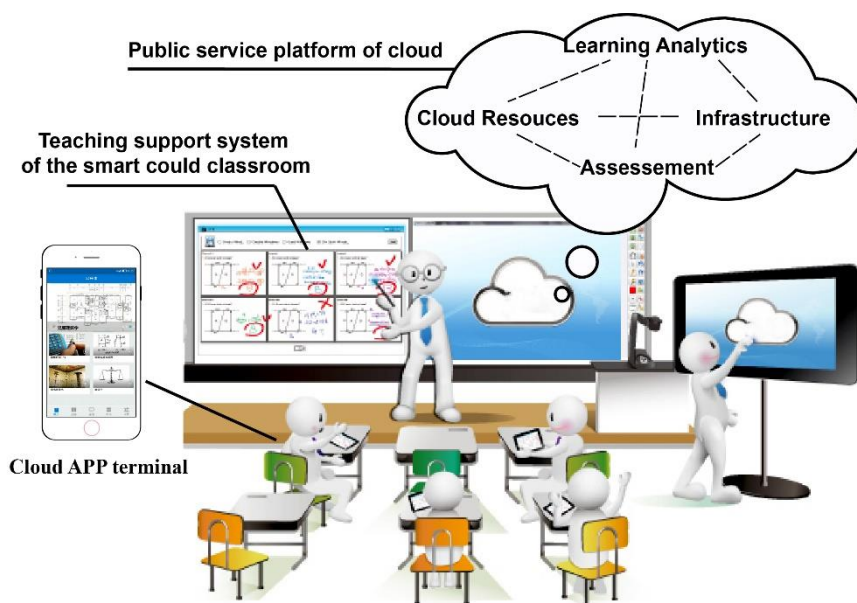


Figure 1. The smart cloud platform

The Connectivism drives individuals to interact with the environment at multi-dimensional levels. The first level is the interaction between the learners and environment (Z. Wang, Anderson, Chen, & Barbera, 2016). The learning environment provides learners with the tasks and feedbacks, and the learners take right responses and adjust their behaviors accordingly (Bell, 2011). The second level is the interaction between the concepts of students and teachers. This process refers to that the teachers' concepts act on the students' concepts, whose purpose is to change the students' original concepts. Teachers and students in the SCP commit different roles. Learners use learning resources provided by the environment including both the technical and pedagogical aspects, while teachers create the environment that supports learning activities including managing the learning groups, counseling, testing, and distributing course resources.

DESIGN

Smart Cloud Platform

This section describes common functions of the SCP shown in **Figure 1**, including the learning terminal, learning analytics on big data, teaching support system and cloud resource.

Cloud App terminal

The terminals mainly involve phones or tablets based on the smart operating system. When students log in SCP, the HTTP protocol is used to request data from the server, including student identity information, course and directory information, and task list. The server side

returns the data to the client in the JSON format. Then the client parses the data and displays on the screens.

Learning analytics

The data in the learning process will be collected in the back-end through the logger. The client uploads the operational records to the server after the student's study. The SCP obtains results through the data analysis and presents it on the target user's terminal. The commonly used analytics include basic statistics, cluster analysis, learning sequence analysis, and temporal pattern mining (Xie, Zheng, & Zhang, 2016).

Teaching support system

The teaching support system builds a bridge between teachers, students, and environments (Kong, 2010). It includes two aspects respectively the cloud teaching and cloud learning. The cloud teaching mainly publishes courseware through the Internet. The teacher creates a discussion forum directing at the learning content, and answer the questions and manage the sessions. They also arrange assignments, maintaining the courseware through the system (Dempster, Williams, Burger, & Taylor, 2005). The cloud learning mainly includes browsing courseware, discussing online, and self-exploring.

Cloud resource

The cloud resources relate to streaming media, courseware, material and so on. The streaming media makes people access to videos anytime and anywhere. There are two types including live videos and videos on demand. The live videos use HLS (HTTP Live Streaming) protocol to play M3U8 format files, and the videos on demand use the HTTP protocol to play MP4 format files. Other cloud resources include courseware, pictures, animations and fun materials.

Pedagogical Interaction Model

The promising education must be that students internalize new knowledge into existing knowledge structures through their self-regulating and teachers' guidance (Zhao & Sullivan, 2016). The PIM embeds in two important procedures, i.e. interaction and communication. The smart class supports teachers' effective teaching and students' well-organized communication (Tanaka et al., 2016). It uses the cloud service to make thinking collisions between the individuals which improve the abilities to communicate inter-individually. The PIM based on SCP can be divided into three stages: exploration before class, internalization in class and extension after class. Before the class, teachers design the teaching theme, determine the objectives, select technical tools and integrate related resources, while students learn the learning goals, obtain the first understanding through independent inquiry. This process is completed by negotiations between teachers and students. In the class, the teachers create contexts, observe the class, answer the questions that students propose. Then, students begin to explore, collaborate and interact with group members. This is to assimilate

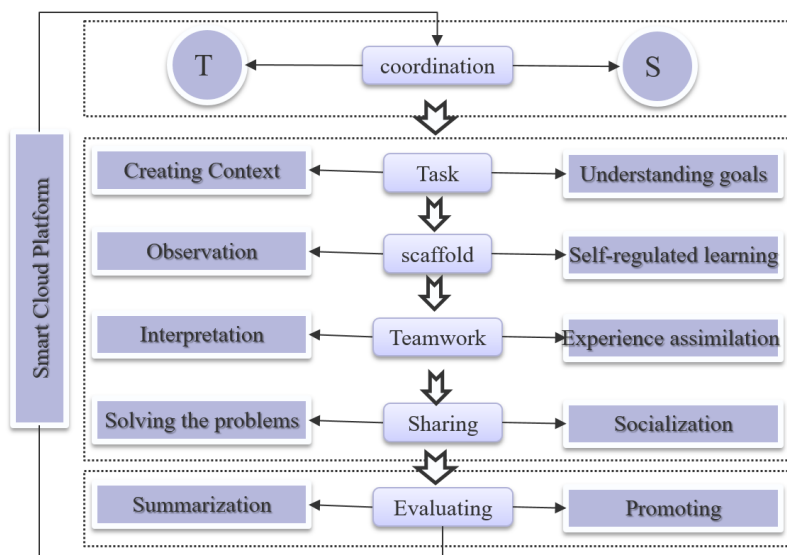


Figure 2. The pedagogical interactive model

the experience. Finally, teachers try to solve the arguments and assimilate concepts through collaborative conversations. After the class, teachers evaluate students, and students reflect the learning process.

The PIM is illustrated in **Figure 2**. We would like to establish the equal relationship of dialogue between teachers and students. This means that the two-way channel between teachers and students can be accomplished by task, scaffold, teamwork, sharing and the evaluation process.

APPLICATION

Objectives

In order to verify the effectiveness of the proposed PIM, this section applies the model to the physics teaching of a junior middle school. In the teaching, teachers use the feedback and evaluation functions of SCP to carry out interactive teaching, and students use mobile terminals in the wireless network to learn. Before the class, teachers let students explore individually and then collaborate with the team members. The goal is to enable students to form clear concepts and master the right way to build their knowledge structures through multi-dimensional interactions. Under the PIM framework, there are two primary objectives we want to achieve:

- 1) Using the PIM in SCP, and designing the detailed sequence of learning activities.
- 2) Testing whether the PIM improves students' achievements.

Samples

The study randomly selects two classes of grade two in a junior school, namely Group A and Group B respectively. A total of 94 students were selected as the subjects. The A class is the experimental group whose students take classes in the SCP, and the B class is the control group whose students take classes in the traditional classroom. Students of both groups have basic knowledge about the physics. The results of the independent sample t-test show that the physics levels of both groups did not have any significant difference before the experiment ($T = -.031, p = .975 > .05$). After the treatment for half a semester, we tested the difference in physics scores between the two classes.

Pedagogical Activity

We want to use the SCP to provide sufficient interactions between teachers and students. Before class, let the students answer interesting questions and group them accordingly. Students use the tablets to preview the digital textbook and discuss with others both online and offline. In the class, teachers follow a procedure of creating contexts, observing the class, interpretation, solving the problems and summarization. We want to reflect multi-dimensional interactions of SCP in this process to promote knowledge discovery and understanding based on the SCP and digital textbook. Finally, teachers encourage students to share their learning outcomes. After the class, teachers evaluate the students. Here, we detail the interaction steps progressively, including the activity sequence, interaction involved and design intention.

- **Step 1: creating contexts**

Activity sequence:

- 1) Students log in the SCP.
- 2) Teachers introduce a case and pose questions.
- 3) Students answer the questions using the app terminal.
- 4) Teachers exhibit the results about the statistics and groups students accordingly.

Interaction involved:

- 1) Using the data collection of SCP.
- 2) Using the learning analytics to obtain the statistics of answers and giving feedbacks.

Design intention: organizing the topic and establishing contact between text and physics concepts.

- **Step 2: observation**

Activity sequence:

- 1) Teachers switch to the "digital textbook" and display pictures.
- 2) Students observe the pictures and perceive the physics effects.

- 3) Students watch videos.

Interaction involved:

- 1) Using synchronized digital textbook.
- 2) Using the drawing function to study.
- 3) Using videos to introduce images about the physics.

Design intention: using fun videos to guide students to think about their initial hypothesis.

- **Step 3: Interpretation**

Activity sequence:

- 1) Students read the textbook and watch animations through learning terminals.
- 2) Teachers use the courseware to present and analyze cases.
- 3) Students complete learning activities on the tablets collaboratively.
- 4) Students design a case and interpret their feelings.

Interaction involved:

- 1) Students use the multimedia to browse the learning resources.
- 2) Teachers distribute PPT to students.
- 3) Students test themselves by multiple choices and filling in the blanks.

Design intention: Letting students explore their problems and make full use of resources in SCP to mobilize enthusiasms and initiatives.

- **Step 4: Solving the problems**

Activity sequence:

- 1) Students watch animations using mobile terminals.
- 2) Students complete tasks collaboratively.
- 3) Teachers show examples and inspired students to analyze problems.

Interaction involved:

- 1) Teachers distribute learning material such as PPT and Flash.
- 2) Teachers use the interactive whiteboard to demonstrate the calculation.

Design intention: Integrating videos, pictures and animations and other teaching resources to provide students technical support.

- **Step 5: Summarization**

Activity sequence:

- 1) Teachers issue testing questions.
- 2) Students submit answers via tablets.
- 3) Teachers check the students' answers and elaborate what they think.

Table 1. Statistics of pre- and post- tests

	N	Pre-test			Post-test		
		Mean	Std.	S.E	Mean	Std.	S.E
Group A	47	73.02	20.889	3.047	85.70	13.416	1.957
Group B	47	73.15	18.448	2.691	73.62	19.947	2.910

4) Students summarize, evaluate, and fill in the corresponding files.

Interaction involved:

- 1) Students submit the answers via learning terminals.
- 2) The system provides statistics.
- 3) Students self-assess, communicate, and vote.

Design intention: Understanding the extent to which students master the knowledge, and inspiring them to make self- and peer- evaluations.

Results

The basic statistics of the pre- and post- tests of both classes are shown in **Table 1**. Before the experiment, the score of the experimental group is 73.02 on average, and the score of the control group is 73.15. The t-test shows that there is no significant difference in both the variance ($F = .369, p = .545 > .05$) and the mean ($T = -.031, p = .975 > .05$) between the two groups. Therefore, the pre-test scores of both groups have no statistical significance. In other words, their physics levels are basically equal before the treatment.

After the experiment, the students in both groups are tested. The homogeneity test shows that the variance of the two classes is not equal, and the t-test shows there is a significant difference in the post-test performance ($F = 10.733, T = 3.446, p = .001 < .05$). This indicates that the performance of the experimental class was significantly higher than that of the control class after the treatment. The use of the PIM proposed in this paper improves students' academic performance.

DISCUSSION

Using the PIM in the SCP, teachers can help students to improve their academic performance significantly. This may result from the sufficient interactions in the PIM. The first level is the interaction between teacher and students. They experience various aspects of pedagogical activity so that the information channel between them is strengthened. The model encourages direct dialogue and consultation by teamwork, sharing, and evaluation. The second level is the interaction between system and human. The SCP provides supports for teaching and learning. The teacher can use the cloud service and learning analytic functions to present knowledge of interest to students, and the students can share their findings with the teacher and other peers in an efficient way. The third level is the interaction between technologies. The SCP includes many technology-enhanced tools which meet the dynamic requirement of teaching and learning by matching and coordination.

Using PIM in the SCP needs to be explored sufficiently. But, it has initially shown promising ability in improving students' academic performance through a simple test in this study. With the deep exploration of PIM, we expect it a better performance in improving:

Deep collaboration

It seamlessly integrates web-based and classroom teaching, so that teaching activities have been extended in time and space which compensates for the defects of the traditional class teaching. In the collaborative learning environment, learners can choose their issues of interest and use SCP resources to access learning materials, enrich their learning content, and lay the groundwork for deep collaboration.

Expanding communication

It realizes the timely and sufficient communication between teachers and students. Students share information immediately both online and offline, making collaborative learning more convenient. In order to achieve the group objectives, students can dialogue, discuss, or even debate to get an optimal learning path. In the process of collaborative learning, learners to cooperate others, sharing information and resources, and taking respective responsibilities.

Personalized learning

Learners regulate their learning, select learning resources and services freely. Learners can store learning resources in their personal learning platforms, and they obtain these resources as long as accessing the network.

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