Inquiry-Based Blended Learning

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ABSTRACT

As a kind of new teaching mode, blended learning is widely carried out now. How to design a micro-lecture based on the education theory of learner centered and teaching methods is the core of improving the quality of blended learning. We design a micro-lecture based on the inquiry-based learning theory, and discuss how to construct a teaching mode of inquiry-based blended learning.

Introduction

With the developing of educational technology, blended learning is widely implemented as a new form of teaching mode. The purpose of blended learning is to make use of the network to combine students' autonomous learning and classroom teaching activities, and form a more efficient and high-quality learning pattern.

In blended learning, the micro-lecture should be designed according to the characteristics of the teaching contents, and also based on different pedagogical approaches, such as problem-based learning, inquiry-based learning, discussion-based learning, and so on. It is the kernel elements to improve the quality of blended learning by designing a micro-lecture based on learner center theory and pedagogical approaches. Researches show that only a few of the micro-lectures open in the network are conforming to the basic principles of instructional design theory [1].

Inquiry-Based Learning (IBL)

Inquiry-based learning is a pedagogical approach in which students face complex, ill-structured (Anderson 2002), and open problems (Simon 1973) in authentic situations. In real life, the types of problems addressed mathematically are often of this nature and therefore inquiry problems can be considered those that more closely reflect real life; with problems often having many open constraints (Simon 1973).
The inquiry problems come from the real life and keep changing while the world developing. As technology advancing, new things are gradually emerging, such as: sharing economy, smart devices, online payment, and so on. Inquiry problems sometimes come from “wondering” these contents. To excavate the inquiry problems in these new things will stimulate students' innovative spirit.

Different from problem-based learning, the inquiry problems are not artificial, but come from the reality. Authentic problems are typically more complex, with additional constraints and specific goals. In inquiry-based learning, authentic problems create opportunities for students to understand reality and research reality. Students can discuss what will happen while the parameters of the problem are changed, what kind of impact it will have on the reality, identify and justify solutions, and incorporate these adjustments into their conclusion.

When addressing the complex problems that come from reality, students experience: analyzing and discussing the meaning of the problems, reviewing relevant mathematical knowledge, finding ways to solve the problems, planning and implementing investigation and putting forward feasible solutions based on mathematical knowledge, and so on. In inquiry-based learning, students continually negotiate the definition and meaning of inquiry problem, redefine problems, and adjust solutions. It is one of the characteristics of the inquiry-based learning that students repeatedly think and study the state of the problems and the solutions. In the process of implementing the solution, sometimes it is also necessary to relax the restriction of the problem appropriately to obtain a special solution. Inquiry-based learning, however, embeds an expectation that students will be involved in an ongoing re-negotiation of the problem statement and/or solution process as they work (Makar 2012).

Students work hard and long in order to find a more better solution. Students will likely respond with varied approaches and solutions, and this gives potential for deeper discussion of the more complex responses, along with deeper student engagement with the problems themselves (Fielding-Wells and Makar 2008). Teacher guides students to find their best solution while these problems do not have the optimal solution. Students will be truly involved for they can feel the meaning of the problems, rather than feel that they are doing a problem which is useless [2].

Kogan and Laursen carried out inquiry-based learning studies at the undergraduate level. Data drawn from the studies suggest that students who learning mathematics through IBL achieved as good as or better than those who did not learn mathematics through IBL. Students who learning mathematics through IBL were more likely to choose new mathematics courses which suggest that inquiry-based learning have a positive influence on engagement and motivation in mathematics learning [3]. Students may achieve better cognitive structure, increase research ability, form tenacious character in inquiry-based learning.

**Inquiry-Based Blended Learning (IBBL)**

We describe inquiry-based blended learning as following: implement inquiry-based learning in blended learning. First, students autonomously solve the authentic problem in the network environment under the guidance of teachers and contact with classmates. Second, students represent their solutions in the class, all the solutions are checked, evaluated, and compared by the whole class. Third, students and
teacher choose a best one from all the solutions. Last, students and teacher make and produce a micro-lecture of the process and conclusion of the inquiry problem.

In inquiry-based blended learning, students study the inquiry problem independently, or in small collaborative group, or discussion in whole class. In the network environment, it is easier for searching background knowledge, demonstrating solutions, discussing the work process, using software to do calculation, comparing the results, and so on. Consider it will be a long time for students to study the inquiry problem, teacher should remind students to keep their activity materials, such as recording the log, taking pictures and videos as the summary report information for the classroom exhibition. At the same time regular whole class and group checks are made by teacher, and complex issues are brought to class discussion.


**A Case of Inquiry-Based Blended Learning**

Mathematics has wide application, many natural science problems, engineering problems and social sciences problems have been solved by using mathematical knowledge. Problems in these areas will provide valuable resources for implementing inquiry-based learning in mathematics teaching. We try to design micro-lecture in accordance with the inquiry-based learning theory in the blended learning, and gradually form a teaching mode of inquiry-based blended learning. The following is a case of inquiry-based blended learning.

A classmate was shocked by the news: the price of agricultural products "Garlic Sprout" sharply fall 0.5 percent, peasants have to throw it away. Then he posed a problem: what is the relationship between product output and price? When will the output and price of commodity tend to be stable?

The problem was enthusiastically discussed by the class after it had been raised. Teacher then used it as an inquiry problem and gave students a week to work on it. Students could study independently or in groups. Teacher provided tips and guidance according to student's work plans during the research process. Teacher also collected activity records, research materials, solutions and other materials of the research process to make the micro-lecture.

After searching for information, discussing in small collaborative groups, students posed an assumption: consider the output and price of commodity as a function of time, study the relationship between the two functions. Since the increment of a function approximates to the increment of its tangent, the problem is transformed into studying the relationship between the tangents of two functions.

Based on this assumption, under the guidance of teacher, students established the equations of the demand function and the supply function to discretize time, sorted out a first-order linear difference equation of the output, which is the model about output and price. Students then used iterative method to solve the difference equation, analyzed and discussed the results, obtained the restrictive conditions about how the output and price will tend to be stable [4]. The model was applied to the news mentioned above. The reasonable suggestions we got were the same as expert's opinion, which indicated that the model and the solutions was accurate. Students further pointed out that this problem
actually was spider's web theory in economics, which had very important practical applications.

Finally, teacher advised students to make a report PPT, and represent their solutions in class. Teacher and students discuss together, evaluate different solutions to deepen mathematical understanding, choose the best one to make micro-lecture. All the processes constitute inquiry-based blended learning.

**Comparison Experiment**

To test the effectiveness of inquiry-based blended learning in mathematics teaching activities, we selected other two groups of students to implement comparative experiments. Group A implemented inquiry-based blended learning, all the students were required to keep the research materials and activity records, and write down the feelings of autonomous learning. Group B had been taught the same subject in the classroom. Finally, all the students were required to take the same stage test.

We used the chi-square test to analyze whether the stage test grades of students was different between two groups, results shown that: \( \chi^2 = 7.201, \text{df} = 2, p = 0.027 \), the p-value is less than 0.05, thus reject the assumption that there is no significant difference between the two groups.

The evidence revealed that inquiry-based blended learning may both increase students' interest and engagement, enhance deep learning. Students in group A who were highly motivated and had good grades expressed their willingness for carrying out inquiry-based blended learning continuously. On the other hand, other students in group A who were ordinary in academic performance expressed that the study process was difficult for them, and they needed guidance from teacher or students.

**Results Analysis and Reflection**

The case above illustrates how to create inquiry-based blended learning process which allows students to self-monitor their learning progress, improves the students' interest and engagement in mathematics learning, and stimulates students' learning potential. As blended learning gradually enters mathematics teaching activities, teachers should pay attention to not only the change of teaching mode, but also how to design micro-lectures based on pedagogical theory.

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**REFERENCES**


