Collaborative Innovation of Engineering Discipline Based on Digital Education Management in Cloud Environment

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Abstract. Cloud computing is becoming increasingly important in providing services and storing data on Engineering Science in higher education. In such a changing technological world, technology integration in learning and education is inevitable, and technology is an integral part of the Engineering Science learning model. There is a significant gap between the level of technology use expected by educators and the actual use and integration of technology in the classroom. However, the emergence of digital educational technology may lead to innovative developments in Engineering Science in higher education. In order to provide convincing evidence that digital educational technology can contribute to the development of collaborative innovation in Engineering Science in higher education when the pedagogy is sound and when technology, skills, and objectives are well matched, this paper combined a questionnaire and a controlled trial to investigate the role of digital educational technology in the Engineering Science language teaching classroom. In addition, the two-semester controlled experiment of the experimental class proved that digital education technology had played a promoting role in college Engineering Science, which could help stimulate students' interest, break classroom silence, and improve the classroom atmosphere, thus enhancing students' activity ability. This study provides a reference value for collaborative innovation of digital education technology in college Engineering Science and a future direction for innovative teaching ideas.

Keywords: Management Innovation; Cloud Technology Environment; Digital Education Technology; College Engineering Science; Digital Education

1 Introduction

Recently, the development of college Engineering Science in the cloud environment has attracted the attention of many scholars. Sadashiv N believed that compared with traditional computing methods, the cloud environment provides complete services [1].

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Yan L. mentioned that college Engineering Science requires cooperation and interaction between students and teachers, as well as information sharing, which helps to cultivate students' team spirit, improve their initiative and develop their critical thinking [2]. Zein M.S discussed the current practice of primary Engineering Science education in relevant fields, paying particular attention to the class size and teaching duration, the role and status of teachers, and the concerns in teaching. He also analyzed the development prospects of education in the foreseeable future [3]. Therefore, it is essential to introduce digital education technology into college Engineering Science classes. Digital education technology is a dynamic and developing field. Therefore, a systematic method is needed to identify and draw research patterns in this field. Adhikari M proposed that the cloud environment receives applications in the form of workflow, composed of a group of interdependent assignments to address large-scale scientific or enterprise problems [4]. Kowsigan M said that cloud computing could share jobs among different cloud data centres and use the Internet as the backbone to process jobs. The data centre can be selected to process jobs based on their potential, job arrival rate and better resource utilization [5]. Ratheeswari K mentioned that in this digital age, it is crucial to use technology in the classroom to allow students to learn and apply the skills needed in the 21st century [6]. Many teachers need to use digital technology as a teaching tool.

In order to verify that digital education technology has a facilitating effect on collaborative innovation in Engineering Science in higher education, this paper has examined the utilization of digital education technology in higher education and set up a related controlled experiment and questionnaire. This paper has conducted two questionnaires among first-year students majoring in Engineering Science. The number of people in the first survey was 267, 263 of whom believed there were problems in the teaching model. The number of people in the second survey was 55 students and Engineering Science teachers in the experimental class. The 55 students scored 8.5 points on the improvement of the introduction of digital education technology into Engineering Science classroom teaching mode. The control experiment was a test control of the average Engineering Science scores of students in this experimental class for two semesters. The four test results showed that digital education technology had the function of collaborative innovation in Engineering Science teaching.

2 College Engineering Science in Cloud Environment

2.1 Security Encryption Technology of Cloud Environment

In the application scenario of cloud environment security encryption technology, users are both data encryptors and data retrievers. All keys are saved by the user, and they have a corresponding password library. The difficulties encountered in searching and setting the key in the password library can be expressed by formulas.

① Computational problems: It is assumed that the multiplicative cyclic group whose order is a large prime G is D, and one of the generators of D is d. The computational problem in D is that for any $x, y \in Z_q^*$ (d, d^x, d^y) are given to compute $d^{xy} \in D$.

If the advantage of any polynomial time adversary S in solving the problem under computation can be ignored, then the computational problem is considered to be difficult, as shown in Formula (1). ε is an ignorable function.

$$P\left[S\left(d,\ \ d^{x},\ \ d^{y}\right)=d^{xy}\right]\geq\varepsilon \tag{1}$$

② Critical problems: For any $x, y \in Z_q^*$ (d, d^x, d^y) are given to compute $T \in D$. Whether T is equal to d^{xy} is judged. If the advantage of any polynomial time adversary S in solving the problem under calculation can be ignored, then the decision problem is considered to be difficult, as shown in Formula (2):

$$P\left[S\left(d,\ \ d^{x},\ \ d^{y},\ d^{xy}\right)=1\right]-P\left[S\left(d,\ \ d^{x},\ \ d^{y},\ T\right)=1\right]\geq\varepsilon \tag{2}$$

③ Bilinear problems: The multiplicative cyclic groups of two large prime numbers G are set as D1, D2. Bilinear mapping k: D1 × D1 → D2. The bilinear problem is that giving (d, d^x, d^y, d^z), where $x, y, z \in Z_q^*$ $k(d, d)^{xyz} \in D2$ is computed. If the advantage of any polynomial time adversary S in solving the problem under calculation can be ignored, the bilinear problem is considered to be difficult, as presented in Formula (3):

$$P\left[S\left(d,\ \ d^{x},\ \ d^{y},d^{z}\right)=k\left(d,d\right)^{xyz}\right]\geq\varepsilon \tag{3}$$

④ Modified bilinear problems: $k(d, d)^{xy/z} \in D2$ is computed. If the advantage of any polynomial time adversary S in solving the problem under calculation can be ignored, the bilinear problem is considered to be difficult, as shown in Formula (4):

$$P\left[S\left(d,\ \ d^{x},\ \ d^{y},d^{z}\right)=k\left(d,d\right)^{xy/z}\right]\geq\varepsilon \tag{4}$$

⑤ Bilinear problem variants: The variation of bilinear problem is that giving $(d, d^x, d^y, d^z, d^{1/x})$ where $x, y, z \in Z_q^*$, $k(d, d)^{xyz} \in D2$ is calculated. If the advantage of any polynomial time adversary S in solving the problem under calculation can be ignored, the bilinear problem is considered to be difficult, as shown in Formula (5):

$$P\left[S\left(d,\ \ d^{x},\ \ d^{y},d^{z},d^{1/x}\right)=k\left(d,d\right)^{xyz}\right]\geq\varepsilon \tag{5}$$

Cloud computing services are dynamically scalable on the cloud. It is the dynamically scalability of the cloud environment that makes it so much more secure. The existing cloud computing usually uses mobile devices to solve performance problems, and college Engineering Science is developed with the help of mobile devices. The security of the cloud environment appeals to Engineering Science in higher education, and the growth of mobile cloud computing has greatly increased the computing and storage performance of mobile devices [7-8]. They are mutually beneficial and coexist with each other.

2.2 Digital Education Technology

Digital education technology has rich digital education resources, a high-speed transmission communication network and an efficient and easy-to-operate front-end platform. These platforms support the education system with modern concepts [9], theories, methods and models. The core of digital education technology is shown in Figure 1.

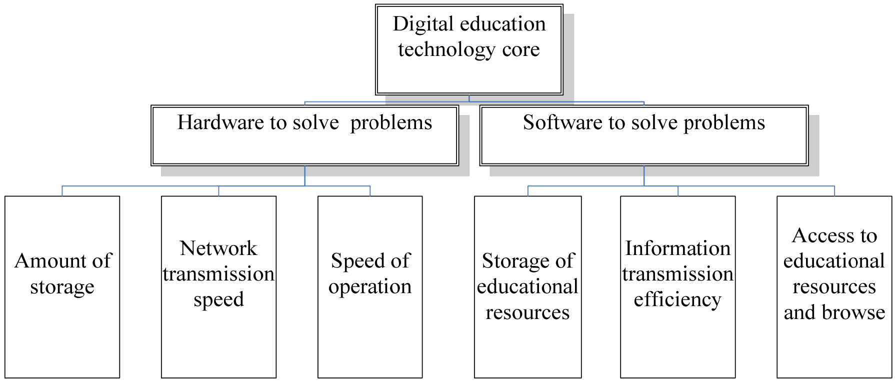

Fig. 1. Core of digital education technology

The teaching modes of digital education technology are all multimedia learning forms, which can be divided into three types: virtual reality education mode, classroom learning mode and personalized self-study mode.

Multimedia learning provides visual instruction for students with no time and space constraints. This form of teaching allows each individual to choose the Engineering Science teacher they like best for the lesson, significantly improving the efficiency of Engineering Science teaching and students' interest in learning. Multimedia learning can also provide students with tools like online search and information retrieval. Therefore, the multimedia learning form supported by digital education technology is the core of educational reform and innovation. It is urgent to introduce digital education technology into college Engineering Science teaching [10].

3 Collaborative Innovation in Engineering Science Teaching

3.1 Questionnaire

This study surveyed 267 first-year students majoring in Engineering Science at a foreign language university, including 8 Engineering Science teachers and 259 students. It was hoped that it could fully and genuinely reflect the situation of college Engineering Science classes, find out the possible problems in college Engineering Science classes, and then discuss and analyze the problems to put forward suggestions for improvement and pave the way for the introduction of digital education technology.

Table 1. Questionnaire reliability

Reliability Statistics			
Number of Items	5	Cronbach's Alpha	
		Text Questionnaire	Form Questionnaire
		0.894	0.913

Questionnaire reliability: A total of 300 questionnaires were distributed in this survey, 289 of which were recovered, with a recovery rate of 96.3%. Twenty-two questionnaires with many missing questions were deleted, and 267 valid questionnaires were finally counted. The questionnaire results were analyzed through SPSS software, and Cronbach's alpha α was selected as the reliability coefficient. If the coefficient was more significant than 0.85, the reliability of the questionnaire was good. The questionnaire of this study was divided into two parts: text questionnaire and form questionnaire, as shown in Table 1. The Cronbach's alpha α of the text and form questionnaires were 0.894 and 0.913, respectively, which indicated that the questionnaire in this study had good reliability.

Questionnaire results: This study made statistics on five problems that existed in college Engineering Science. The questionnaire findings are shown in Figure 2 (multiple choices were allowed).

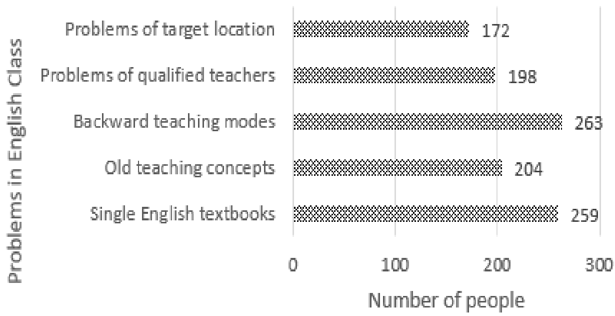

Fig. 2. Questionnaire of problems in Engineering Science class

From the results of the questionnaire, it can be seen that 259 people believed that there was a problem with single Engineering Science textbooks in college Engineering Science classes; the number of people who thought that there were problems in the teaching modes was the largest, up to 263, and the total number of people surveyed by questionnaire was 267, accounting for 98.5% of the total number of people surveyed; 204 people thought the teaching concepts were old; the number of people who thought that the problem of qualified teachers and the problem of target orientation were 198 and 172 respectively, accounting for a relatively small proportion. It can be found that the problems of backward Engineering Science teaching modes and single Engineering Science teaching textbooks in colleges and universities were particularly prominent. Therefore, relevant controlled experiments were set up to prove the innovation of digital education technology in college Engineering Science teaching modes.

3.2 Questionnaire

This paper conducted a comparative experiment with a class of freshmen in the college. The experiment was divided into two semesters, with four tests each semester. The average Engineering Science score of four tests was tested when using the traditional Engineering Science teaching mode. One semester after the introduction of digital education technology, the average Engineering Science scores of the four tests were compared. The comparison results are shown in Figure 3 and Figure 4.

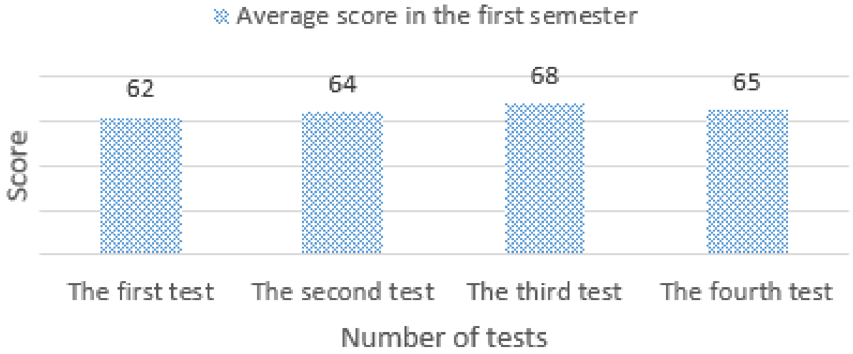

Fig. 3. Average score of four Engineering Science tests in the first semester

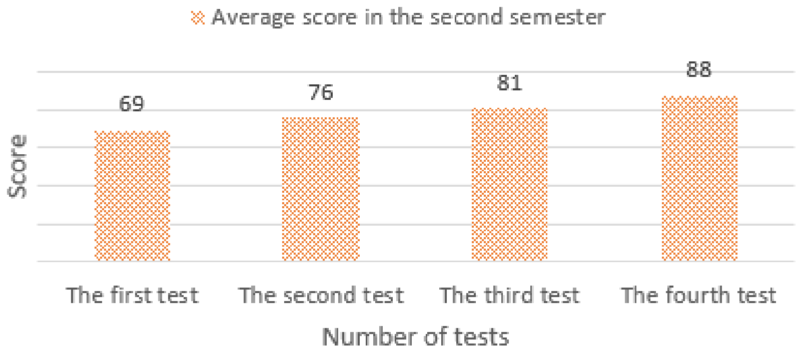

Fig. 4. Average score of four Engineering Science tests in the second semester

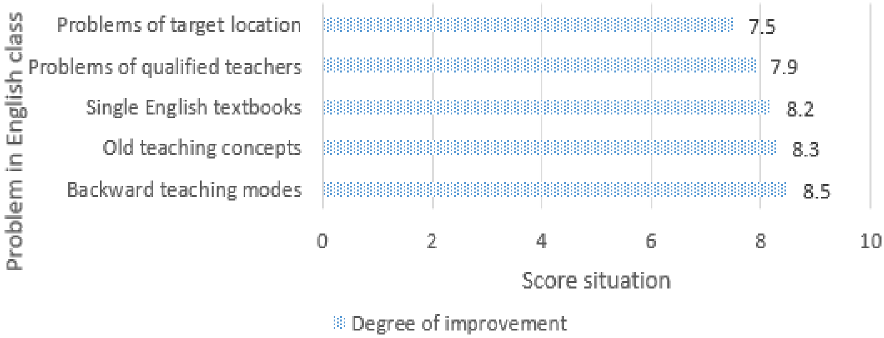

Fig. 5. Average score of improvement progress in Engineering Science class

From the experimental data, it can be learned that in the traditional Engineering Science teaching mode, students' average scores on four Engineering Science tests were at the pass level, and the results of the four tests were relatively stable with little change. After introducing digital education technology into college Engineering Science teaching, it can be learned that the scores on the four Engineering Science tests in the second semester increased. Especially at the end of the second semester, that is, one semester after using digital education technology, the Engineering Science test score could reach 88 points, demonstrating the role of digital education technology in promoting college Engineering Science classrooms.

As the findings of the first questionnaire showed that the problems of backward Engineering Science teaching modes and single Engineering Science teaching textbooks were particularly prominent, the students in this class were investigated again after the introduction of digital education technology. This survey mainly reflected on whether digital education technology improved the Engineering Science teaching mode and the single Engineering Science textbook. The number of students in the experimental class was 54, and there was 1 Engineering Science teacher. Fifty-five questionnaires were distributed, and 55 were recovered, with a recovery rate of 100%. There was no invalid questionnaire with many missing questions. Therefore, 55 valid questionnaires were finally entered into the statistics. The 55 people scored the improvement degree of the problem, with a total score of 10 points, and the average score was taken finally. The questionnaire findings are shown in Figure 5 (Multiple choices were allowed).

According to the data of the questionnaire, the average score of the students who thought that the teaching mode was effectively improved was the largest, 8.5 points, followed by the innovation of teaching ideas, 8.3 points, and the score of improving the single question of Engineering Science textbooks was 8.2 points. The students in this experimental class recognized the innovative role of digital education technology in college Engineering Science classrooms, which had a good role in promoting the reform of teaching mode, realizing the diversification of Engineering Science textbooks, and updating teaching concepts.

4 Conclusion

The speed of diversified development of college Engineering Science is beyond anyone's expectation. Digital education technology still has some shortcomings in college Engineering Science education: First of all, as far as the hardware development of digital education technology is concerned, the software technology has developed slowly, and the Engineering Science education data resource library has not been established; secondly, the solution to improve the transmission network speed needs to be improved; thirdly, the primary software facilities and platforms used for search and browsing are in the initial stage. There are also some problems in college Engineering Science teaching, such as the unscientific application of digital education technology, incomplete promotion, and teachers' low utilization rate. As digital education technology gradually develops, these issues must be addressed immediately. To better understand the impact of digital education technology on college Engineering Science innovation, the analysis results should be further improved in the follow-up research.

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