



# Considerations on Digital Teaching in Computer Science Courses in Universities in the Post-pandemic Era - Taking Computer Operating Systems as an Example

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**Abstract.** As the domestic epidemic in China is gradually and effectively controlled, slowly stepping into the post-pandemic era, this study aims to explore and consider the current performance of the combined online and offline teaching model being experienced for the digital teaching of computer courses Chinese university education in response to the sudden and spot new crown epidemic. The current state of teaching and learning of the course Computer Operating Systems is presented as an example of the practice in the semester teaching in response to the sudden epidemic in Taigu District, Jinzhong City, Shanxi Province, where Jinzhong College of Information Technology is located, during the sudden epidemic on February 20, 2022. Through qualitative analysis of the digital practices in emergency online teaching methods and in-depth reflection and analysis of the feedback from the teaching activities, a glimpse is taken to reflect on the digital teaching experiences of computer courses in the post-epidemic era, providing lessons for future teaching activities.

**Keywords:** post-pandemic era · digital teaching of universities · computer science courses

## 1 Introduction

Since the outbreak of the pandemic, universities are facing many challenges in education and teaching. Especially as the deepening reform of university education is in full swing, digital hybrid teaching is an important part of the deepening reform of university education, such as the use of AI in the classroom. In the post-epidemic era, every university is faced with the problem of adapting its curriculum to online teaching in the face of sudden and spot outbreaks.

This paper deals with the teaching practice of Jinzhong College of Information in the face of the sudden epidemic prevention and control events, which had to shift from offline teaching to online teaching. Taking the core course of computer science - Computer Operating System as an example, this paper focuses on the changes in teaching ideology and mode in colleges and universities under the epidemic, the practice of digital

teaching during the epidemic and the computer science course. The current situation of digital education in universities is reviewed in three aspects. Based on the real data of the students in the course during that semester, the teaching practices are analysed using the digital teaching evaluation model and the standard scores in educational statistics. The main conclusions of this paper are: in the post-epidemic era in the face of the still unfinished epidemic, the experience brought by using epidemic teaching should be summarised and digital tools should be used to achieve diversified assessment to motivate students; university teachers should always pay attention to students' active learning and psychological health; university teachers should be able to respond to emergencies and control students, etc.

## 2 Literature Review

### 2.1 The Change in Thinking and Patterns of Teaching and Learning in Universities in the Context of the Epidemic

The sudden outbreak of the epidemic had a significant impact on the teaching and learning order in Chinese universities [1], especially as schools had to be 'closed' during the epidemic prevention and control period, forcing students and teachers to communicate via the Internet instead of face-to-face [2]. However, there are some unsatisfactory aspects of online teaching, such as misunderstanding the nature of online teaching, lack of quality teaching resources, and neglect of teaching organization and management [3]. With the increasing industrialization and informatization, some teaching resources for professional courses are currently too slow to be updated [4].

In the post-pandemic period, pandemics will continue to occur sporadically, especially under the influence of global epidemic fluctuations and climate change, and this state of affairs will continue for some time, which will have far-reaching effects on the education and teaching of universities [4]. How to teach knowledge in schools in the "post-epidemic era" is an important issue worth exploring in educational theory [2].

### 2.2 Digital Teaching and Learning in Practice During the Pandemic

Learning in the information age requires full reliance on digital technology and the application of information technology in the process of teachers' teaching and students' learning, which enables the cross-integration of digital technology and information-based curriculum, which is a requirement for the digital curriculum teaching mode for university students in the context of smart education [5], however, the smart classroom in Chinese universities started late, only from 2015 full-scale construction began.<sup>1</sup> During the pandemic, big data online platforms (e.g., WeChat Health Code, Alipay, Nail Health Punch Card, online shopping contactless delivery, etc.) were widely used, bringing convenient technical support for epidemic prevention measures, and allowing for the orderly supply of basic necessities [6]. At the same time, to better teach professional and technical courses, China University MOOC, Love Course, Xueyin Online, Chaoxing Xuexitong, and UCLA have launched online quality courses for students in universities to choose to study [4]. On the other hand, for students' classroom performance during

the epidemic, there are relevant data that show that students' class attendance was consistently high, even higher than in traditional classes, but attendance dropped significantly in the middle weeks of the due period [7] this is supported by a study by Zhang et al. and others [5], who found that undergraduate students, compared to master's students' higher levels of online teaching engagement; also, the team found that postgraduate students were generally better at teaching in the digital classroom than undergraduate students by using a combined weighting-TOPSIS model to measure weights. This demonstrates that technology is not always the most important aspect of digital teaching and learning, but rather the people [8].

### **2.3 The Current Situation of Teaching Pattern of Computer Courses in Universities**

In 2013, the Teaching Guidance Committee of University Computer Courses in Higher Education of the Ministry of Education officially released the "Declaration on Teaching Reform of Computational Thinking", which further clarified the important role of computational thinking cultivation in the teaching of basic university computer courses [9] Luo et al. pointed out in the related literature that teachers, due to their geographical location, imperfect training system and imperfection, their information-based teaching ability needs to be improved, especially computer science teachers should adapt to the changes in university teaching brought about by the epidemic in terms of choosing quality teaching platforms, reconstructing teaching resources and paying attention to teaching evaluation and summaries [3]. Focusing on students' ability to apply the computer language knowledge and skills they have learnt to solve practical problems and enhance their professional self-learning ability and overall quality, Zhang et al. emphasise that for computer language teaching should be centred on student development so that students have a sense of professional mission [10].

## **3 Analysis of Teaching Results**

### **3.1 Brief Summary on Teaching Sessions of the Course "Computer Operating Systems" in Practice**

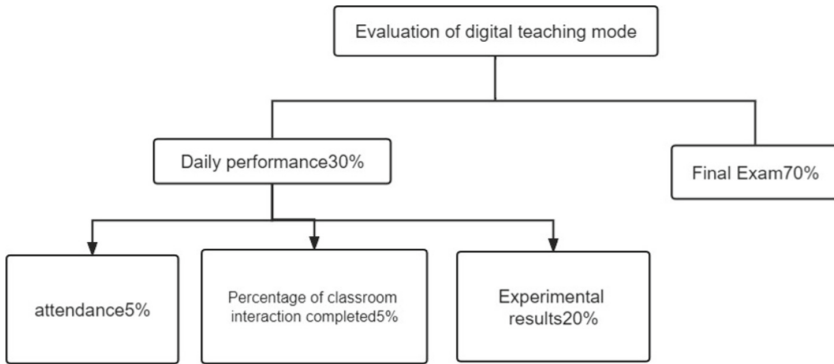
In response to the sudden epidemic prevention and control, Jinzhong College of Information has launched its digital course platform, Xuexitong, as a matter of urgency. To fit the actual teaching situation, teachers can work with online tools such as Tencent Meeting/QQ Group/WeChat Group to enhance communication when the situation allows.

The operating system course is a typical computer knowledge-based course with conceptual, theoretical, and abstract characteristics. The purpose of learning the operating system is to master its principles on the one hand, and to enable students to develop the ability to think in terms of computers to solve problems on the other. Therefore, the teaching sessions are usually divided into 16 weeks of theoretical teaching and 3 weeks of practical teaching, with a total of 44 class hours.

Table 1 presents the average data for the three subjects' participation in session activities over the 16 teaching weeks.

**Table 1.** Digital teaching results of the course “Computer Operating Systems” in various subjects (Learned through a questionnaire)

Index	Software engineering	Digital media technology	Network engineering
Attendance rate	97%	99%	97%
Completion rate of Experimental results	100%	100%	100%
Group discussion participation	91%	62%	79%
Completion rate of exercises	83%	85%	74%



**Fig. 1.** Computer Operating System Course Digital Teaching Mode Evaluation System (self-painted)

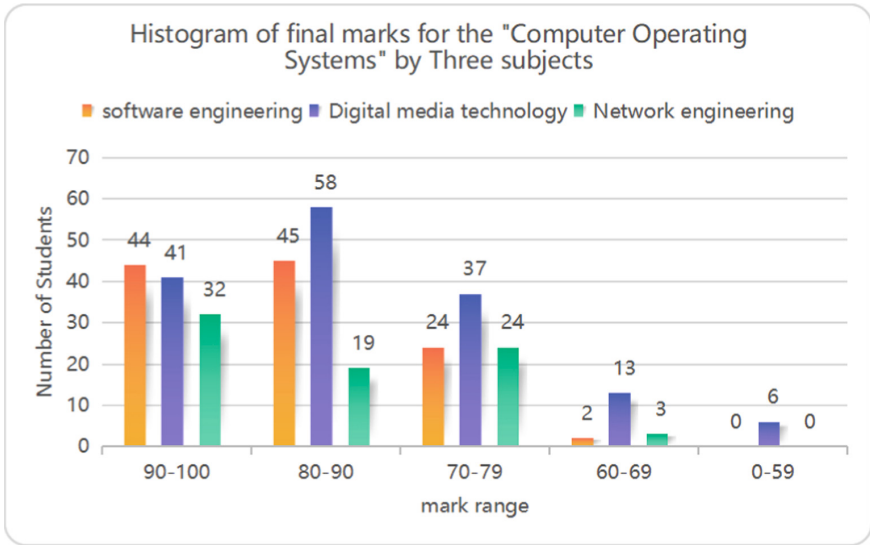
**3.2 Demonstration of Examination Results**

Student outcomes are usually reflected in exam results, but day-to-day student and teacher performance should also be used as an influencing factor in teaching outcomes. The data for this section is derived from the learning and examination results from Xuexitong and our academic system (Figs. 1 and 2).

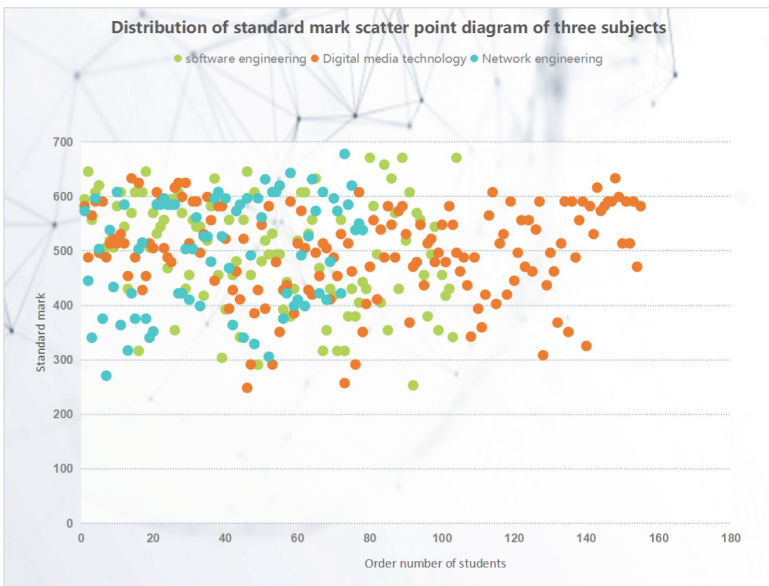
Due to the difficulty of the test questions, the total final exam results alone do not indicate the teaching outcomes. Figure 3 shows the distribution of the transposed standard mark data.

$$Z = (X - A)/S \tag{1}$$

$$T = 500 + 100 * Z \tag{2}$$



**Fig. 2.** Histogram of final marks for the “Computer Operating Systems” by three subjects<sup>1</sup> (self-painted)



**Fig. 3.** Distribution of standard mark scatter point diagram of three subjects (self-painted)

<sup>1</sup> This data sample does not include data transferred to the dual system, although the school has included the results of these students in this transcript.

## 4 Conclusion and Discussion

Digital tools are used to achieve a diverse range of assessments to motivate students. Student-centered, self-organizing teaching strategies are also used, with a student-led learning approach and interactions between teachers and students, between students and students, and between students and teaching resources and the online environment, such as posting questions, answering questions, and participating in group discussions [7, 12]. This semester's practical teaching in an operating systems course using Xuexitong and Tencent Meeting; Xuexitong and Zoom found that.

The use of online group discussions has limitations, as evidenced by the different permissions set by the three software programs for the teacher's end. a. Xuexitong can post online topic discussions, i.e., the teacher proposes a topic for students to follow below, like a forum posting. Such a teaching session suffers from the disadvantages of students following random posts, limited expression of views and lack of active participation.

- 1 The group discussion function of Zoom and Tencent Meeting. For example, the personal version of Tencent Meeting can only be divided into two discussion groups even if the teacher releases the meeting, which is not enough to meet the teaching needs even for the current small class sizes in universities. On the other hand, Zoom cannot be used as a mainstream software for online teaching due to the restrictions imposed on the software in China, but there is no version restriction on its group discussions. The teacher.
- 2 The use of Xuexitong to set course exercises is of obvious help to students, especially when they are included in the regular mark assessment. In line with traditional teaching philosophies, including a certain amount of class exercises in class sessions helps students to consolidate what they have learnt. The advantage of using the Learning Connect platform is that teachers can monitor students' answers in real time and provide timely feedback on some statistics. This places a number of demands on the teacher's questioning, the first of which is that the questions should be representative of the knowledge taught in the lesson. In fact, the type of questions should be considered for key and difficult points, for example, multiple-choice questions for points that are confusing to students and judgement questions for some understanding of core concepts. Finally for different courses there should be different characteristic question types, for example, for programming courses, there are 1 or 2 exercises for the course that can review the knowledge points used, but also have a certain degree of difficulty for the students, so that it will be challenging.
- 3 An effective combination of online learning and offline self-study would require that students read course specific literature before class and even submit papers during offline self-study so that teachers can receive feedback [13]. However, this requirement is too demanding for most students, and there is evidence that Chinese universities have few educational technologies like course paper checking systems available to students and teachers for academic misconduct detection. This requires teachers not only to provide a variety of teaching resources to students through digital platforms, but also to continually utilize relevant educational technologies for teaching purposes.

Requirements for teachers: although not in the role of counsellor, they should always be concerned about the mental health of students in the face of epidemic prevention and control. Teachers can use the digital teaching platform to control students' learning status in real time, and the Learning Pass platform can record all data in real time during the teaching process, allowing both teachers and students to view data related to the course being taught in real time [14]. It is important for teachers to check the effectiveness of online teaching and learning, and to understand and address any problems that arise in the teaching process [15, 16].

In the post-epidemic era, it is important not only to make use of a mixed teaching model offline and online, but also to be aware of the need to respond to sudden outbreaks of epidemic prevention and control by switching from offline to online distance learning. This is not a step backwards, but rather a test of whether colleges and college teachers have the right responses and plans in place for special times, and a test of the responsible attitude of every college teacher towards their profession towards their students. Each teacher at the Taiya campus can be said to have done an exemplary job in responding to this sudden outbreak, however, the lack of supervision of students' learning in the teaching sessions is also helpless. Online teaching, where teachers and students can only communicate with each other in a virtual environment and have narrow access to information about each other, has inconvenienced the management of teaching and learning, and the teacher's control has been greatly reduced [7]. The adverse effect of this is that students' passive access to teaching resources in general is also hindered. Most students are at a stage where they do not have textbooks as an aid, and many of them do not have a clear understanding of the teacher's delivery system. Teachers should identify and monitor the omission of teaching resources and students' subjective learning motivation during this period.

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