Application of Big Data Technology in Blended Teaching of College Students: A Case Study on Rain Classroom

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Abstract—Rain classroom is a big data tool that effectively connects the teacher with students throughout the teaching process. This paper mainly applies rain classroom in blended teaching of college students, and evaluates the application effect. Firstly, the authors set up a model of rain classroom, covering all three phases of the teaching process: before-class (B), in-class (I) and after-class (A). Next, the BIA model was applied to the course Film and Television Appreciation, and the key issues in each phase were explained. To evaluate the effect of the BIA model, two questionnaire surveys were carried out among engineering students in Chongqing Three Gorges University. The results show that rain classroom can greatly improve the learning effect of the target course in various aspects: the teacher could arouse the students' learning interest by sending red packets, make students more attentive through limited-time quiz, and reduce the absence through random roll call; the students were actively involved in group activities and confident in presenting their findings; however, many students most students switched to other apps in the class. The research results provide new insights to the application of big data technology in college education.

Keywords—Big data technology, rain classroom, blended teaching, college students

1 Introduction

In the era of big data, many countries have recognized the potential of information technology (IT) to optimize the teaching model in colleges. For instance, the Chinese government issued an important development plan on education in 2019, which promises to modernize the teaching model with the IT (Xinhua New Media, Accelerating the Implementation Plan for Education Modernization (2018-2022), Printed and distributed by General Office of the CPC Central Committee and general office of the State Council). However, only a few colleges have informatize their teaching models in the context of big data. The rain classroom, a blended teaching model, is one of the few teaching models renovated by the IT [1].

Rain classroom is an app jointly developed by Tsinghua University and Xuetang, and released in April, 2016 [2]. The app brings cutting-edge IT (e.g. big data, cloud computing and mobile Internet) to the classroom, aiming to provide data and

information supports to all teaching processes [3]. Thanks to the promotion of the WeChat platform [4], rain classroom has become a popular model for online-offline blended teaching. Online teaching is the core of this blended teaching model, while offline teaching plays a complementary role [5].

In terms of software, rain classroom involves a remote server, a teacher side and a student side. The remote server supports the operation of the IT system and the processing of the big data on teaching (e.g. collection, storage, analysis and decision-making [6]. The teacher side includes the PowerPoint on the desktop computer and the WeChat in the smartphone of the teacher. The student side refers to the WeChat in the smartphone of each student.

All the software interfaces of rain classroom are realized on PowerPoint and WeChat [7]. Once a rain classroom plug-in is installed in his/her computer, the teacher will be enabled to edit courseware on PowerPoint, such as online audios and inserting massive open online course (MOOC) videos [8]. To sync the desktop contents to the smartphone, the teacher only needs to scan the QR code of the courseware. After that, the preview materials can be packaged and sent to students in his/her class. Hence, the defining feature of rain classroom is the integration between PowerPoint, MOOC and WeChat [9].

Rain classroom is an intelligent tool that effectively connects the teacher with students throughout the teaching process. Before class, every student can access the course and browse the courseware by scanning the QR code of the courseware on WeChat or input the passwords for the class. If a student comes across a knowledge point that he/she does not understand, he/she can click the "Don't Understand" button to feed back the knowledge point to the teacher. The students' preview data are displayed in real time on the teacher's smartphone. In the class, the teacher can check the attendance, issue red packets, and choose students to answer questions on his/her smartphone, while the students can discuss topics, answer questions and leave comments on the screen in real time [10]. After class, the teacher can push review exercises to the students, and gather the in-class answers of the students, which are captured and stored automatically in the smartphone [11]. Overall, rain classroom endows the teacher and students with a brand-new experience, giving full play to their teaching and learning potential [12].

This paper innovatively applies rain classroom, a popular big data technique, to the blended teaching of engineering students in the course Film and Television Appreciation, a public elective course in many colleges. Firstly, the model of rain classroom was established and introduced to the said course. Then, the attitudes of college students towards rain classroom and its key aspects were collected through questionnaire survey. Based on the survey results, the authors summarized the strengths and limitations of rain classroom. The research findings provide important reference to the promotion and improvement of rain classroom and similar big data tools.

2 Rain Classroom Model

As shown in Figure 1, our model of rain classroom covers all three phases of the teaching process: before-class (B), in-class (I) and after-class (A), and is thus denoted as the BIA model.

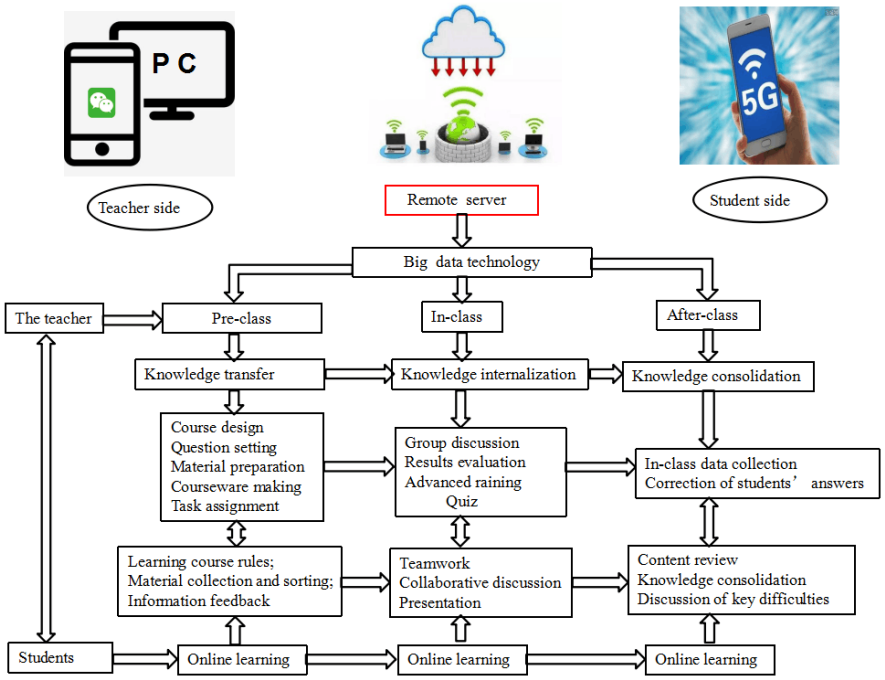

Fig. 1. The BIA model for rain classroom

2.1 Before-class

The before-class is a phase of knowledge transfer and online preview. In this phase, the teacher needs to design the course, set questions, select audios/videos, make courseware and assign tasks on the desktop computer, and send the materials to his/her students. The students learn the course rules, collects and sorts out materials, and gives feedbacks to the teacher.

2.2 In-class

The in-class is a phase of knowledge internalization among the students under the guidance from the teacher. The teacher leads the students to engage in activities, such as quiz, results evaluation and advanced training, and adjusts the activities in time according to the students' data recorded in real time. Meanwhile, the students work together to discuss topics collaboratively, and present their findings to others.

2.3 After-class

After class, the teacher collects the in-class data of the students and correct students' answers. Meanwhile, the students review what they have learned to consolidate their knowledge points, and discuss key difficulties with the teacher online. In addition, the teacher will release new learning tasks, kicking off another round of online learning.

With the aid of the BIA model, the teacher can interact online and offline with the students before, during and after class. Besides imparting knowledge and managing the class, the teacher serves as a tutor and encourager of his/her students. The students no longer passively receive knowledge, but actively explore new knowledge. Therefore, the rain classroom promotes the abilities of students in autonomous learning, teamwork, communication and innovation.

3 Application of Rain Classroom in Blended Teaching of College Students

This section applies the rain classroom as a big data technology to the blended teaching of engineering students in the course Film and Television Appreciation, a public elective course in many colleges.

3.1 Before-class

The teacher searched for and selected related materials on XuetangX, the first Chinese MOOC platform [13], namely, Chinese Classic Films Appreciation lectured by Prof. Zhou of Peking University, and Film and Television Appreciation taught by Prof. Gao of Liaoning University. These materials contain a variety of videos and audios, making the teaching process highly intuitive.

Moreover, the teacher collected more materials like books and online literature related to our course. For example, *The First Intimate Contact* by Cai Zhiheng was selected as the preview material. The novel is a tragic campus love story widely received among college students in China. In 2000, the novel was adapted to a popular movie.

Other materials include videos, audios and animations related to the teaching contents. These materials were inserted to the courseware on PowerPoint. If necessary, single- and multiple-choice questions were also added to the courseware for in-class tests.

When all the preview materials and the courseware were ready, the teacher pushed them to the smartphones of his/her students, and asked them to preview the materials and think about the questions. The preview data of students were tracked by the teacher anytime, anywhere, including puzzles, opinions and the number of pages read.

3.2 In-class

During the class, the students internalize knowledge under the guidance of the teacher. There are three types of in-class activities: topic-based, exercise-based and

topic- and exercise-based (mixed). The former two types are generally adopted in humanities and social sciences, while the latter is preferred for science courses [14]. Here, mixed activities are carried out during the class of Film and Television Appreciation. The entire phase consists of five student-centered steps: attendance check, group discussion, presentation, result evaluation, and quiz.

Step 1. Attendance check

Right before class, every student must scan the QR code of the courseware on WeChat or input the passwords for the class. Therefore, the teacher could know which student is absent on his/her smartphone in real time.

Step 2. Group discussion

Group discussion was carried out offline. Since every student had previewed the materials and thought about the questions before class, the teacher divided the students into groups for collaborative discussion. In each group, the students shared and explained their views, and listened to those of other members. In the meantime, the members were encouraged to challenge each other.

Step 3. Presentation

Each group selected a member to present their discussion results to the entire class. The presentation is a paraphrase and summary of the opinions of every group member. The members of other groups could share their views and raise questions to the presenter on the screen. The entire interaction was moderated by the teacher, who corrected the wrong points and gave additional views [15].

Step 4. Result evaluation

After all groups had finished their presentations, the teacher summed up and made comments on the views of each group. The innovative ideas were praised, the incorrect points were corrected, and the puzzles were answered. The result evaluation aims to increase the students' breadth and depth of thinking, and encourage them to think about the same problem from multiple angles. In return, the students could raise questions to the teacher on the screen, and defend their own views.

Step 5. Quiz

To monitor the in-class learning effect, the teacher launched a quiz of single- and multiple-choice questions, using the voting function. The questions were pushed to the smartphone of each student in turn. The students must answer each question within a limited time. Once all questions had been answered, the results were displayed on the screen as a column chart. Those who had provide correct answers quickly received red packets from the teacher. Finally, the teacher explained the key difficulties to the students again. If a student came across a knowledge point that he/she did not understand, he/she could click the "Don't Understand" button to make real-time feedback to the teacher.

3.3 After-class

In this phase, the teacher collected the in-class learning data and sorted out the students' answers via WeChat, and prepared the materials for the next class. Meanwhile, the students consolidated what they learned in class on WeChat, and received and previewed the courseware of the next class. If a student felt that he/she still did not

understand or wanted to discuss about a knowledge point, he/she could leave a message to the teacher by the "Report to Teacher" function of the rain classroom.

4 Teaching Effect of the BIA Model

4.1 Students' attitudes towards rain classroom

To evaluate the students' attitudes towards rain classroom, the teacher distributed 99 questionnaires among engineering students in Chongqing Three Gorges University, China. A total of 82 valid questionnaires were returned. The questionnaire is presented in Table 1 below.

Table 1. Survey on attitudes of college students towards rain classroom

No.	Questions	Optional answers	Number of respondents	Percentage (%)
1	Are you willing to learn autonomously before class?	I am very willing to do so.	31	37.42
		I am willing to do so, only if the preview task is not too heavy.	40	49.12
		I am not willing to do so.	11	13.46
2	Is it necessary to shorten the class hours after using rain classroom?	It is necessary, because I have learned part of the lessons autonomously.	43	52.34
		It is not necessary, due to the importance of in-class activities.	39	47.66
3	Did rain classroom help with autonomous learning?	Yes.	72	88.36
		No.	10	11.64
4	Do you like the teaching model of rain classroom?	I like the model very much.	31	38.10
		I like the model.	43	53.00
		I do not like the model.	2	2.95
		I am not sure.	6	5.95
5	What do you think of the learning effect of rain classroom?	It is very good.	35	42.68
		It is general.	37	45.12
		It is not good.	10	12.30
6	What do you think of the future of rain classroom?	It is promising.	48	58.69
		It is general.	22	26.21
		It is not promising.	12	15.10

As shown in Table 1, among the 82 respondents, 88.36% held that rain classroom is helpful to autonomous learning, 53% were fond of this teaching model (38.10% were very fond of the model), 58.69% predicted a promising future of rain classroom, and 42.68% recognized the good learning effect of rain classroom, while only 12.30% thought the learning effect of rain classroom is not good. Therefore, most students are in favor of the application of rain classroom in the said course, and agree that rain classroom promotes autonomous learning and improves learning effect.

4.2 Students' attitudes towards key aspects of rain classroom

Another questionnaire survey was carried out among engineering students in Chongqing Three Gorges University to disclose their attitude towards seven key aspects of rain classroom, namely, real-time comments on screen, red packets, random roll call, limited-time quiz, app switch, participation in group activities and confidence in presentation. A total of 82 valid questionnaires were received. The questions of the survey are listed in Table 2, each of which was rated against the Likert 5-point scale.

Table 2. Survey on attitudes of college students towards key aspects of rain classroom

	A	**B**	**C**	**D**	**E**	**F**	**G**
Strongly agree	20	25	16	23	17	18	15
	24.39%	30.49%	19.51%	28.05%	20.73%	21.95%	18.29%
Slightly agree	28	31	46	25	18	25	25
	34.15%	37.79%	56.10%	30.49%	21.95%	30.49%	30.49%
Neutral	16	9	15	13	8	15	24
	19.51%	10.98%	18.29%	15.85%	9.76%	18.29%	29.27%
Slightly disagree	11	9	5	18	32	15	12
	13.41%	10.98%	6.10%	21.95%	39.02%	18.29%	14.63%
Strongly disagree	7	8	0	3	7	9	6
	8.54%	9.76%	0	3.66%	8.54%	10.98%	7.32%

A: You often interact with the teacher and classmates via real-time comments on screen in rain classroom.
B: You are more interested in learning due to the red packets in rain classroom.
C: You have not been absent since the teacher made random roll call in rain classroom.
D: You are more attentive in learning due to the limited-time quiz in rain classroom.
E: You have never switched to the other apps after entering rain classroom.
F: You are active in group activities.
G: You can express views and present results confidently.

As shown in Table 2, the statement "you often interact with the teacher and classmates via real-time comments on screen in rain classroom" was slightly agreed by 34.15% of the respondents, i.e. 28 out of 82, and slightly agreed by 24.39%. Hence, the majority of the respondents often leave real-time comments on screen.

The statement "you are more interested in learning due to the red packets in rain classroom" was strongly agreed by 30.49% of the respondents, and slightly agreed by 37.79%, that is, 68.28% of all respondent agreed with the statement.

The statement "you have not been absent since the teacher made random roll call in rain classroom" was slightly agreed by more than half (56.10%) of the respondents, and strongly disagreed by zero respondent. This means the teacher can greatly improve attendance by the random roll call function of rain classroom.

The statement "you are more attentive in learning due to the limited-time quiz in rain classroom" was slightly agreed by 30.49% of the respondents, more than the percentage of any of the other four levels. Hence, the attentiveness and learning effect of the students could be substantially improved through limited-time quiz.

The statement "you have never switched to the other apps after entering rain classroom" was slightly disagreed by 39.02% of the respondents, the largest percentage of the five levels. Besides, there were more respondents that disagreed with the statement

than those that agreed with the statement. As a result, some students are absent-minded rather than take part in in-class activities.

The statement "you are active in group activities" was agreed by 52.44% of the respondents.

The statement "you can express views and present results confidently" was slightly agreed by 30.49% of the respondents, while 29.27% remained neutral to the statement. These two groups of respondents make up 1/3 of the total number.

Overall, most respondents either strongly agree or slightly agree with the statement in the questionnaire. Figure 2 describes the survey results in the form of a bar chart.

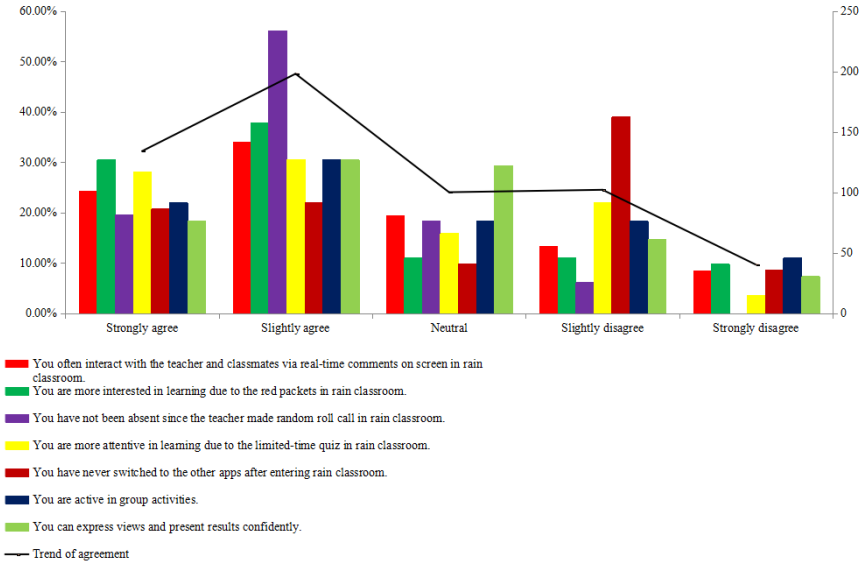

Fig. 2. Bar chart on students' attitudes towards key aspects of rain classroom

As shown in Figure 2, there were fewer respondents with strong agreement than those with slight agreement; the teacher could arouse the students' learning interest by sending red packets, make students more attentive through limited-time quiz, and reduce the absence through random roll call; the students were actively involved in group activities and confident in presenting their findings.

However, it is worth noting that 39.02% of the respondents slightly disagreed with the statement "you have never switched to the other apps after entering rain classroom". Despite being less than half of the total number, the percentage is larger than the proportion of slightly disagreements in other statements. Besides, those that agreed with the statement were fewer than those that disagreed with the statement, indicating that most students switched to other apps in the class. This is a major disadvantage of rain classroom.

5 Discussion

5.1 Strengths of rain classroom

1. Student side

Our surveys show that rain classroom is very popular among college students. Most students believe the teaching model helps to improve their autonomous learning.

Rain classroom provides the teacher with the real-time learning data of his/her students, laying the basis of procedural evaluation and multi-dimensional appraisal. The real-time data, coupled with attendance check and limited-time quiz, make the students more active in class.

Rain classroom also enables effective interactions between students and the teacher, and between students and students. On the one hand, the interactions promote the multiple abilities of the students: teamwork, communication and speaking. On the other hand, the interactions make the learning process easier and more interesting, so that the students could willingly complete tasks. This overcomes the shortcomings of the traditional cramming method.

In addition, the red packets and real-time comments create a relaxed learning environment, which arouses the enthusiasm of learning and establishes a good relationship between the teacher and students.

2. Teacher side

Before class, the teacher can provide his/her students with courseware and other preview materials, leaving plenty of time for preview. Our survey results show that rain classroom improves autonomous learning. With the aid of rain classroom, the teacher receives instant feedbacks from the students, and evaluates their learning results in an objective manner.

During the class, the teacher can implement various teaching methods flexibly, depending on the teaching contents. The optional methods include role plays, scenario simulation, students Q&A and case sharing, to name but a few. The flexible use of these methods gives students the opportunity to express their ideas, placing them at the center of the learning process.

After class, the teacher can still supervise students anytime, anywhere [16], and answer their questions online. The key difficulties to be explained can be determined based on the attendance, correctness of answers and score distribution.

3. Remote server

Rain classroom is easy to operate and popularize, requiring only a desktop computer and a number of smartphones. Every teacher can access a wide range of resources, such as research results and videos of famous colleges, and utilize them flexibly according the needs of specific courses. In addition, the teacher can arrange teaching plans and send teaching resources to his/her students, in the light of the preview state of each student. This is beneficial to the overall improvement of the students.

5.2 Limitations of rain classroom

1. The functions of rain classroom need further improvement.

Despite the attendance check function, the students can secretly switch to other apps or browse webpages after entering rain classroom. These actions are not detectable by the teacher. Besides, rain classroom only supports a few types of questions, e.g. single choice and multiple choices, failing to support subjective questions in class. Furthermore, the online resources for specific courses should be enriched, the compatibility with online videos should be improved, and new functions like automatic scoring should be added to rain classroom.

2. More investments are expected for teachers and advanced IT equipment in remote areas.

In rain classroom, the teacher has to spend much time in preparing and sending preview materials, but receives little reward for the before-class work. It is very possible that the teachers will soon lose the enthusiasm of rain classroom. What is more, not every college is equipped with advanced IT equipment, especially those in remote areas. To solve the problem, the local education authorities must step up investment on teachers and advanced IT equipment in remote areas.

3. Humanities and social sciences cannot solely rely on big data technology.

The learning of humanities and social sciences does not stop at knowledge acquisition. Communication and experience sharing are also critical to the learning process. Besides theories and creative thinking, the teacher should train the abilities of his/her students in an all-round way, ranging from morality, culture to aesthetics. The teaching process must also enhance the emotional exchange between students and that between teacher and students. Therefore, rain classroom, as a big data technology, should be coupled with personalized teaching (e.g. one-on-one teaching) in colleges, aiming to promote the acquisition of knowledge, abilities and emotions.

4. Rain classroom does not necessarily reduce the class hours.

The rain classroom involves three phases: before-class, in-class and after-class. There is not yet an agreement on whether the time spent in the first phase should be counted as part of class hours. In our survey, quite many (47.66%) of the respondents said that rain classroom does not necessarily reduce the class hours, because of the importance of in-class activities. What is worse, the class hours are determined by the education authority in China, rather than teachers or administrators in colleges.

6 Conclusion

This paper applies the rain classroom, a big data technology, to the blended teaching of engineering students in the course Film and Television Appreciation, and evaluates

the teaching effect of this model through questionnaire surveys. The main conclusions are as follows:

During the rain classroom, the students are more interested in learning due to the red packets, attentive in learning due to the limited-time quiz, active in group activities, often interacted with the teacher and classmates via real-time comments on screen, expressed views and present results confidently, and have not been absent since the teacher made random roll call. However, the majority of the students have switched to the other apps after entering rain classroom.

The rain classroom has various advantages on the teacher side, on the student side and in terms of the remote server. Nevertheless, the functions of rain classroom need further improvement; more investments are expected for teachers and advanced IT equipment in remote areas; humanities and social sciences cannot solely rely on big data technology; rain classroom does not necessarily reduce the class hours.

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