Smartphone+ Teaching mode: Practice of Surveying Course Delivery for Undergraduates based on the Rain Classroom

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Key words: Teaching modes, the Rain Classroom, the WeChat, smartphone+ teaching mode.

SUMMARY

Traditional teaching modes or tools, e.g. blackboards, slides and the Internet, play leading roles in university teaching in past decades and nowadays. Nevertheless, common use of We-Media and other information communication techniques, especially popularity of smartphones, has made the appearance of new teaching modes and tools possible. Meanwhile, university instructors and students are also eager to see more efficient teaching and learning tools. Under such a background, this paper proposes a new teaching mode named "smartphone+" which is an integration of the traditional teaching tools and smartphones and can be realized using smartphone-based APPs.

A practice of the smartphone+ teaching mode has been implemented in surveying course for the undergraduates majoring in Geomatics in Lanzhou Jiaotong University. The APP used in the practice is the Rain Classroom. The practice has shown that the Rain Classroom-based smartphone+ teaching mode is efficient. It is a valuable supplement to traditional teaching modes. It has a number of advantages that the traditional teaching modes do not have in teaching surveying course, including its online quizzes and tests, real time assessments, quick interaction, before-class preview and after-class online assessments.

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1. INTRODUCTION

Surveying is a mandatory course for undergraduates majoring in Geomatics. In some universities in China, it is also a required course for the undergraduates majoring in transportation engineering, environment engineering, hydrology engineering and civil engineering. Indeed, millions of undergraduates need to learn surveying in universities. Therefore, how to deliver surveying course to undergraduates is of great importance for the instructors. Actually, instructors in surveying in universities have never stopped exploring new teaching methods that can efficiently deliver knowledge and techniques to their students, and a number of achievements have been made by far.

Past teaching methods used in surveying course can be divided into three categories: (1) Using blackboard teaching courses was almost earliest teaching method and was commonly employed in China's universities 40 years ago. This is called blackboard teaching mode. (2) At early 1990s, computers became popular, and professors began to use the PowerPoint (PPT), a software made by the Microsoft, to organize their teaching materials and deliver courses using the slides made by PPT. At this stage, blackboards were still used; thus, this kind of teaching method is called "blackboard + slide" mode. (3) Starting from the middle of 1990s the Internet became a fashion in universities in China, and professors begin to use the Internet in classroom. Because at this period slides and blackboards are still used in teaching, course delivery at this stage is called "blackboard + slides + the Internet" mode (Wang, 2019; Zhang, 2019a).

The above traditional teaching modes have been widely and successfully used in China's universities for years, and they basically work well (Li, Zhang & Yuan, 2017; Shu, Fan & Zhu, 2019). However, shortcomings of the traditional teaching modes were exposed in past years because of advancement of information communication technology, especially common use of We-Media and smartphones.

Firstly, the instructor and his/her students cannot interact efficiently in the class. Although communications between the instructors and the students can be done by the traditional teaching modes, they are usually a type of interactions between the instructor and one or a couple of students. It is difficult for the instructor to interact with all of the students in the class, for the time spending in this process is intolerable generally.

Secondly, if only the traditional teaching modes are used, it is not easy for the instructor to quickly know the basic information of regarding a teaching activity, e.g. the number of the students who have previewed the materials given before the class, the number of the students that can catch up with the course delivery speed, the number of the students who do not known a knowledge point after the instructor presents a concept, etc.

Indeed, university students and instructors are no longer satisfied with the traditional teaching methods. Students hope to have more chances to interact and communicate with their instructors in or even after the class and know if they can get the knowledge points of the course well, and instructors also hope to quickly know if their students get what they really want to deliver to them. Fortunately, progress of information communication technology has made it possible to

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overcome the two limitations, especially when mobile phones becomes a type of popular communication tools in universities.

In this sense, a new teaching mode is necessary. On one hand, it should satisfy both instructors' and students' requirements in quick interaction in and after the class. On the other hand, it needs to inherit the advantages of the traditional teaching modes. In other words, this new teaching mode should be an integration of blackboard, slides, the Internet and smart terminals. Because smart terminals used in our daily life are usually smartphones, this mode is named "smartphone+" mode in this paper.

After the introduction, the remainder of this paper will give a thorough discuss on how the "smartphone+" mode has been practiced in teaching surveying to undergraduates majoring in Geomatics in a university in China, including a brief scan of the software platform used (Section 2), how the new teaching mode is implemented in teaching surveying course (Section 3), and conclusion of this study.

2. PLATFORMS USED IN THE SMARTPHONE+ TEACHING MODE

The smartphone+ teaching mode was practiced by a couple of professors and lecturers in Lanzhou Jiaotong University from 2017 to 2019 when they delivered surveying course to the undergraduates majoring in Geomatics. The practices were implemented using a software called "Rain Classroom" which is an APP developed for installing in mobile communication devices and personal computers. The Rain Classroom is not an independent software. It relies on an APP called "WeChat". Actually, the Rain Classroom can be viewed as an APP embedded in the WeChat, and it uses almost all functions of WeChat. Thus, this section will introduce the WeChat before the Rain Classroom.
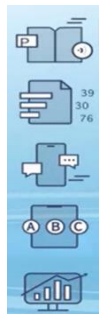

Fig.1 WeChat

2.1 The WeChat

The WeChat was released in 2011 by the Tencent company. Fig.1 shows the interface of the WeChat. At beginning, the WeChat had only some simple functions like an ordinary messenger APP used in China. Only after a couple of years, it has become a multi-purpose messenger, social media and mobile payment free APP. Its users have covered majority of Chinese, and it has become the main mode of communication and interaction among Chinese. Based on the 2019 WeChat Data insights and statistics, its monthly active users are more than 1.15 billion. More than 99% of university students in China use the WeChat. This is not only because of the WeChat's friendly multi-functions but also because of its affordable data charge. This has made it possible for the WeChat to be used in China's universities as a teaching platform to help professors to deliver courses.

2.2 The Rain Classroom

The Rain Classroom is a smart and free teaching tool jointly developed by the Xuetang Online and the Online Education Office of Tsinghua University and launched in 2016 (Zhang, 2019b). It is embedded in the WeChat and used for the purpose of teaching and learning in higher

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schools, colleges and universities. As a toolbox for teaching, the Rain Classroom can provide

Flipped Class: Package MOOCs, videos, exercises and their voice into a PPT and push it to students' smartphones via WeChat.

Realtime Assessment: Tests can be posted anytime according to the teaching needs, and feedback can be got quickly.

Class Interaction: Bullet screen, submission, red envelope and random roll call motivate students to speak.

Online Assignments and Quizzes: Objective and subjective questions, attachment reply, photo reply with answers or voice reply

Data Report: Provide analysis of full cycle teaching data before class, in class and after class, and understand the teaching process quantitatively.

Fig.2 Five functions of the Rain Classroom

enough teaching tools for instructors to assist them in the process of classroom teaching. The platform is students-centered and can accumulates the teaching and learning knowledges and experiences through the Internet. The purpose is to break the time and space constraints of interaction between the instructor and his/her students, and provide data-based information support for the teaching process.

Fig.2 shows five commonly used functions of the Rain Classroom.

- Flipped classroom

This means the students, but not the instructor, are the center in the process of teaching and learning. Therefore, the Rain Classroom provides this function to the instructor to guarantee he/she can conveniently push all teaching materials such as the teaching slides, syllabus, quizzes, voice and video files to the students via the APP. Each student may easily get these materials on his/her Rain Classroom at any time and complete the tasks (e.g. preview before class, do quizzes in class, review after class) given by the instructor.

- Real-time assessment

Using this function, the instructor may send a question to the students in the class and get feedbacks from the students instantly. This can help the instructor to know to what extent the students have got a knowledge point that the instructor hopes they know (e.g. a concept, a formula or a technique).

- Class interaction

The APP provides functions such as "bullet screen" which allows each student to post his/her opinions, suggestions and questions at any time when the Rain Classroom is going. If the instructor finds a topic among the posters that needs to be responded, he/she may instantly discuss with the students and solve the problem. In this way, the course delivery and learning process can be more efficient and the student can be more active than that of the traditional teaching modes.

- Online assignments and quizzes

The instructor can send assignments, tests and quizzes to the students by this function, and the students can complete these tasks online, in or after the class, according to the deadline given by the instructor. The instructor may mark students' submissions online and each student can check his/her scores or/and answers given by the instructor.

- Data reports

This function provides the instructor with a number of fundamental data of the rain classroom about this course. These data are considerably useful for the instructor to assess his/her own

teaching effectiveness and every student's participation and performance. The data include the number of the students attending this course in each lecture, the number of the students who have completed a specific assignment, average of a test/quiz/assignment, the number of the students who failed in a quiz/test/exam etc. By these data, the instructor can understand his/her teaching process in a quantitative way, which helps the instructor to improve his/her teaching reasonably and scientifically.

The above as well as other functions has made the Rain Classroom a promising teaching tool in China's universities. The instructors who have used this APP have summarized at least three of its advantages or characteristics (Shu, Fan & Zhu, 2019; Zhang, 2019a; Zhang 2019b).

Firstly, it is convenient to start a rain class. After the instructor starts the PowerPoint in the computer, clicks on "Rain Classroom" on the top row of the PowerPoint and logs in the WeChat using his/her username (Fig.3), a rain classroom begins at the instructor's end (a smartphone and/or a personal computer) and a QR code appears on the screen. The instructor sends the QR code to the students' smartphones or projects it on the screen and let them scan the code. After this step, both the instructor and the students have completed the sign in process and enter the rain classroom. Only the instructor need to download a Rain Classroom plugin in the computer. The students do not need to download any additional plugins.
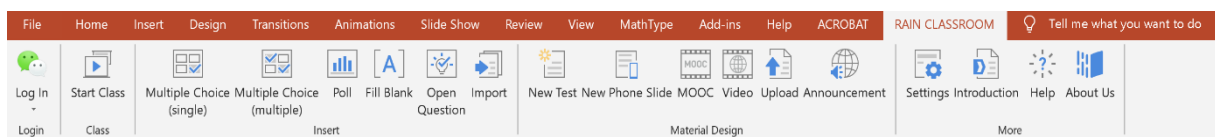

Fig.3 The interface of the Rain Classroom in the PowerPoint

Secondly, it is easy to learn and operate the APP. Because in China the WeChat and the PowerPoint are popular APPs in universities among students and instructors; hence, it is considerably easy for students and instructors to learn the Rain Classroom embedded in the WeChat and the PowerPoint. The operations on the Rain Classroom are just like that of the WeChat which has been operated by them almost everyday.

Thirdly, the Rain Classroom provides a more convenient and easier communication and interaction way for the students and the instructor than the traditional teaching modes do. For example, Communications between the students and the instructor can be done at any time anywhere when and where the Wi-Fi works well. The instructor can upload his/her teaching materials (e.g. slides, assignments) via the Rain classroom and send them to the students in or after class. The students can discuss with each other, feedback something to the instructor via the APP, and resort the instructor to answer their puzzles at any time anywhere. In addition, the instructor can timely test if the teaching goals at a specific knowledge point have been achieved by giving the students some exercises and getting their quick feedbacks via the Rain Classroom, which cannot be realized by the traditional teaching modes. These are actually useful for delivering a course like surveying which contains complicated calculations and graphics in exercises, because by this function the instructor can simultaneously know the number of students that have grasp a knowledge point that he/she has presented, and quickly determine if he/she may start to present other knowledge points.

3. PRACTICE OF THE SMARTPHONE+ MODE: A RAIN CLASSROOM FOR UNDERGRADUATES IN SURVEYING

Surveying is a mandatory and fundamental course for undergraduates majoring in Geomatics in Lanzhou Jiaotong University, China. The course emphasizes both theories and practical techniques in surveying. In theories, students are required to know basic concepts, fundamental principles and methods used in surveying, and the formulae used in surveying data processing. In practical techniques, students are required to know how to operate surveying instruments such as total stations and GPSs, how to measure the length of a curve and the angle formed by two line segments using surveying instruments, how to survey and make topographic maps, and how to layout given points from maps to the surface of the Earth.

Although the traditional teaching modes have been used for decades, instructors and students feel they are not efficient and satisfactory in teaching and learning surveying after new communication tools such as smartphones have become commonly used. According a survey done by the authors, the students hope they have sufficient chances to participate in the whole teaching process including before class, in class and after class, and they can be given sufficient time to discuss with their classmates and the instructor, and they are allowed to know the basic information of the course (e.g. syllabus of the course, slides the instructor will use in next lecture, the score and answers in a test or quiz) as quickly as possible. On the other hand, the instructor also hopes to know sufficient information of the course and enough feedbacks from the students before, in and after class.

Obviously, the Rain Classroom-based smartphone+ mode is an ideal teaching and learning way for meeting the above wishes expressed by the instructors and the students of Lanzhou Jiaotong University. Naturally, this mode has been put into practice in teaching surveying course to undergraduates in Geomatics by the authors and their colleagues in the university. To facilitate the following discussion the teaching and learning process is divided into three procedures, i.e. before class, in class and after class, though they are inseparable in practice.

3.1 Before the class

Before the first class in surveying, the instructor should set up the Rain Class APP in his/her own computer or smartphone and send the QR code generated by the APP to each student who has enrolled in this course. Each student then enter the Rain Classroom in his/her smartphone by scanning the QR code given by the instructor. After this step, a rain classroom in surveying is set up.

The instructor can upload the teaching materials and push them to the students via the rain classroom at any time for the students to preview. These materials may be course syllabus, slides of the lectures, reading materials, videos, audios, assignments, tests, quizzes, news, announcements, questions and some links etc. The APP can also push the materials to a specific student at a specific time according to the instructor's instruction. The student can instantly get the notification from the Rain Classroom on his/her smartphone at almost the same time when the new message is pushed by the instructor.

When a student finishes doing a test, a quiz, an assignment, or a reading material, he/she can submit it to the rain classroom managed by the instructor. After checking the rain class using the Rain Classroom APP (see Fig.4), the instructor can get how the students' preview is going by the number of students that has finished doing a specific task, the average score of a quiz etc.

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If a student has a question in the preview, he/she can post the question on the discussion board and discusses it with the classmates. He/she may also push the question quickly to the instructor via the APP and discusses it with the instructor online.

To arouse the students' interests in learning surveying, questions can be pushed to the students before class by the instructor. For example, before the lecture of "traverse surveying", the following questions are pushed to the students:

- Why is traverse surveying necessary?
- What instruments are necessary in traverse surveying?
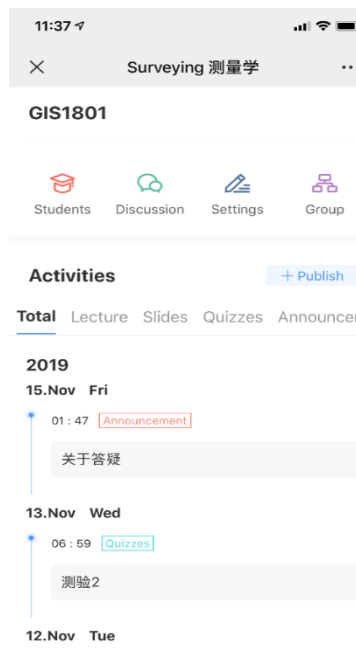- How to obtain the coordinates of the traverse points in different types of traverse?

Fig. 4 Interface of the Rain Classroom on the smartphone

3.2 In the class

When a rain class in surveying begins, each student is required to start his/her smartphone, login the Rain Classroom by scanning the QR code or entering his/her own username and password. The instructor starts the PowerPoint in his/her personal computer and login the Rain Classroom which embeds in the PowerPoint. After this step, the instructor can see a name list of the students attending the rain class. This actually plays a role of roll call.

In the process of course delivery, the traditional teaching tools/modes such as blackboards, slides and the Internet are still in use and play important roles. For example, in our rain class in surveying course, the lectures are mainly presented by slides made and shown using the PowerPoint, and the blackboard is also used occasionally for discussing questions temporarily raised by the students in class. Nevertheless, the Rain Classroom, as a new element, plays a special role that cannot be substituted by other traditional teaching tools and modes, which has been practiced in our rain class in surveying.

- Quick comments and interactions

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Using the Rain Classroom, the students may leave comments on any slides of the course before, in or after the class if they have any questions about any points of the slides. The comments can instantly appear on the screen of the instructor's side. If the instructor deems that one or more comments are worthy of a stop, he/she may stop the lecture and launch a short discussion with the students.

Here is such a typical example. A number of students asked a similar question "why a 60-based system is used in angle conversion?" on the discussion board when one of the authors was lecturing on "Angle Surveying". When the instructor got this message, he/she started a discussion with the students, because he/she thought that only after this question had been solved, could the students easily understand the other formulae and techniques.

- Quick exercises and answers

As has been discussed in previous section, surveying for undergraduates emphasizes on both fundamental theories and practical techniques. Because some theories in surveying contain complicated graphics and/or formulae and some surveying techniques need to be implemented using various special tables, it is usually difficult to do exercises in class if only the traditional teaching modes/tools are used. Use of the Rain Classroom has changed this situation. In our rain class, it is very common for the instructor to give the students some complicated exercises and ask them to submit their answers in given time via the APP. The following presents such an example.

The students are given a graphics of a traverse with surveyed distances and angles marked on it (Fig.5) and surveyed data are listed in Table 1. The figure and the table are pushed to the students. They are required to submit some of their answers in 15 minutes by filling the blanks on the Rain Classroom APP.

After the students completed submitting their answers via the APP, the Rain Classroom APP can quickly mark the questions within almost a second and send the mark to each student together with the correct answer that are prepared in advance by the instructor. The instructor also can know the number of students who have completed the exercise correctly, which helps him/her determine what to do in the next step.

Table 1 Calculation of the closed traverse in Fig.5

stations	Interior angles β （left angle）		Azimuth (° ′ ″)	length (m)	DEPs and LATs		Corrected DEPs and LATs		Coordinates	
	surveyed angles (° ′ ″)	Corrected angles (° ′ ″)			DEPs(m)	LATs(m)	DEPs(m)	LATs(m)	E(m)	N(m)
1	2	3	4	5	6	7	8	9	10	11
A									125.000	75.000
			168 10 44	109.551						
B	81 00 42									
C	105 28 06			46.930						
D	84 21 06			102.027						
A	89 11 00			57.844						
B										
Σ	360 00 54			316.352						

- In-class quizzes and real time marking

The Rain Classroom makes quizzes and tests much simpler to both the instructor and the students than that of the traditional teaching tools such as blackboards and slides, because this can be done in a simple way by the former: the instructor pushes a quiz to each student via the Rain Classroom; each student can be notified instantly by his/her rain class in surveying in the smartphone, and he/she may start the quiz quickly. After completing the quiz, he/she submits the answers via the APP. The APP at the instructor's side receives the submissions right away and the instructor may immediately mark the submissions and know the whole status of the quiz, such as the average score, the highest/lowest score, the number of the students who pass the quiz, and the students who answer a specific question correctly (Fig.6). The instructor can also tell the information of the quiz to each student by the APP.
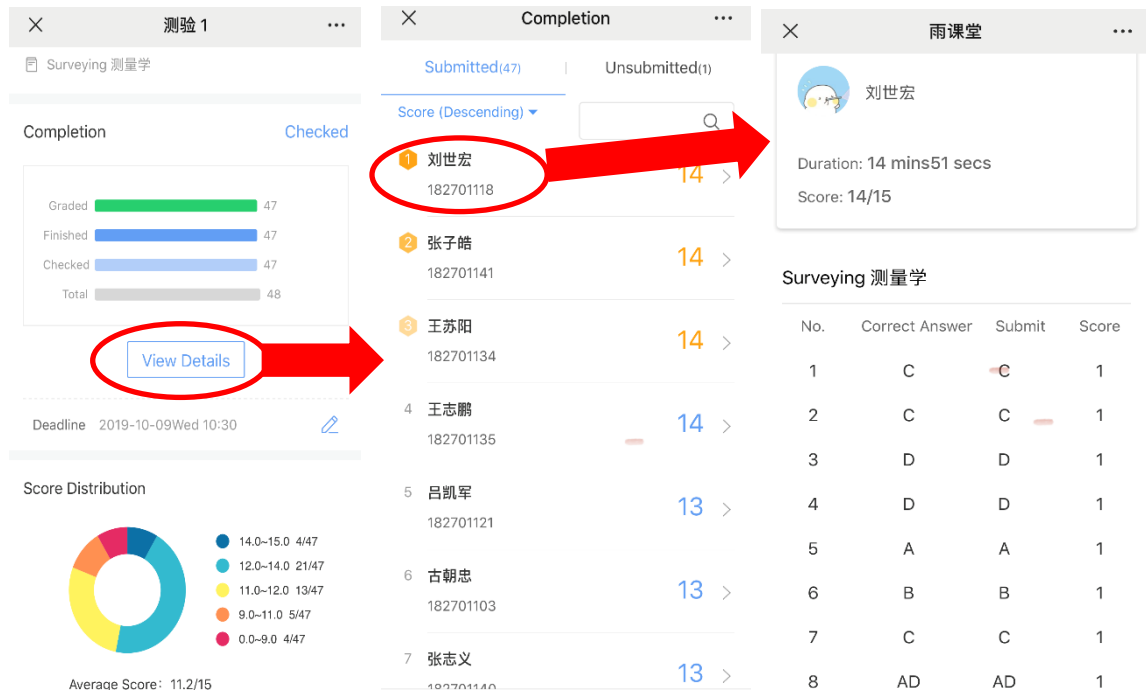

Fig. 6 Statistical data of a quiz shown on the instructor's smartphone

Indeed, in-class quiz and quick marking by the Rain Classroom makes our surveying class simpler and more efficient than the traditional teaching modes do. It helps both the instructor and the students know each other well in short time regarding some knowledge points, and help the instructor to make decision to continue with the teaching process quickly.

3.3 After the class

In the time of the traditional teaching modes, it is difficult for the instructor to interact with the students, mark students' assignments, and test students online after class. But these functions are really necessary to the instructor and the students.

- Quick interaction

If the instructor suddenly finds that he/she has made a mistake in an assignment which the students are doing, or a student encounters a problem or a puzzle that he/she cannot be solved

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without the instructor's help, quick interactions between them become particularly important after class. The functions provided by the Rain Class make after-class interactions easy.

- Realtime assessment at home

The instructor may assign some exercises to the students by the Rain Classroom APP and hope the students to finish them at home. Correctness of the answers of the exercises are automatically and instantly judged by the APP online. So, sometimes, each student is usually allowed to practice any specific exercises repetitively until he/she feels the answers are satisfactory.

- Online quizzes and tests

Online quizzes and tests are inevitable after class. For example, if a student cannot attend a lecture due to a natural hazard or something emergent, he/she may do the quiz or test at home just like he/she is in the classroom using the APP.

4. CONCLUSION

Traditional teaching modes or tools, including blackboards, slides and the Internet, plays leading roles in past university teaching. Nevertheless, they need to be improved with the coming of We-Media and other modern information communication technologies such as smartphones. Hence, this paper proposed a new teaching mode called smartphone+, and gives a practical example regarding realizing the smartphone teaching mode.

The smartphone+ teaching mode practice has been implemented in surveying in China for the undergraduates majoring in Geomatics in Lanzhou Jiaotong University using an APP named "Rain Classroom". The practice has shown that the Rain Classroom-based smartphone+ teaching mode is a valuable supplement to existing teaching modes. It has a number of advantages that the traditional teaching modes do not have in teaching surveying, including its online quizzes and tests, real time assessments, quick interaction and communications after class.

Our explorations on the smartphone+ teaching mode and the practice using the Rain Classroom have proved that smartphone+ is an efficient teaching mode; but the practice in teaching surveying is just a preliminary work. How to take advantage of the characteristics of surveying course together with the advantages of the smartphone+ teaching mode and the Rain Classroom is worth our further investigation in future.

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