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# An Empirical Study on the Comprehensive Evaluation of Teaching and Learning Quality in Rain Classroom*

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***Abstract*—In the mixed teaching mode of "Internet + education", this paper extracts the wisdom classroom data of Rain Classroom of 81 majors and 5, 313 students comprehensively evaluating the teaching quality. The research shows that the evaluation model of teaching quality constructed by methods such as cluster analysis, LSD and reliability analysis has significant differences in the analysis of the comprehensive scores of the relevant professions using the rain classroom. Simultaneously, further Cronbach Coefficient Analysis also obtained the main influencing factors affecting the score of majors in this university. This study provides an empirical experience in the introduction of Rain Classroom for teaching quality evaluation. It also has certain reference significance in using smart teaching tools effectively to improve the quality of teaching.**

***Keywords—Rain Classroom; evaluation model; cluster analysis; teaching quality***

## I. INTRODUCTION

"Internet + education" has spawned a hybrid-teaching model that has quickly entered college classrooms. Represented by wisdom teaching has advanced rapidly, but academic research based on wisdom teaching lags behind the pace of practice.

This study intends to carry out comprehensive evaluation of teaching quality with the wisdom teaching tool Rain Classroom as the object. The Rain Classroom was developed by Tsinghua University and launched by the well-known MOOC platform "School Online" in April 2016 [1] as a new teaching tool. At present, the Rain Classroom has been widely promoted and used in colleges and universities nationwide. Liu Fang [2] originally pointed out that the new hybrid-teaching model that combines the advantages of traditional learning methods with the advantages of digital learning has a greater practical significance, and gives the concept of a hybrid- teaching method. Liu Jing [3] also explored this hybrid-teaching mode and introduced the specific application methods and functions of the Rain Classroom.

For students, the rain classroom can stimulate their interest in learning and enhance the ability of more students to learn independently through modern "Internet + education". Therefore, many students have a positive attitude towards the Rain Classroom [4]. For teachers, the Rain Classroom is their powerful assistant, which makes the hybrid-learning model the mainstream of the information-based teaching model [5].

According to the literature analysis, due to the wisdom-teaching tool is a new type of teaching method, the current research mainly focuses on the application and function introduction of a certain course, but comprehensively evaluates and analyzes the behavior data and teaching quality of students using the Rain Classroom are relatively limited. From the point of the time series, there is less research on the behavior data of Rain Classroom in a full semester. From the scope of use, there is very little analysis of all the majors in the entire school.

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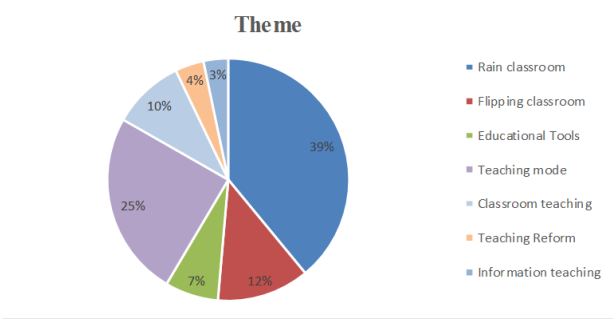


Fig. 1. Percentage of Topics in the Rain Classroom Research.

Taking the "Rain Classroom" as the key word searched in the CNKI database, the distribution of the research topics are shown in “Fig. 1”. The research topics focus on the use of teaching tools, the development of teaching models, examples of classroom teaching, and the teaching process. There is almost no research on information data in the teaching process.

In view of this, this paper uses the clustering analysis, LSD and reliability analysis methods to analyze the classroom data of the entire school using the Rain Classroom in a school year in a university of Yunnan Province. By constructing a teaching quality evaluation model, the research provides a scientific development reference for how the wisdom teaching tools in the” Internet + education” era can improve students' learning efficiency.

## II. SOURCE

### A. *Rain Classroom*

From a technical point of view, Rain Classroom is a plugin that installed on Microsoft Office Power Point 2010 and above. It started small-scale testing on February 2016, opened to the public in April, and was used in 20,000 classrooms in September, which fully reflects the passion of teachers and students for the Rain Classroom [6].

The data source of this paper is from the online and offline interactive teaching by the teachers in the mixed teaching mode after the university introduced the wisdom teaching tool Rain Classroom in 2017. The wisdom teaching mode is compatible with the advantages of today's popular MOOC, micro-curriculum, and flipping classrooms. It greatly releases the energy of teaching and learning, so that all aspects of the classroom are closely linked and interlocked. At the same time, it also includes a large amount of internet teaching resources, pre-school self-study and cooperative learning functions, classroom interaction links, post-class review task and single-form upgraded links.

In addition to the above-mentioned visual function tool of the wisdom teaching, Rain Classroom is also an invisible recording tool. The Rain Classroom has achieved the record data of each course covered by each student. Through these data, the student's learning status can be judged in time so that the teacher can adjust the teaching content. At the same time, the analysis of accumulated data can also reflect the characteristics and deficiencies of teaching. Therefore, the recording of real-time data throughout the teaching process allows teachers to analyze students' classroom learning behaviors, and schools to understand professional teaching situations. Both of them are important resources.

According to the real-time data structure in the teaching process of Rain Classroom, this study selects and defines the data indicators and specific conditions of some schools as shown in “Table I”.

TABLE I. INDICATOR SYSTEM

| Index | Indicator Meaning |
|---|---|
| Majors | Majors (2017) |
| Number of Students | Number of Students Covered by Rain Classroom |
| Average Number of Selected Courses | The Average Number of Courses per Student in the Major |
| Average Class Rate | The Average Student Attendance Rate of the Major |
| Average Exercises Correctness Rate | The Average of the Correctness of the Exercises in the Classroom of the Major |
| Average Composite Score | The Average of the Total Scores of All Students in the Semester of the Major |

### B. *The Early Warning Mechanism of Undergraduate "Penalty Card"*

To enhance the guarantee mechanism of teaching quality assurance, the university has implemented the early warning mechanism of “Penalty Card” earlier in the country through self-evaluation of majors since 2010. People's Daily reported on the event of the school's early warnings to 19 majors, and many colleges and universities went to the school to exchange experiences for the early warning work.

The specific practice is to evaluate the quantitative indicators including volunteers, teaching and training processes, employment, etc., and put the lower-ranking majors on the “Penalty Card” warning. For the majors posted the “Penalty Card” for two consecutive years, the university administration will stop the enrollment of students. The evaluation results show that the two undergraduate majors of Agricultural Electrification and Packaging Engineering that have been posted “Penalty Card” for two consecutive times in 2017 have stopped enrolling students in 2018.

On the one hand, the guarantee of teaching quality requires the construction of the teaching faculty; on the other hand, it is necessary to pay attention to the cultivation of students. The wisdom teaching tools represented by the Rain Classroom effectively reflect the process quality management of teaching and learning, and fully embody the

attention and cultivation of the whole process of student learning.

Therefore, this study will select two majors of the suspension by "Penalty Card" as a reference group, and further analyze the 2017 undergraduate majors covered by the Rain Classroom.

## III. Selection of Evaluation Methods

### A. Processing of Cluster Analysis for Different Majors

Due to differences in majors, there are also large differences in the number of students, courses and courses selection. In addition, the independent management of majors in colleges also makes it impossible to achieve a unified standard in comparison for the curriculum selection for students and the teaching plan for teachers. To this end, this study will cluster the school's majors in order to solve the problem of unified evaluation due to diversification, and scientifically judge the overall effect of the school's various majors after using the Rain Classroom.

Cluster analysis is a statistical method for studying (sample or variable) classification problems. It further adopts Q-type cluster analysis and R-type cluster analysis according to different classification objects. Q-type clustering is the clustering of samples; R-type clustering is the clustering of variables.

### B. Significant Analysis of Different Majors

This study used LSD to compare the various average scores in the Rain Classroom to determine whether each major achieved significant differences. The specific method is as follows: The first step is to perform an F test. Under the condition of significant F test, the minimum significant difference method is applied to analyze the multiple comparisons. In the second step, the minimum significant difference is calculated when the significant difference level of the major score is $\alpha$ , and it is compared with the absolute value $\left|\overline{x}_i - \overline{x}_j\right|$ of the difference of the average scores of any two majors' comprehensive scores. In the third step, the absolute value of the difference in the multiple comparison results of the comprehensive scores of each major is compared with the smallest significant difference whose score reaches a significant level, and statistical inference is concluded.

The characteristic of the least significant difference method is that the test sensitivity is high, and the statistic of the test is the T statistic.

### C. Improvement of Indicator Reliability

This study will use the Cronbach alpha coefficient for reliability index calculation. The Cronbach α coefficient is the degree of agreement within a certain dimension and is a measure of the reliability of a psychological or educational test.

In the data analysis of the Rain Classroom, the internal consistency of various major indicators is estimated based on the comprehensive score, and used as a reliability indicator to measure the reliability of a set of synonymous or parallel test "sum". In this paper, by adjusting or deleting the 0-score data of an indicator, the pre- and post-changes of the Cronbach α coefficient value are compared to determine the main factors affecting the major score, and the conclusion is drawn. In general, the α coefficient is between 0 and 1: if the α coefficient is less than 0.6, the internal consistency is insufficient; if it is 0.7 to 0.8, it means that the internal consistency has considerable reliability; if it reaches 0.8 to 0.9, the results are very reliable.

## IV. Case Analysis

The comprehensive evaluation of teaching quality based on data collection in the Rain Classroom is to analyze the data of all student behaviors in the majors covered by the university using the Rain Classroom. This study imported data from the school's undergraduate students in 2017, 81 majors all of which were independent samples. At the same time, this study also includes the Agricultural Electrification and Packaging Engineering that were stopped the enrollment in the results of the early warning mechanism of the "Penalty Card" in 2018. The average value of each major index is obtained and imported into SPSS for analysis.

The research hypothesis:

- There is no significant difference between the majors;
- There is no significant difference between the two majors of Agricultural Electrification and Packaging Engineering and other majors.

### A. Professional Clustering

According to the real-time data in the Rain Classroom, the variables of the number of courses, the class rate, and the correctness rate of the exercises, the preview rate and the comprehensive score are selected. From the results of the cluster analysis, 81 majors can be divided into three categories:

- Class I: 65 majors in energy, new materials and resources, geographic information, marketing, oil transportation, applied chemistry, electronics, measurement and control, information engineering, packaging engineering, agricultural electrification, mining engineering, finance, business management, etc.;
- Class II: civil, electrical and automation, chemical, construction, transportation, computer science, metallurgy, electronics, energy power, automation, materials, water conservancy;
- Class III: engineering design, biomedical, broadcast.

It can be inferred from the cluster analysis of majors that metallurgy, construction and water conservancy belong to the national specialty of the school, and the number of certification and evaluation majors for engineering education passed by them also ranks first among local universities and is the key enrollment specialty and high-level major of the school. About 80% of the school's overall level of majors is good, of which science and engineering majors are the majority, and there are also a few major's indicators with

low scores, their comprehensive score are at a medium level. The number of students in the three majors of industrial design, biomedical and broadcast is relatively small, and the correct rate and pre-study of the exercises are relatively weak.

In general, the university belongs to the polytechnic school, and its specialty level is outstanding. The overall comprehensive score of its engineering major is generally higher than that of other majors; most of the majors have a good overall level, and all indicators are at the upper-middle level; at the same time, the characteristics of relatively weak majors are also obvious. It is necessary to further increase the collection of real-time data in the use of Rain Classroom teaching in order to draw conclusions that are more scientific.

### B. Discussion and Analysis

On the basis of the overall main effect of majors comprehensive scores of the school (F=14.678, P<0.01), the comparative analysis of multiple factors between the Agricultural Electrification and Packaging Engineering, and characteristic majors of high-scoring in the cluster analysis, can further determine the degree that different levels of controlled variables affecting the observed ones.

TABLE II. MULTIPLE COMPARISONS (LSD)

| Profession (I) | Profession (J) | Mean Difference(I-J) | Significant | Confidence Interval (95%) | |
|---|---|---|---|---|---|
| | | | | Lower Limit | Upper Limit |
| Packaging Engineering | Agricultural Electrification | -1.800 | .147 | -4.24 | .64 |
| | Metallurgy | -4.500* | .000 | -6.94 | -2.06 |
| | Construction | -5.200* | .000 | -7.64 | -2.76 |
| | Water Conservancy | -9.467* | .000 | -11.90 | -7.03 |
| Agricultural Electrification | Packaging Engineering | 1.800 | .147 | -.64 | 4.24 |
| | Metallurgy | -2.700* | .030 | -5.14 | -.26 |
| | Construction | -3.400* | .007 | -5.84 | -.96 |
| | Water Conservancy | -7.667* | .000 | -10.10 | -5.23 |
| Metallurgy | Packaging Engineering | 4.500* | .000 | 2.06 | 6.94 |
| | Agricultural Electrification | 2.700* | .030 | .26 | 5.14 |
| | Construction | -.700 | .571 | -3.14 | 1.74 |
| | Water Conservancy | -4.967* | .000 | -7.40 | -2.53 |
| Construction | Packaging Engineering | 5.200* | .000 | 2.76 | 7.64 |
| | Agricultural Electrification | 3.400* | .007 | .96 | 5.84 |
| | Metallurgy | .700 | .571 | -1.74 | 3.14 |
| | Water Conservancy | -4.267* | .001 | -6.70 | -1.83 |
| Water Conservancy | Packaging Engineering | 9.467* | .000 | 7.03 | 11.90 |
| | Agricultural Electrification | 7.667* | .000 | 5.23 | 10.10 |
| | Metallurgy | 4.967* | .000 | 2.53 | 7.40 |
| | Construction | 4.267* | .001 | 1.83 | 6.70 |

a. *:P<0.05.

From the results of "Table II", there are significant differences in the overall population under different levels of controlled variables. Among them, the comprehensive scores of Packaging Engineering and Agricultural Electrification majors are significantly lower than other majors; among the three specialties of metallurgy, construction and water conservancy, the scores of water conservancy categories are significantly higher than other majors, which is basically consistent with the reality.

### C. Determination of Influencing Factors

The three national-level specialty of metallurgy, construction and water conservancy, and the data of Packaging Engineering and Agricultural Electrification as the controlled group are imported into SPSS for reliability analysis. The Cronbach $\alpha$ coefficients show in "Table III" below:

TABLE III. CRONBACH $\alpha$ COEFFICIENTS OF FIVE MAJORS

| Professional Title | *Packaging Engineering* | *Agricultural Electrification* | *Metallurgy* | *Construction* | *Water Conservancy* |
|---|---|---|---|---|---|
| **Cronbach's Alpha value** | 0.146 | 0.217 | 0.412 | 0.375 | 0.545 |

From "Table III" that the Cronbach $\alpha$ coefficients of all majors are below 0.6, the consistency is weak, indicating that the Rain Classroom used in the initial stage of the school are not universal, and the data contained in each index has zero data, resulting in lower internal consistency checks.

Taking the major of Agricultural Electrification as an example, "Table IV" shows that if the item "Correctness Rate of the Problem" is deleted, the coefficient value of the $\alpha$ coefficient increases by 0.232, and the range of change is the largest. This indicates that the indicator has the greatest impact on the consistency test. This also shows that the student's classroom interaction is relatively silent. The students' ability to absorb new knowledge from the classroom is weak. It is necessary to strengthen students' interest and cultivate the concentration in classroom.

TABLE IV. TOTAL STATISTICS OF AGRICULTURAL ELECTRIFICATION MAJORS

| Index | Item Deleted Scale Variance | Total Corrected Items Correlation | Item Deleted Cronbach's Alpha Value |
|---|---|---|---|
| Number of Courses | 8.673 | -.153 | .126 |
| Rate of Attendance | 9.655 | .800 | .160 |
| Problem Correctness Rate | 10.318 | .664 | .232 |
| Preview Rate | 10.089 | .686 | .216 |
| Overall Ratings | .744 | .731 | -.046 |

## V. CONCLUSION

The Rain Classroom data can effectively reflect the evaluation of teaching quality of colleges and universities, and objectively enhance the current use of smart teaching models in domestic universities. The daily behavioral performance data of students in Rain Classroom also shows the teaching characteristics and teaching level of the university as a whole.

This paper makes a comprehensive evaluation of the use of Rain Classroom in colleges and universities by describing statistics. The method of cluster analysis initially analyzes the use of Rain Classroom in various majors of the school.

After analysis, there are significant differences in the use of Rain Classroom among the majors, and the results of majors' evaluations displayed by the data analysis are consistent with the results of the evaluation mechanism in reality. The scores of the two majors of the suspended Packaging Engineering and Agricultural Electrification Engineering are generally lower than those of other majors. The data of the two majors shows that the average pre-study rate and the correct rate of class exercises have the greatest impact on the comprehensive score of the major. The major can guarantee the quality of classroom teaching by strengthening the students' pre-study awareness and efficiency of classroom attendance.

The Rain Classroom data is a wisdom-teaching tool under the "Internet + Education" model. This study uses its objective real-time data further analyzing the behavior of students as "self-study" subjects, thus providing a direction for building the "first-class majors".

Due to the initial introduction of the Rain Classroom in the university, there are still some disturbances such as unskilled teachers and the data that cannot fully cover all the students' behaviors. This is also a shortcoming of this paper. In the future, with the integrity of the data volume, there will be conclusions that are more scientific.

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