Optimization of Wisdom Classroom Teaching Resources Based on Visualization Software

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Abstract. University classroom is the main place for classroom teaching, group discussion, students' self-study and other activities. With the development of science and technology and the optimization of educational resources, traditional fixed desks and chairs cannot meet the needs of students' discussion, so more and more colleges and universities adopt the design of movable desks and chairs. To date, most research has focused on schemes that design moving desks and chairs directly according to classroom capacity, but little consideration has been given to adjusting the classroom as long as the schedule remains the same. Combined with the classroom schedule of the first Teaching Building of Huazhong Agricultural University and the maximum capacity of the movable desks and chairs in each classroom, Tableau software is used for visualization analysis, and two ideal schemes are finally designed.

Keywords: Wisdom Classroom, Movable Table And Chair, Visualization Analysis, Tableau Software

1. Introduction
With the continuous exploration and optimization of classroom teaching models, fixed tables and chairs can no longer meet the needs of students' discussions. The design of movable tables and chairs has been favored by a large number of universities in recent years. However, it has always been a complicated problem to adjust the tables and chairs of the classroom. To adjust the seats in the classroom as long as the original schedule is unchanged, what kind of plan can be designed to maximize the use of resources while meeting the needs of classroom seating? Visualization analysis is a very popular direction recently. There are many kinds of visualization analysis software. Tableau has a very powerful visual analysis function and is a very mature global business software.

At present, Tableau has been applied in many fields to solve practical problems, Szymon et al. combined the ESRI ArcGIS and BI Tableau systems in the realization of spatial data visualization problems to achieve stronger visualization results, and realized the combination of systems by loading the information contained in GIS into the Tableau environment [1]. Małgorzata et al. used Tableau Software (Seattle, WA, USA) and Dell Statistica software (Round Rock, TX, USA) to visualize the geographic area of foodshed based on the relationship between food production locations and their consumption, and the food zone was mapped using ArcGIS Software (Redlands, CA, USA) [2]. Waye et al. used Tableau Software to draw a distribution map of overdose death and naloxone in order to
describe the anchoring and anchoring activities and the implementation process [3]. Morton used Tableau to analyze the use of online visual analysis system [4]. Fezarudin et al. used Tableau software to analyze the growth of human capital in the halal industry in Malaysia and the relationship between human capital and halal training [5]. Chen et al. and others used Tableau to analyze the differences and common characteristics of certain social, economic and welfare measures in different areas of London [6]. In addition, Tableau is also used in the field of education. Hallinger et al. [7] used VOSviewer, Excel and Tableau software to analyze 22,361 peer-reviewed articles published in 22 Scopus indexed EA journals from 1960 to 2018, identified the documents with great influence, and identified four main schools of thought that emerged over time. Batt et al. [8] introduced the application of tableau in the field of economics. In order to develop Tableau in the medical field, Ko [9] and others created a simple view of the average length of stay of colon cancer patients by using Tableau. Burgoyne et al. [10] using the research data in the field of education policy, they made a visual table with tableau, and compared it with the static and tabular representation of the same data. Nestorov et al. [11] discussed the suitability and position of data visualization course based on tableau in information system course. Although Tableau has been gradually used in education research, there are few researches on the optimization design of teaching resources in colleges and universities.

Based on Tableau, the author makes a Visualization analysis on the optimization of teaching resources.

2. Classroom Analysis of Adjustment of Curriculum Schedule

2.1. Problem Description

Due to the classroom and the class are relatively unfixed, in order to avoid the loss of tables and chairs, the design of classroom tables and chairs generally adopts a fixed structure. Although such desks and chairs can meet the traditional teacher-centered classroom teaching, they are not suitable for students and teachers to carry out group discussions or hold some small meetings. In short, modern university classroom desks and chairs should be designed to meet the needs of lectures, group discussions, meetings and other requirements at the same time. Therefore, the design of movable seats is a hot issue among colleges and universities.

The purpose of reforming the first Teaching building of Huazhong Agricultural University is to adjust the seats in the classroom as long as the original schedule is unchanged, so as to maximize the use of resources in the case of meeting the seats demand of the classroom.

Huazhong Agricultural University first teaching building currently has 35 classrooms for classes and discussions. Classrooms can be divided into three types by capacity: small, medium and large.

The known data include the classroom number of the classroom number, classroom seating capacity, course title and number of students (Figure 1, some data in the table are intercepted), and the data of each classroom schedule.

| Classroom number | Classroom seating capacity | Academy | Course Title | Number of students |
|------------------|---------------------------|---------|--------------|-------------------|
| 102              | 104                       | Zoology | Frontiers of Animal Science | 94 |
| 102              | 104                       | Zoology | Basic Veterinary Science New Technology | 28 |
| 102              | 104                       | Zoology | Nutrition Physiology and Biochemistry | 12 |
| 102              | 104                       | Grammar | Intermediate Social Research Methods | 91 |
| 102              | 104                       | Grammar | Intermediate Social Research Methods | 57 |
| 102              | 104                       | Grammar | Intermediate Social Research Methods | 57 |
| 102              | 104                       | Grammar | Western sociological theory | 46 |
| 102              | 104                       | Grammar | Qualitative research methods | 23 |
| 102              | 104                       | Grammar | Research on Social Welfare Thought | 75 |
| 102              | 104                       | Grammar | Jurisprudence topics | 15 |
| 102              | 104                       | Grammar | Frontiers of Media Development Research | 10 |

Figure 1. Information of the first Teaching in Huazhong Agricultural University
It is proposed to adjust each classroom to transform the original fixed seats into the following three types of seats (Figure 2).

| Types       | Schoolbag chair | Single table | Table for two |
|-------------|-----------------|--------------|---------------|
| Pictures    |                 |              |               |
| Small rooms | Capacity: 28    | Capacity: 24 | Capacity: 24  |
| Medium rooms| Capacity: 64    | Capacity: 48 | Capacity: 48  |
| Large rooms | Capacity: 90    | Capacity: 63 | Capacity: 63  |

**Figure 2.** Three types of seats

In order to keep the original schedule as unchanged as possible, the classrooms that can be adjusted and cannot be adjusted are selected first. The screening condition is that when the original maximum attendance is larger than the maximum capacity (for schoolbag chair), the classroom is deemed as "non-adjustable classroom". But in fact, we can carry out further analysis on these "non-adjustable classrooms", such as considering transferring the curriculum schedule of some classrooms to other classrooms or exchanging the curriculum schedule with other "undersaturated" classrooms, so as to optimize "non-adjustable classrooms" into "completely non-adjustable classrooms". In this way, we can get some idle classrooms for the later analysis.

2.2. **Visualization Analysis**

Based on the above ideas, the data visualization software Tableau is used for analysis. Data visualization tools meet the characteristics of rapid development, easy operation, and changeable information in the Internet era, which is one of the hot topics between universities and enterprises. At present, the mainstream software for visualization analysis includes Tableau, Microsoft Power BI, Fine BI, etc. Tableau visualization software has become one of the most popular software for visualization analysis due to its advantages such as simple operation, rapid operation and excellent display effect. The concrete steps for visualization analysis of the above problems using Tableau are as follows:

1. Step1. Tableau was used to visualize the number of students in each classroom.
2. Step2. Screen out the original maximum attendance of each classrooms
3. Step3. Use visual analysis to judge the classroom which the original maximum attendance is larger than the maximum capacity (for schoolbag chair).

Since there are three cases (90, 64, 28) for the adjusted classroom capacity, these screened classrooms are analyzed separately below.

a) First consider the classrooms that the original maximum attendance is larger than 90. Seven classrooms were screened out for analysis.
Consider retaining partial classrooms. The reserved classrooms can satisfy the need to add courses from the unreserved classrooms to the reserved classrooms. After analyzing the arrangement of the above 7 classrooms (102, 104, 203, 204, 302, 303, 304) according to the saturation level, 6 reserved classrooms (102, 104, 203, 204, 303, 304) were selected.

Purpose: To keep these 6 classrooms, the courses of other classrooms 302 can be added to these classrooms, so that classroom 302 can be idle.

In the schedule of 302, one course needs to change the time period and classroom on Thursday, while the other courses need not change the time period, just change the classroom.

b) Then analyze the three classrooms that the original maximum attendance is larger than 64.

(1) First consider arranging 106’s class in the previously idle classroom 302 (the capacity of schoolbag chairs in 302 is greater than 90) because 106’s class schedule is relatively saturated. After this operation, the idle classroom becomes 106 (the capacity of schoolbags and chairs in the classroom is 64).

(2) For the remaining two classrooms, 107 and 205, consider adjusting the schedule of these two classrooms with another classroom with a capacity greater than 90 but the original maximum attendance is less than 64 (the schedule remains unchanged, only the class locations are interchanged). Through analysis, it is found that the courses of 107 and 402 can be exchanged, and the courses of 205 and 403 can be exchanged.

c) Finally, analyze the three classrooms to be adjusted where the original maximum attendance is larger than 28.

Directly arrange the courses in the 108 classrooms to the idle 106 classrooms (capacity for schoolbag chair is 64). After this operation, the idle classroom becomes 108 (capacity for schoolbag chair is 28).

After the above analysis, the individually considered classrooms have been analyzed, and then only an optimal value needs to be selected for the seating arrangements of the remaining classrooms.

The list of classrooms that can eventually be adjusted to movable tables and chairs is as follows.
Based on the previous results, the above classrooms can be designed as movable tables and chairs. Below we give two plans. Plan 1 only considers the case of changing to schoolbag chair, and the maximum capacity of the classroom is the same after changing to a single table or table for two, so plan 2 only considers one of the cases.

3. Scheme Design

**Plan 1: Only consider the case of changing to schoolbag chair.**

In plan 1, the classroom with the original configuration is kept according to the results of the previous analysis; the classroom that capacity for schoolbag chair is 90, but maximum attendance more than 64 is designed as 90; the classroom that capacity for schoolbag chair is 90, but maximum attendance less than 64 is designed as 64; the classroom that capacity for schoolbag chair is 64, but maximum attendance more than 45 is designed as 64; the classroom that capacity for schoolbag chair is 64, but maximum attendance less than 45 is designed as 48; the classroom that capacity for schoolbag chair is 28 is designed as 28.

**Plan 2: Consider the combination of chair and other chairs.**

In plan 2, the classroom with the original configuration is still kept according to the results of the previous analysis; the classroom that capacity for single table is 63, but maximum attendance more than 63 is designed as schoolbag chairs with 90; the classroom that capacity for single table is 63, but maximum attendance less than 63 is designed as single tables with 63; the classroom that capacity for single table is 48, but maximum attendance more than 48 is designed as schoolbag chairs with 64; the classroom that capacity for single table is 48, but maximum attendance less than 48 is designed as single tables with 48; in particular, the classroom that maximum attendance less than 30 is designed as single tables with 36; finally, the classroom that capacity for single table is 24, but maximum attendance more than 20 is designed as schoolbag chairs with 28; the classrooms that maximum attendance is 4 and the idle classrooms are designed as single tables with 24.

**Figure 5.** Filter the non-adjustable classrooms
The above two plans are the optimal results designed according to the results of the previous analysis and the actual demand of the first Teaching Building of Huazhong Agricultural University.

4. Conclusion
The problems encountered in the design of classroom movable tables and chairs in colleges and universities are often complicated and cumbersome. If the number of elective classes in the class schedule is not considered, the classrooms are directly rearranged. If the number of tables and chairs after adjustment cannot meet the maximum number of elective classes, the result will be very serious. According to the actual needs of Huazhong Agricultural University, the author first considered this problem, and first analyzed the "non-adjustable classroom" when solving such problems. After that, the author further thought about the problem and proposed to fine-tune the timetable, and optimized a "classroom that cannot be adjusted at all". This method of fine-tuning the schedule is very suitable and has a significant impact on subsequent optimization. Secondly, when optimizing the design of tables and chairs, the author considers swapping classroom schedules with large capacity and high redundancy with classrooms with low redundancy or small capacity that cannot meet the maximum number of elective classes, which also has an important impact on the optimization plan. More importantly, using Tableau software to deal with such problems can simplify the original complex problems.

The final solution is simple and easy to implement and has achieved excellent results. It perfectly solves the purpose of transforming the first teaching building of Huazhong Agricultural University, and the Postgraduate Academy has given a high evaluation.

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