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# Study on Improving Students' Learning Efficiency by Rationally Designing Classroom Space Layout in Teaching Performing Arts Majors

**Yu Li**[1,*]
[1] School of Film Television and Communication, Xiamen University of Technology, Xiamen, Fujian, 361000, China
Corresponding authors: (e-mail: liyu03042022@163.com).

**Abstract** Performing arts education plays an important role in the cultural literacy and physical and mental development of students in higher vocational colleges and universities. However, the existing classroom space layout often fails to meet the teaching needs and affects the learning efficiency of students. Traditional classroom space design does not take into account the multifunctional needs and personalized learning environment, resulting in unsatisfactory teaching results. This paper proposes a classroom space layout optimization method for performing arts majors based on genetic algorithms to enhance students' learning efficiency through rational design of classroom space. The study uses five comparative algorithms to conduct experiments, and analyzes indicators such as space use efficiency, space adaptation and noise impact score. The results show that the optimized classroom space use efficiency reaches 91.41%, which is 38.19% higher than the traditional layout method; the space adaptability reaches 0.9472, indicating that the teaching function has been significantly improved; the noise impact score is the smallest at 0.105, which reduces the interference of the noise to students. The learning efficiency of students in the experimental group was improved by a significant difference over the control group (P=0.004). This study shows that the rational design of classroom space layout can not only improve the efficiency of space use, but also provide students with a more suitable learning environment, which can significantly improve the learning effect.

**Index Terms** performing arts, classroom space, layout optimization, genetic algorithm, learning efficiency, noise effect

## I. Introduction

Due to the prosperous development of the current cultural market has brought historic opportunities for the field of performing arts, and the demand for performing arts professionals is becoming more and more urgent [1], [2]. For the teaching of performing arts majors in higher vocational colleges and universities, art practice is an extension of performing arts classroom teaching, and it is one of the indispensable and important contents of performing arts teaching management [3]. The key to the training of performing arts professionals is the construction of an effective teaching mode in line with the law of professional development [4]. Performing arts professional teaching mode to seize its professional characteristics, that is, the stage as the pursuit and goal, students from the classroom teaching training of basic skills to start, and then the theoretical knowledge and professional skills to integrate and extend to the stage, and ultimately to achieve the goal of training applied talents [5]-[8].

From the connotation of teaching space, although different scholars define it differently, teaching space is essentially the field that carries teaching activities [9]. Performing arts professional teaching as a practical teaching activities, naturally very dependent on the teaching space [10]. In the process of student education to ensure the reasonable design of the classroom space layout, not only can fully meet the students' individualized needs, but also for the information technology in the process of performing arts teaching to lay the foundation for good play [11]-[13]. Some studies have shown that the spatial architecture of the classroom will have an impact on the learning efficiency of students majoring in performing arts [14]. Thus, improving the spatial layout and teaching equipment in the educational process can make students have a better learning experience, thus guaranteeing the free and lively teaching atmosphere needed for the teaching of art majors [15], [16].

In the modern educational environment, the design and layout of classroom space has an important impact on the quality of teaching and the learning effect of students. With the development of science and technology and the continuous innovation of educational concepts, the traditional design of teaching space gradually fails to meet the needs of contemporary education. Especially in the teaching of performing arts majors, the classroom is not only a place to teach knowledge, but also needs to have a variety of functions, such as performance practice, discussion and communication, display of creations and so on. The learning effect of students is largely influenced by the rationality of the functional configuration and layout of the classroom space.

Traditional classroom space design is often teacher-centered, ignoring students' learning needs and interactive space, resulting in low space utilization. Especially in performing arts majors, students need more flexible activity space for physical performance and teamwork. In this case, the layout of the classroom space should not only consider the division of functional areas, but also take into account the openness and interactivity of the space. In order to cope with these problems, a space layout optimization method based on modern technology is proposed, aiming to improve space utilization and teaching efficiency.

In this paper, we optimize the spatial layout of performing arts professional classrooms through genetic algorithms to explore how to optimize the spatial partitioning and enhance the spatial adaptability without significantly changing the original building structure, so as to create a more efficient learning environment for students. Through this study, it is hoped that a new way of thinking can be provided for performing arts education, and that it can provide a reference for the design of classroom space for other majors.

In the research process, a genetic algorithm was used to optimize the multi-level layout of the classroom space in order to improve the functionality and comfort of the teaching space. By comparing the effects of different optimization algorithms, this paper aims to reveal the practical effect of reasonable layout on enhancing students' learning efficiency, and to provide a scientific basis for future classroom space renovation and design in colleges and universities.

## II. Classroom Space Layout Design for Teaching Performing Arts Majors

### *II. A. The necessity of teaching performing arts majors*

Arts education plays an important role in the physical and mental development of young students. Performing arts, as an important part of art education, synthesizes language, expression, human movement, dance and so on into one, through the artistic expression of life and emotion. The development of performing arts education in higher vocational colleges and universities, on the one hand, is conducive to the cultivation of cultural and artistic cultivation of college and university students, the formation of a higher level of aesthetic ability, improve art appreciation, and ultimately arrive at the improvement of the comprehensive quality of all higher vocational colleges and universities. On the other hand, it can promote the development of students' physical and mental health, performance through the mutual cooperation between the participants, the life, emotion on stage, inspired the performers' creative enthusiasm and innovation ability, enhance the concept of collective cooperation and collaboration, is conducive to team building, and enhance cohesion. However, at present, there are still certain problems in the teaching of performing arts in colleges and universities, which makes the teaching efficiency of performing arts in colleges and universities not high enough, and the teaching of performing arts can be optimized and improved through the reasonable design of classroom space layout.

### *II. B. Characterization of classroom space*

#### II. B. 1) Main forms of classrooms

Under the rapid development of artificial intelligence, big data technology, blockchain and other technologies, the functional layout of the classroom space is no longer limited to the teaching-oriented model, with the steady progress of the national strategy of building “double first-class” universities, the construction of intelligent multimedia classrooms has become an important part of the improvement and upgrading of the basic environment for teaching in colleges and universities. Multimedia classroom as an important carrier of education informatization construction, is an extremely important part of the construction of digital campus, undertake to promote education from the traditional teaching to the direction of digital intelligence innovation and development. Teaching in the era of information technology to adapt to the rapid economic and social development of the new requirements for talent training, to adapt to the new characteristics of modern student growth and the new laws of education and teaching in the era of information technology. The current multimedia classroom currently consists of two main forms, one is the traditional classroom upgraded to a multimedia classroom, the use of electronic displays (such as interactive electronic blackboards, 4K high-definition large screen, etc.) or high-definition LED projector for teaching, and the other is a variety of forms of interactive intelligent classroom, in addition to digital teaching display equipment, but also configured with an interactive e-textbook, intelligent analysis system, classroom patrol system, image Acquisition equipment, console and other equipment and facilities, based on the application of Internet information technology, artificial intelligence, big data and other emerging technologies, the integration of a variety of resources in hardware and software, to build a new type of support for teaching and learning in a variety of ways flexible changes in the space environment. From the form of teaching display equipment, the current multimedia classroom in colleges and universities is mainly the first form, teaching is mainly used in two ways: projection multimedia and intelligent touch electronic display.

#### II. B. 2) Spatial layout characteristics

In order to adapt to the teaching needs of performing arts majors, the multimedia classroom space layout form can be changed according to the needs of different professional learning, to realize a variety of ways of teaching interaction to meet different teaching needs. In the form of classroom layout, the main forms of multimedia classroom space layout in colleges and universities include common layout type, group discussion type, U-shaped semi-enclosed and arc-shaped semi-enclosed several kinds. Group discussion type layout form of classroom and U-type semi-enclosed classroom number accounted for a small percentage, is not the main form of teaching classroom. Arc-shaped semi-enclosed classroom space layout is more in the ladder classroom applications, for teaching the use of classroom space layout form is currently mainly used in the ordinary layout, the use of high-definition projectors (interactive whiteboards are mostly short focal length projection) or LED display for teaching, so that the presentation of teaching content and dissemination methods can be upgraded. Ordinary layout form of classroom in the multimedia classroom space layout accounted for a large proportion of its lighting environment distribution characteristics are representative.

#### II. B. 3) Planar dimensional characteristics

Multimedia classroom space in the layout of the architectural plane function can usually be divided into teaching area, learning area and activity storage area, teaching area is usually the activities of the teacher teaching area, the layout of the podium and other teaching facilities, teaching with the projection screen or touch electronic display screen installed in the blackboard position. Learning area tables and chairs in accordance with the rows and columns of the space sequence neatly arranged, the current design of the multimedia classroom space plane size of the university has no special standards, mainly with reference to the current “School Design Code” GB50099-2011 on the classroom space plane size of the regulations. The current standard provides that the front edge of the front row of desks and the blackboard horizontal distance should not be less than 2.27m, the last row of desks and the back edge of the classroom space behind the fixed furniture or wall distance is not less than 1.23m, desks and chairs between the rows of the distance is not less than 0.95m. In order to ensure that the students have a good line of sight angle, the front row of the two sides of the side of the location and the blackboard far end of the horizontal view angle should not be less than 45 °.

### *II. C.Multi-level layout model for structural features of classroom space*

The classroom space structure layout problem is to place some objects in the classroom space according to certain requirements, or to divide the classroom space, and to place some objects in a number of small spaces obtained by the division, in which the classroom space is the layout container and the objects placed in the space are the layout objects. In the field of classroom space layout, the basic classroom space layout process is as follows:

(1) Determine the specific function of the classroom space.

(2) Understand the spatial structure, divide the functional area of the spatial structure, and determine the specific location and size of the area.

(3) Select objects of appropriate sizes to be placed in the corresponding locations. By observing the classroom space layout strategy in the Reality Record Library, it can be found that there is a correlation between the classroom space structure and the size and location of the functional areas.

Through the above analysis, taking into account the positional distribution relationship between functional areas and classroom space, the multi-level layout method of classroom space structural features adopts a machine learning method to learn the layout laws of classroom space on the basis of massive indoor layout schemes, determine the geometrical features of classroom space and the layout attributes of the objects, and construct the classroom space structural features multi-level layout model according to the layout laws.

#### II. C. 1) Geometric characteristics of classroom space

In the $xoy$ plane the classroom space is projected as a layout container, i.e., a closed space, the structural features of the classroom space multilevel layout method is used to normalize the classroom space, to unify the scale and orientation of the classroom space, and to set up a coordinate system in the classroom space, stipulating that the direction of the entry door is in the same direction as the positive direction of the $y$ axis. The minimum coordinate of the vertex of the classroom space is the coordinate origin, and the parallel directions of the $x$ and $y$ axes correspond to the width $W$ and length $L$ of the classroom space respectively.

Normalize the entrance position $(E_x, E_y)$ of the classroom space, i.e., normalize the coordinates of the entrance door under the local coordinate system of the classroom space. The expression for the entrance position $(E_x, E_y)$ is given below:

$$E_x = E_{x_0} / W \tag{1}$$

$$E_y = E_{y_0} / L \tag{2}$$

Let $S$ represent the area of the classroom space, i.e., the area of the polygon formed by the edges of the classroom. $R$ represents the ratio of the length and width of the classroom space. $C$ represents the extension of the shape of the classroom space, i.e., the degree to which the classroom space adheres to the rectangle, described by the covariance matrices $C_1$ and $C_2$ of the rectangle center point in the direction of the $x$-axis and the $y$-axis, and the two-dimensional covariance matrices $C_{2\times2}$ have the following expressions:

$$C_{2\times2} = \begin{pmatrix} \text{cov}(x,x) & \text{cov}(x,y) \\ \text{cov}(y,x) & \text{cov}(y,y) \end{pmatrix} \tag{3}$$

$$\text{cov}(x,y) = \text{cov}(y,x) \tag{4}$$

Analyzing Eq. (3) and Eq. (4), it can be seen that the covariance matrix $C$ can be represented by just three numbers $\text{cov}(x,x)$, $\text{cov}(x,y)$, and $\text{cov}(y,y)$. Let $F$ represent the geometric features of the classroom space with the following expression:

$$F = (E_x, E_y, S, R, C) \tag{5}$$

#### II. C. 2) Layout Properties of Layout Objects

The Layout object represents a functional area of the classroom space. Set $(x_p, y_p)$ represents the location coordinate attribute with the following expression:

$$x_p = x / W \tag{6}$$

$$y_p = y / L \tag{7}$$

where $x$ and $y$ represent the coordinate values of the location points of the functional area in the local coordinate $x$ axis and $y$ axis of the classroom space, respectively, and the coordinate attributes $x_p$ and $y_p$ take values in the interval $[0,1]$. Let $\theta_p$ represent the orientation attribute with the following expression:

$$\theta_p = \theta / (\pi / 2) + 1 \tag{8}$$

where $\theta$ represents the orientation angle of the functional area in the classroom space. Let $(l_p, w_p)$ represent the dimensional scale with the following expression:

$$l_p = l_y / L \tag{9}$$

$$w_p = l_x / W \tag{10}$$

where $l_x$ represents the width of the functional area in the classroom space. $l_y$ represents the length of the functional region in the classroom space.

The layout attribute $\pi(G)$ of the functional region $G$ in the classroom space is obtained by the above equation:

$$\pi(G) = (x_p, y_p, \theta_p, l_p, w_p) \tag{11}$$

Let $E$ represent the energy consumed by the functional area in the classroom space, which is calculated as follows:

$$E = a_1 E_1 + a_2 E_2 + a_3 E_3 + a_4 E_4 \tag{12}$$

where $E_1$ represents the through-wall constraint. The $E_2$ represents the energy consumption constraint. The $E_3$ represents the passage constraint. $E_4$ represents the location constraint. The $a_i$ represents the criterion factor.

A multilevel layout model $M$ of structural features of classroom space is constructed by geometric features $F$ and layout attributes $\pi(G)$ of classroom space:

$$M = \min E\left(\pi(G), F\right) \tag{13}$$

#### II. C. 3) Genetic Algorithm Solution

Genetic algorithm (GA) was originally a mathematical method modeled on biological evolution, and they proposed a probabilistic adaptive optimization technique suitable for solving complex problems, based on the theoretical foundation of biological inheritance and evolutionary mechanism, through the study of simulation techniques of biological systems in nature [17]. The development of nature can be regarded as the evolutionary process of organisms, which cannot be separated from the crossover and mutation between chromosomes [18]. Taking this as the fundamental, facing different categories of problems, experts and scholars have proposed various methods to simulate the genetic characteristics of organisms in various environments. The whole arithmetic process of genetic algorithms follows the principle of: selection of the best of the best and the best of the worst of the worst, which gradually produces a solution close to the optimum in the population derived from each iteration. Unlike traditional search methods, genetic algorithms use artificial evolution to find the optimal solution [19]. Each feasible solution in the problem region is considered as an individual or a chromosome in the population and encoded. The whole population mimics the biological genetic and evolutionary mechanisms of constant inheritance, crossover and mutation. During the operation of the algorithm, the fitness value of each generation of individuals in the feasible domain of the problem determines whether they can be selected or not, and the winners and the losers are eliminated, and a better population is obtained in a continuous cycle. With the in-depth study of genetic algorithm by many experts and scholars and the publication of relevant monographs, it has created a new idea for the machine learning of genetic algorithm, clarified the working framework of the algorithm, further promoted the development of genetic algorithm, and also laid the foundation for popularization and application of genetic algorithm to lay a solid foundation. In this study, genetic algorithm is used to solve the multi-level layout model of classroom spatial structural features and complete the multi-level layout of classroom spatial structural features, the specific steps are as follows:

(1) Analyze the optimization design problem and determine the number of design variables.

(2) Set the genetic parameters and choose the appropriate coding method according to the characteristics of the optimization model combined with the number of design variables.

(3) Determine the size of the population and randomly generate the initial population based on the size.

(4) Evolve to the $i$th generation (the maximum number of evolutionary generations is Maxgen), perform decoding operations on the chromosomes in the population, and bring them into the fitness function to derive the fitness value.

(5) The size of the fitness value determines which of the individuals can be selected, followed by crossover and mutation among the selected individuals to obtain the constituent new chromosomes.

(6) Determine whether the new generation of population $(i+1)$ composed of new individuals can satisfy the set maximum evolution Maxgen, if it does, then decoding operation can be carried out to output the optimal solution of the classroom spatial structural features multilevel layout model. If the condition is not met, the operation in steps 4 and 5 should be continued until the requirements are met before outputting the optimal solution of the classroom spatial structure feature multilevel layout model.

### *II. D.Application path of the model*

According to the field study of the school, it is found that there are many problems in the functionality and rationality of the spatial layout of the teaching classrooms of the performing arts majors, and the setting of the functional areas does not better reflect the goal of “student-centeredness”, and there are many factors such as the imperfect setting of the functionalities, the lack of conformity to the ergonomic dimensions, the per capita area of the classrooms not reaching the design standards, and the number of classes. There are many factors that affect and restrict the learning efficiency of the students, which can be realized through the model of this paper to realize the rational planning of the classroom space for performing arts majors, aiming at improving the learning efficiency of the students.

#### II. D. 1) Rationalization of space layout

Through the research on art classrooms, it can be found that the limitation of classroom space seriously affects the curricular behavior of teachers and students. The small space inside the classrooms, the average student area generally lower than the average student area recommended by the design specifications, the large class size, the small average student area, and the missing diversified space in the classrooms all limit students' autonomy and creativity, as well as new teaching concepts and teaching methods. In addition, the planning of the teaching area is not very reasonable, some art classrooms have a large area, the number of students is relatively small, but the division of space layout is not clear, and is too loose, the area of restriction is more, there is no reasonable use of this part of the space, some classrooms are small in the area itself, should be through the model of this paper to plan the optimal classroom space layout program, as far as possible to increase the functional partition, reduce the average number of students in the class, to achieve a balance point, in the premise of trying not to change the structure of the classroom, to create a better art environment, to create a perfect art hall for students, which helps to improve the learning efficiency of students.

#### II. D. 2) Use of functional utility

The research found that most of the classrooms are still in the “primitive stage”, only in the ability to teach, can teach, but for the functionality of the concept, and by the impact of the classroom area, there is no extra space to set up a diversified range of functional areas, such as the teacher's area, the exhibition area, the library area, the storage area, the cleaning area and so on. For students, the classroom is the battlefield and home, students receive formal education, from elementary school to university, are in the classroom to complete the course, under the influence of new teaching concepts, the teaching mode and teaching methods have changed, and the needs of teachers and students will be increased with the development of society, through this paper modeling the rational setup of multifunctional partition of the classroom, so that the students have a good learning environment, which is beneficial to enhance the students' learning efficiency.

## III. Example analysis of classroom space layout design

### *III. A. Model validation analysis*

#### III. A. 1) Study case selection and presentation

A large-scale performing arts professional classroom space is selected as the case of this study, which contains 10 indoor spaces, and in order to meet the different needs of students, the classroom space is divided into different functional areas, such as the teacher's podium area A1, the student's seating area A2, the academic tutoring area A3, the reading area A4, the performance practice area A5, the group cooperation area A6, and the study material placement area A7, rest area A8, recreational activities area A9, student honor display area A10, etc., and the connection between each area is smooth, providing students with a convenient learning environment. The spatial layout design of these performing arts teaching classrooms should consider the comfort and needs of students and provide necessary facilities and services. It can be seen that the selected experimental subjects meet the needs of the proposed method application test.

#### III. A. 2) Experimental setup

Based on the experimental objects selected above, five comparison algorithms (Sparrow Algorithm: SSA, Wolf Pack Algorithm: WPA, Particle Swarm Algorithm: PSO, Differential Evolutionary Algorithm: DE, Ant Colony Algorithm: ACO) are jointly conducted for the comparative experiments of classroom space layout design. Due to the large number of classroom space layout design contents and the limited space of the experiment, the space use efficiency (the usable area divided by the total area), the spatial adaptability (the sum of the students' satisfaction scores for different space functional needs divided by the number of students) and the noise impact score (the noise impact score mainly reflects the impact of classroom space noise on the students, which can be obtained through the student scoring method) were selected as the evaluation indicators of the optimization design results of the indoor space of the building, and the test data were used as the basis. The evaluation indicators were calculated and analyzed.

#### III. A. 3) Comparative analysis of space utilization efficiency

The results of the comparative analysis of space use efficiency are shown in Figure 1, the classroom space use efficiency is 53.22% before the optimization design, and the classroom space use efficiency is significantly improved after the application of different methods. It can be seen through the data comparison, compared with the five comparative algorithms, after applying the algorithm in this paper, the classroom space use efficiency is improved by the largest 38.19%, which makes the classroom space use efficiency reach 91.41%, and the classroom space is more fully utilized.

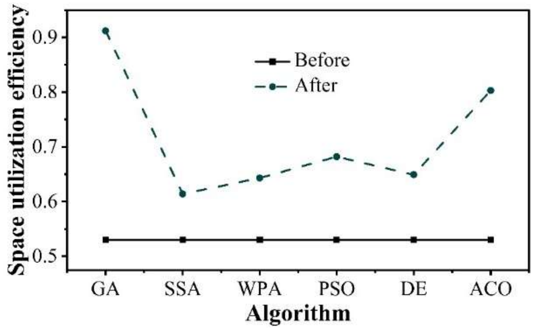


Figure 1: Comparative analysis results of space utilization efficiency

#### III. A. 4) Spatial adaptation analysis

This section takes classroom spaces A1, A3, A5, A7, and A9 as research objects and calculates their corresponding spatial adaptability based on the test data, as shown in Figure 2. The spatial adaptation degree takes values in the range of 0~1, and the larger the value indicates the better the functionality of the classroom space. The spatial adaptability values of this paper's method are larger than those of the five comparison methods, and the maximum value reaches 0.9472, which indicates that after adopting this paper's method, the functionality of classroom space is better, so that students have a better learning environment.

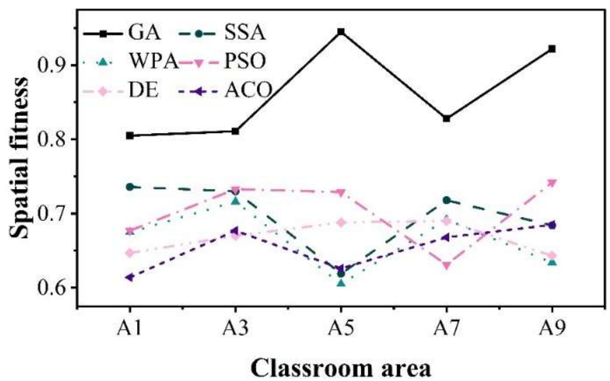


Figure 2: Spatial fitness analysis

#### III. A. 5) Analysis of noise impact scores

In this section, building indoor spaces A2, A4, A6, A8 and A10 are taken as research objects, and their corresponding noise impact scores are calculated based on the test data, as shown in Figure 3. The noise impact score ranges from 0 to 1, and the smaller the value, the smaller the impact of noise on the user in the indoor space of the building. The noise impact scores of this paper's method are smaller than those of the five comparison methods, and the minimum value is 0.105, which indicates that using this paper's method can make the acoustic environment of the classroom space better, and facilitate the development of teaching activities for performing arts majors.

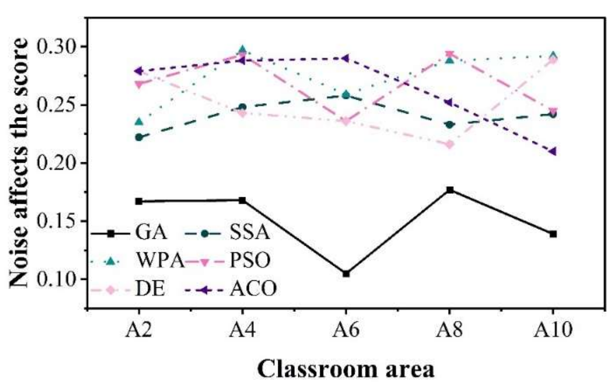


Figure 3: Analysis of noise Impact Score

### *III. B. Model application path validation analysis*

#### III. B. 1) Objects of study

In order to verify the role of the model application path of this paper on the enhancement of students' learning efficiency, according to the needs of the experiment, this paper randomly selected 50 students as the experimental subjects of this study from 100 students in the performing arts major class of a key university in a province and launched the experimental research.

#### III. B. 2) Research methodology

(1) Literature method

For the needs of this study, the main use of library websites and other sources to collect information and literature on classroom space layout design, student learning efficiency, and classroom space layout design to enhance student learning efficiency. Literature publication or publication date is mainly related to the last ten years. Types mainly include monographs, textbooks, journal articles, excellent master's thesis and other situations are specifically analyzed to expand the research ideas and provide a theoretical basis for specific research.

(2) Classroom Observation Method

The classroom observation method mainly focuses on the performance of art performance majors in different classroom environments, as well as the subsequent performance of performing arts professional class learning in the classroom. It mainly includes the learning process as well as the learning results such as students' motivation in class, concentration, duration of attention during the learning process, and the degree of cooperation between the classroom and the teacher.

(3) Questionnaire Survey Method

According to the needs of this study designed the “classroom space layout on the impact of student learning efficiency questionnaire”, in order to ensure the quality of the questionnaire, this paper on the questionnaire for the corresponding reliability and validity test. The questionnaire was distributed 50 copies, 50 copies were recovered, 50 copies were valid questionnaires, and the validity rate was 100%.

(4) Mathematical statistics and analysis method

Using SPSS22.0 and Excel statistical software, the data collected during the research process are processed and statistically analyzed, using the methods of induction and deduction, analysis and synthesis, to explore the effects and changes of different classroom environments on students' learning process and performance in performing arts professional classes in the experimental pre-test and experimental post-test. Accordingly, this paper presents and argues the role of the model application path on the improvement of students' learning efficiency.

(5) Experimental Method

This experimental research is a controlled research method to assess the effect it produces on multiple variables through the change of one variable, and the experimental period is tentatively set at 6 months. The specific experimental research ideas are as follows:

Experimental group: the above research subjects are divided into an experimental group (25 people) and a control group (25 people), and the experimental group adopts the application path of the multilevel layout model of classroom spatial structural features, while the control group adopts the traditional classroom spatial layout environment.

Experimental hypothesis: the application path of the classroom space structure feature multi-level layout model can effectively improve students' learning efficiency.

Independent variable: different methods of classroom space layout.

Dependent variable: for the students' learning efficiency in the teaching of performing arts majors.

Irrelevant variables: other factors affecting students' learning efficiency, mainly including: the randomness of the experimental grouping, the variability of the lecturing teachers, the variability of the students' learning bases and learning habits, the variability of the management, the variability of the family education and so on.

Experimental steps: put forward the research question and determine the experimental hypothesis → design the experimental program → control the experimental process → collect experimental information → analyze and process the data → draw experimental conclusions.

#### III. B. 3) Analysis of experimental data

(1) Comparative analysis between groups

The results of the comparative analysis between groups before intervention are shown in Figure 4, and the results of the comparative analysis between groups after intervention are shown in Figure 5. The data in the figure show that there is no significant difference in the quantitative value of students' learning efficiency between the pre-intervention groups ($P=0.237>0.05$), while the quantitative value of students' learning efficiency between the post-intervention groups exhibits a significant difference ($P=0.004<0.05$), which proves the experimental hypotheses put forward in the previous section, and in order to improve the results of the analysis of the experimental data, the following section will further expand the comparative analysis of the intra-group.

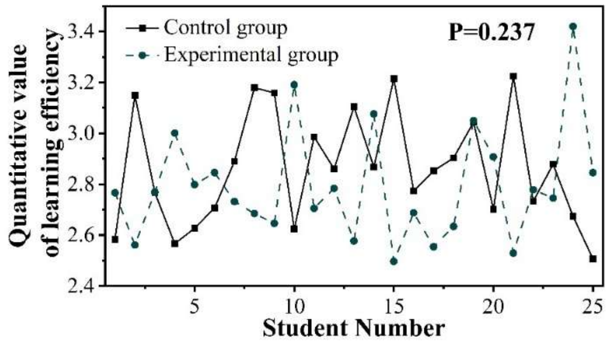


Figure 4: The results of inter-group comparative analysis before the intervention

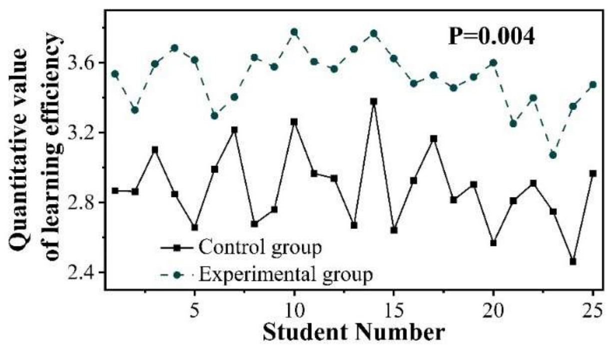


Figure 5: The results of inter-group comparative analysis after the intervention

(2) Within-group comparative analysis

The results of the within-group comparative analysis of the control group are shown in Figure 6, and the results of the within-group comparative analysis of the experimental group are shown in Figure 7. The quantitative value of students' learning efficiency in the figure shows that it was found that the control group did not have a significant difference within the group (P=0.093>0.05), on the contrary, the experimental group presented a significant difference (P=0.001<0.05), which strengthens the credibility of the experimental hypothesis of this paper.

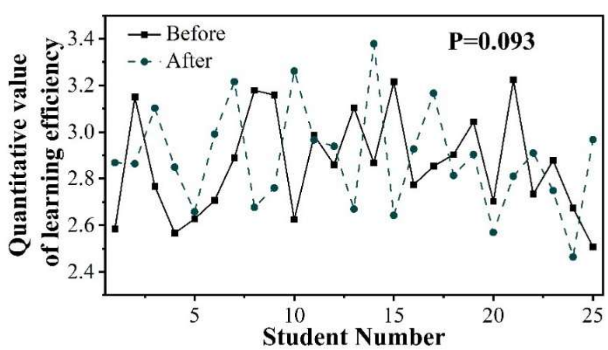


Figure 6: The results of intra-group comparative analysis in the control group

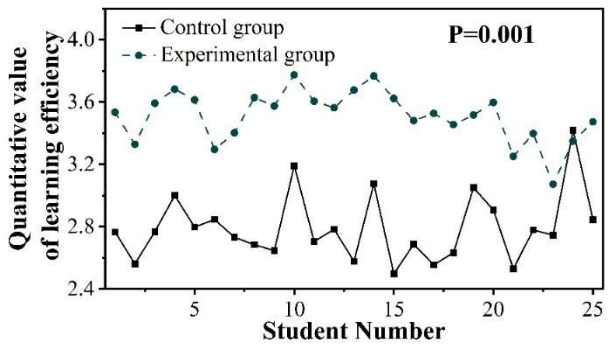


Figure 7: Comparison and analysis results within the experimental group

## IV. Conclusion

In this study, the optimization design of classroom space for performing arts majors was carried out, and the genetic algorithm was used to optimize the classroom space layout. Through the comparative analysis of experimental data, the following conclusions are drawn: the efficiency of the optimized classroom space is significantly improved to 91.41%, which is 38.19% higher than that of the traditional layout method; the degree of spatial adaptability is also greatly improved, with the maximum value of 0.9472, indicating that the classroom space is significantly improved in terms of the matching of the functionality and the needs of the students; in terms of the noise influence score, the optimized classroom noise In terms of noise impact score, the optimized classroom noise impact score is 0.105, which is significantly lower than the results of other algorithms, indicating that the interference of noise on learning is effectively reduced.

The experimental results also showed that students in the experimental group with optimized layout performed significantly better than the control group in terms of learning efficiency, and the within-group comparison showed that the quantitative value of learning efficiency of the experimental group was significantly improved after the intervention (P=0.001). These results verify the positive impact of rational classroom space layout on the teaching of performing arts majors.

Through the experimental verification of this study, the optimized classroom space layout not only improves the space utilization rate, but also provides students with a teaching environment that is more in line with their learning needs, which effectively enhances learning efficiency. This study provides useful references and lessons for classroom space design in performing arts majors and other teaching fields.

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