Thought and Practice on Teaching Space Planning and Design of New Engineering --Based on the Case of Reconstruction of Teaching Space at College of Human Settlements, Xi’an Eurasia University

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Abstract. "New Engineering" corresponds to emerging industries that first refers to specialties for emerging industries such as artificial intelligence, intelligent manufacturing, robotics, cloud computing, etc., and also includes the upgrading of traditional engineering majors. Through the understanding of the new engineering education and the development of science and technology, this paper studies and designs the teaching space for the new engineering specialties and upgrading engineering ones. Based on the analysis of the case of teaching space reconstruction of the Human Settlements College of Xi'an Eurasia University, we can draw some conclusions: the first is to summarize the method of teaching space planning and design of new engineering subjects; The second is how to create a teaching space that stimulates innovation ability and normalizes learning behavior; The third is to promote a new student-centered education model. We hope it will be able to provide certain reference value for teaching space planning designers of both new engineering and engineering majors.

Keywords: New Engineering Majors, Teaching Space, Student-centered

1. Introduction

Planning and design are a creative and innovative activity that conveys an idea through reasonable
planning and thorough scheming by using various sensory forms and technologies [1]. Education is a purposeful and planned activity. To reach the goal of education, teaching mode, teaching process and teaching method all should be designed. Since the teaching space has the direct important influence on the teaching model, the education process and the teaching method. It is necessary to constantly re-plan and design the teaching space to form a new education model and enable students to have more standardized learning behavior.

Xi’an Eurasia University conducts subversive planning and design against the traditional teaching space that are originated from the student-oriented innovation implemented by the university [1]. There is not only art teaching space in Ed College of Art and Design which inspires artistic character and reflects artistic atmosphere, but also engineering teaching space in the College of Human Settlements which is very rational and creative. However, this paper will mainly focus on the engineering teaching space renovation design.

Taking College of Human Settlements of Xi’an Eurasia University (hereinafter referred to as the College of Human Settlements) as an example, this paper summarizes and expounds the teaching space planning and design methods, the formation of new education models and the norms of students’ learning behavior [2].

2. Analysis on Existing Teaching Apace and Survey on New Teaching Space

College of Human Settlements is a second-level branch of Xi’an Eurasia University’s new engineering group with 4 engineering majors (undergraduate): civil engineering, engineering management, engineering cost, real estate development and management, which has more than 1300 students.

Through discussions and sorting out by users and managers, the existing teaching space mainly has the following problems, as shown in the figure1.

| Problem Description                                      | Very agree | Agree | Disagree |
|----------------------------------------------------------|------------|-------|----------|
| Low intelligent teaching                                 | 22.3%      | 28.1% | 49.6%    |
| There are few teaching space and facilities              | 18.7%      | 25.4% | 55.9%    |
| Low information teaching equipment                       | 24.1%      | 32.4% | 43.5%    |
| Old teaching tables and chairs                           | 25.4%      | 33.6% | 41.0%    |
| Single teaching space                                    | 31.1%      | 41.6% | 27.3%    |

Figure1: The problems of existing teaching space

First, 72.7% questioned that the teaching space is relatively single with basically only two types of space such as classroom and laboratory; Secondly, 59.0% questioned that the teaching desks and chairs are old that basically are arranged as the traditional rows of fixed ones; Thirdly, 56.5% questioned that the information teaching equipment can’t adapt to needs of the existing notebook computers, smart phones and professional software; Fourthly, 44.1% questioned that there is no air
conditioning in the teaching space while noise interference leads to insufficient comfort for learning; Fifthly, 50.4% questioned that the intelligence level of teaching space is low, which is neither energy saving nor intelligent.

By visiting, studying, searching for materials, investigating and visiting, the planning and design team discussed warmly and combined with the education and teaching philosophy of Xi’an Eurasia University. We concluded that the teaching space of the college should have the following characteristics and strategies to adapt to the development of new engineering:

First, to stimulate students’ creativity and innovative spirit[3]. The student-centered teaching space should be a rich and active place.

Secondly, the space planning and design should fully display the aesthetic visual art, letting students accept the edification of beauty.

Thirdly, to promote communications between students and teachers, students and students, schools and enterprises, education and industry.

Fourthly, the teaching space planning and design should be energy saving, environment friendly, comfortable and pleasant.

3. Teaching Space Planning and Design of College of Human Settlements

When planning and designing the teaching space of College of Human Settlements, we encourage all the teachers of the branch and representatives of selected students of all grades to participate in activities of positive demand combing, critical reflection and innovative thinking design and carry out planning and design with the idea and philosophy mentioned above[4]. To a large extent, we are willing to give the initiative of the teaching space planning and design to the users of the space;

We have set up a team of teachers and administrators for preliminary planning whose function is mainly to conduct researches and discussions on the future reform direction and trend of education and teaching, professional development and curriculum reform, practice and industry-school integration and learning support as well as studies on the matching performance between the space and the core of teaching pattern and content.

We set up a student team whose function is mainly to stimulate students to propose the possibility of using space and give different defining types of space with great imagination triggered by innovative courses.

At the same time, the team also invites planning designers to participate together. On the one hand, they understand the educational content and functional development needs together with the preliminary planning team. Meanwhile, they are also responsible for the promotion and demands of art of the space and the layout of the design tasks.

3.1. Analyze the Influencing Factors and Determine the Spatial Location

For providing a healthy, comfortable and adaptable teaching space for College of Human Settlements, the following factors are considered at the beginning of the planning and design of the teaching space:
First, the scale of teachers and students: prediction of the scale of students and teachers; scale, structure, category and task.

The second is the professional layout: relationships among the four majors, the industrial chain and the professional and cross-field professional integration.

Thirdly, curriculum setting: the relationship among curriculum map, spatial matching and development.

The fourth is the space condition: the physical characteristic limitation of the given space construction.

The fifth is financial index: comprehensive analysis and evaluation of investment benefits.

Sixthly, other factors: parents and other personnel visit and participation in the teaching space.

We think that the major layout, talent training objectives, curriculum setting, teaching methods and other factors are the most important parts according to the thorough analysis[5]. Therefore, in the planning and design of teaching space, we mainly consider the following aspects:

The first is the positioning of teaching space planning and design function, which should clearly define the formal learning space or the informal learning one.

Secondly, it also should be determined that the users of the learning space are not only teachers and students of the branch but also cooperative enterprises and related personnel in the integration of industry and education outside the branch. As an open educational unit, users should also include teachers and students of other branches of the university, community residents and other users. According to the special requirements of different groups, teaching space is not only the one for learning and communication but also a place for publicity and education of green living and healthy life.

Thirdly, sound, light, temperature, air quality and other environmental factors should be fully considered. According to the knowledge of environmental psychology, we focus on the lighting, noise control and air quality of different spaces.

Fourthly, the configuration of learning space should fully consider the needs of multi-form teaching, teachers’ office and students' comprehensive development[6]. Space configuration should be both static and movable, which means it should be flexible.

Fifthly, educational technical equipment should be improved while teaching and management information should be fully used. Multiple systems should be able to integrate seamlessly and remain the space for expansion at the same time.

Sixthly, the education in the future is changeable and rich. Therefore, we should leave some space for the change of teaching methods, teachers and students' learning and teaching mode so that both the space and education mode can be flexible. Specifically speaking, we should interact with the teachers and students living in it and make them grow together. Educational space should also be growing and with the ability of learning.
Seventhly, support construction and creation. Support collaboration and cooperation, making it the catalyst of the reform of teaching model.

The eighth is to let teachers and students fall in love with teaching space, making it fully serve both teachers and students. Both students and teachers should be dedicated to the design and construction of the teaching space.

3.2. Confirmation of Functions of Teaching Space

The teaching building of College of Human Settlements covers a building area of 7,000 square meters with 6 floors. It is part of the I-shape building that looks like a long and narrow square box.

According to the characteristics of the long and narrow regular building, the space planning and design concept is as follows combined with the eight main needs and demands of the teaching space of College of Human Settlements summarized above: Let "change" redefine and become the way and theme of this space innovation -- each floor has its own theme, experience and innovation point; Let the building and space environment give students and teachers more sense of belonging and happiness; The space has the function of management and its content can clearly convey and express the value of education, which is "function means more than form": 40% of the original style should be retained while 60% of the used space and public space are transformed; Make the space more "open"; "Let the space be planned to the maximum extent as possible as it can be", which means the public areas on each floor are covered with various exhibition projects to reflect the atmosphere.

The specific needs of space and the three development directions of green building, building information and real estate service of College of Human Settlements should be considered collectively, such as the existing BIM studio, green construction center studio, cost studio, bidding studio, real estate studio, etc. Different themes and functions are set for different floors while the design style of different floors is unified. The functions are both independent and complementary, forming an organic whole with characteristics of individuality, diversity and unity.

The first floor is for exhibition, display, reception and exchange.

The second floor is for learning, training, practice, project, culture, exhibition, research, road show release and other teaching and learning space of building informatization.

The third floor is the center of green building, which recognizes what green is, including development research and teaching of green DNA curriculum, green building alliance, green project practice, industrial government platform construction and school-enterprise cooperation;

The fourth floor is the project management center whose main functions include curriculum research and development, project practice, teaching, school-enterprise cooperation and etc. focusing on industry standardization and information development, such as projects, costs, bidding and cost evaluation;

The fifth floor is the real estate center, making it a training base, cultivation base, subject development, school-enterprise cooperation and innovation incubation base for high-end real estate service talents;
The sixth floor is for comprehensive office. It is a platform for teaching and learning research, curriculum research and development, management and teachers' office, industry club, experts' office and public conference and discussion.

Moreover, according to the needs and characteristics of each space, we divide the space into office space, school-enterprise cooperation space, formal learning space and informal learning space. The office space includes research office space and transactional office space. The formal learning space includes ordinary classroom, special classroom, seminar room and studio while the informal learning space has discussion room, public exhibition area, public exchange area and so on.

4. Main Characteristics of Teaching Space

4.1. A Student-centered Teaching Space

The classroom teaching here breaks through the limitation of traditional classroom one and is defined as large public class, small lecture class, specialized class (making, modeling, drawing) and discussion homework class. According to different needs of courses, there are movable desks and chairs in the classroom, which are convenient for teachers to teach in groups and students to discuss in groups after class. This completely overturns the traditional teaching mode of students sitting in rows and forms a teaching space with students as the main body of teaching.

Classrooms boast highly intelligent levels. The classroom is equipped with integrated functions of space reservation, check-in, multimedia teaching equipment control, air quality detection and control, intelligent lighting control and other multi-functional information system, which can seamlessly connect with the course information system. We design an environment that is flexible enough to accommodate and create a dynamic, flexible and collaborative learning style with rich technologies. Students should make an appointment for the teaching space on the Internet so that they can become the master of the teaching space, which will fully embody the student-centered education and teaching philosophy.

The open exhibition space is planned as the display platform for cutting-edge research exhibition, homework exhibition, graduation design exhibition and activity exhibition in forms of fixed exhibition, mobile exhibition, periodic exhibition and others, making it become a learning space and an exchange space. Thus students can visit and learn here at any time.

Working place is redefined as workshop that will serve project-based teaching and practical projects. The diversified, malleable and sustainable forms of education and teaching can be realized through the diverse and comprehensive allocation of space, such as homework discussion room, group discussion room and other auxiliary functions, which can also better meet the learning needs of various students like group study or independent study. Workshop can also help achieve the student-centered learning purpose while it will be able to standardize the learning behavior of students, such as having discussions in the discussion room and having practice project learning in the studio.

Communication space mainly includes: 1-to-1 discussion and communication room, public video and audio room, building tea room, public communication area, VR experience area, industry club, teachers' rest room, etc. Collective and individual value realized by communication will not only
promote the participation of collaborative learning but also enhance the communication among teachers, students and teachers and students as well as the cross-disciplinary cooperation.

Public space is mainly to meet the needs of students’ communication, self-study, rest and others. On design requirement, it needs to satisfy characteristics of sufficient daylighting and high comfort level to realize flexibility and free combination.

4.2. Comfortable and Diverse Office Space

Teachers' office space includes semi-open reception office, intensive office of internal affairs, discussion and exchange office, professional group office, school-enterprise integration office and expert and consultant office, making the diversity of space break the invisible rules to form diversified behavior and thinking mode.

Public service space and the way of semi-open office can be convenient for students to handle all kinds of business and enhance the exchange of information between teachers and students.

5. Conclusion

5.1. Planning and Design Method of New Engineering Teaching Space

First, the planning and design of new engineering teaching space are to overturn the planning and design concept of the basic functional space of the previous teaching space. The second is to do full research, letting all the users of the teaching space participate in the planning and design; Thirdly, intelligent design and green design should be considered in the design of teaching space. Fourthly, there should be enough communication and public space in the teaching space to meet the demands of scene appeals for the interaction between main teaching subjects.

5.2. Form a Student-centered Education Model

The three basic characteristics of the teaching space of College of Human Settlements are:

First, workplace simulation teaching: cultivating professional direction + innovation project as the core of the scene teaching, cultural guidance; Set up the management process mode of the enterprise, and carry out the study, hands-on practice and project implementation together; The status of students is advanced, students, interns, enterprise employees, project members and other role training.

The second is to enhance the training of students' applied skills: all the staff should increase the practical teaching and homework modules of courses, groups, projects and projects. The application and research of theoretical knowledge will be really enlarged here; Practical classroom will surpass theoretical classroom space proportion;

Thirdly, synchronous design and planning of soft environment and hardware transformation: let cognition touch the frontier of world and industry innovation; Let knowledge breakthrough industry and regional physical environment; Make the learning results have a visual sense of ritual.

The three basic characteristics of the above teaching space are designed from the student-centered education model.
5.3. Stimulate Students' Innovation Ability and Standardize Their Learning Behavior

According to the result of the use after delivery, on the one hand, teaching space of each function specification the behavior of users, students and teachers in the planning and design to consider the various possible behavior, group discussion, 1 on 1 discussion, small meetings, collective student, etc., through the space management system nearly a year, according to all kinds of non-arranging space booking rate was 60%, the teachers and students is obviously prolonged stay inside the building before modification.

Received nearly 30 universities and enterprises in and out of the province nearly a year after the renovation; Many engineering universities mentioned that the overall layout of engineering teaching buildings, various types of space research, teaching model innovation, architectural beauty and design are of great reference significance. And successfully held the national concrete conference, the first national university "toilet revolution exhibition" and other activities, all kinds of cooperative enterprises and the requirements of entering and jointly carrying out talent training enterprises from the quantity and quality of obvious improvement, for the branch of industry-school cooperation, students practice and brand communication have produced a positive role;

Relying on good space and discipline development advantages, College of Human Settlements has successfully applied for the intelligent construction major, which is achieved by the combination of building informatization and branch development on the basis of civil engineering specialty after its construction. In 2019, the first class of students of this major has been approved and the major is available only in seven universities nationwide.

On the case study of teaching space reconstruction in the College of Human Settlements of Xi’an Eurasia University, the first part is that we get the method of planning and designing the teaching space of new engineering. The second is to summarize how to create a teaching space to stimulate innovation ability and standardize learning behavior; The third is to promote a new student-centered education model. We sincerely hope it can provide some reference value for the designers of new engineering teaching space planning.

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