

Exploring the Communication Path of Public Art in Campus Ecosystems from a Constructivist RtD Perspective

Tong LI ^{a,*}, Guan LIN ^{a,*}, Yuyi LIU ^a, and Chunxia LIU ^{a,1}

^a*HeXiangNing College of Art and Design, Zhongkai University of Agriculture and Engineering, China*

Abstract. A beautiful campus public environment is the material foundation of students' campus life, and it is also an indispensable part of building campus ecological environment. Modern research in the field of campus ecological environment pays more attention to the design strategies and paths of ecological civilization resources, and focuses on the universality and regularity of the design strategies and paths of the research results. Drawing on the concept of constructivist RtD, this study aims to expand the means of expression of campus public art installations, enhance their intrinsic interactive modes, enrich the forms of expression of public art works in the campus space, and empower the campus ecological environment through the combination of multimedia art, interactive design and fiber art. The project uses literature analysis method, questionnaire analysis method, AHP hierarchical analysis method, practical research method and field observation method. Among them, the questionnaire research allows the author to understand the needs of campus students' activities, which provides data support for the practice of the topic, and the practical program is deduced by the hierarchical analysis method. And combined with computer simulation multimedia interaction and fiber art design combined with campus public art fusion design, and its application scenarios. In the field observation, the practice is summarized through structured observation and interviews, and finally an inductive method is used for in-depth discussion. The results of the study show that based on the concept of constructivist RtD, campus public art combining multimedia interaction and fiber art provides a feasible practical solution for campus ecological environment beautification. Innovative perspectives and directions enrich the expression of campus public art and provide a useful supplement to campus ecological environment design.

Keywords. Constructivism, Campus Ecology, Public Art, Multimedia Interaction, Fiber Art

1. Introduction

According to the statistics of ZhiNET, the top 9 disciplines in terms of the number of publications in the field of ecological art and design application in China involve architecture, tourism, literary theory, fine arts, education, culture and other disciplines,

* The first two authors contributed equally to the article.

¹ Corresponding Author: Chunxia LIU, Hexiangning College of Art and Design, Zhongkai University of Agriculture and Engineering, 24 Dongsha Street, Fangzhi Road, Haizhu District, Guangzhou, China, 510225, E-mail: xia1608@126.com

which can reflect the current trend of multidisciplinary development of the related research field in China. According to Figure 1, it can be seen that among the domestic research articles on ecology and design application, 4 of the top 9 institutions are double first-class colleges and universities, and 4 of these 9 institutions are art universities, which corresponds to the fact that the research field of ecological art and design is currently concentrated in the research of public art, environment and life. At the same time, 5 of the top 9 institutions are from comprehensive universities, which is in line with the connection between the applied research of eco-art and the technical research field, which is the reason for the high number of articles published.

Top 9 disciplines by publication volume		Top 9 universities by publication volume		Top 9 disciplines by publication volume		Top 9 universities by publication volume		Top 9 disciplines by publication volume		Top 9 universities by publication volume	
1	Literary Theory	Guangxi University for Nationalities		4	Music and Dance	Hunan Normal University		7	Tourism	Shandong University	
2	Fine Arts, Calligraphy, Sculpture, and Photography	Yunnan University		5	Cultural Economics	Central Academy of Fine Arts		8	Environmental Science and Resource Utilization	Shandong University of Arts	
3	Architectural Science and Engineering	Sichuan Fine Arts Institute		6	Cultural Studies	Sichuan University		9	Disciplinary Education	Shanghai University	

Figure 1. Statistics on the top 9 disciplines and institutions in terms of publications in the field of ecological art and design research in China

Campus public art is closely related to the campus ecological environment, mutually shaping campus culture. Campus public art integrates art and culture with the natural environment through sculpture, murals and other forms, which improves students' satisfaction with the campus environment and stimulates their sense of belonging. At the same time, as a means of ecological education, public art conveys the concept of environmental protection and triggers the attention of students involved in art creation to environmental issues. Setting up art installations in the campus and turning the green space into a space for rest and art display realize the organic combination of greening and culture. The creation and interactive participation of public art energizes the campus ecosystem and promotes sustainable community development.SL Han (2016) produced a campus art installation, through which different modes of interaction with students improved the mental health of the MIT population.SM Sharif (SM Sharif et al., 2017) argues that art, advocacy, and culture, which together make campus public art a miniature template for the educational ecosystem.C Gao and CYWang (2017), in order to meet the needs of students, argued that campus environments need additional public spaces for formal activities beyond teaching and learning. N Hasriyantil and other scholars (2018) argued that, when designing a campus, priority should be given to creating a useful and multifunctional educational environment of open public spaces. Therefore, it is particularly important to utilize multimedia art and interactive design to expand art installations in campus public spaces.

In recent decades, advances in technology have dramatically changed the way people communicate and interact. (Benjamin Hirsch and Jason W.P. Ng 2011) This shift has led to a growing demand for spatial experiences. Despite the evolution of technological tools, certain traditional design methods, such as graphic printing and posting, are still present in the decoration of campus environments. These methods fail to fulfill contemporary students' experiences and expectations of rich and meaningful spaces. To this end, this study explores how public art design that incorporates constructivist RtD concepts, multimedia interaction and fiber art fusion can revitalize

campus public spaces, using the Zhuhai campus of Zhongkai Agricultural Engineering College as a case study. Drawing on national literature, case studies, fieldwork and exploratory practice, this study creates a theoretical foundation and scenario model for implementing these concepts.

This project combines campus public art with multimedia interaction and fiber art to enrich campus culture and broaden the form of campus culture and art presentation. Combined with computer science and technology means, it provides interactive space, enriches students' extracurricular life, develops campus culture in multiple dimensions, and empowers the campus ecological environment. From the perspective of public art, the art form combining art and technology and integrating multiple disciplines enriches the extracurricular life of campus students and provides diversified activities and choices for the multidimensional development of campus culture.

This study was divided into four phases as shown in Figure 2 below. Stage 1 is the problem analysis, field survey and field observation of campus public space. Stage 2, the questionnaire was distributed to investigate the needs of campus students for campus public space, and the factors in the questionnaire scale were analyzed by AHP hierarchy based on the students' intrinsic needs. Stage 3: Decision-making based on the weighting ratio of the hierarchical analysis of needs. Stage 4: Deepen the design of the project. Finally, the design decision and design plan were perfected. Finally, the qualitative data of 331 pedestrians were collected through structured observation and interviews, and discussed and summarized.

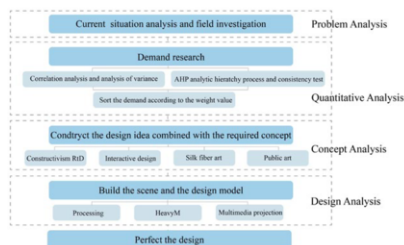


Figure 2. Flowchart of the research stage of the project.

The purpose of the research is to provide ideas and process models for designing campus public space and beautifying campus ecological environment. By combining constructivist RtD concepts with multimedia art and interactive design, fiber art, novel design concepts and practices are introduced into campus public space. At the same time, it creates a multi-dimensional interactive campus space and constructs a campus ecological environment that integrates artistry and technology.

2. Materials and Methodology

2.1. Constructivism RtD

RtD (Research through Design, abbreviated as RtD) is a theoretical model of research methodology, which can be summarized as follows: 1. the design process acts as a

medium for the research methodology, and design and research complement each other; 2. the results of the research, in addition to solving the specific needs of the design solution, can be shared with the academic community, and the existence of knowledge out of the scope of design. Constructivism is human-centered, with attitudes, beliefs, interactions, and experiences as its main research objects. Constructivist RtD is applicable to spatial design, and the constructivist RtD view of knowledge can be used to explore the new and unknown in spatial design.

2.2. AHP Analytic Hierarchy Process

Analytic Hierarchy Process (AHP for short) was proposed by American operations researcher Satie in the 1970s, applying network system theory and multi-objective comprehensive evaluation method to provide a hierarchical weighting decision analysis. Hierarchical analysis facilitates the hierarchization of complex decision-making systems, and provides a quantitative basis for the final decision by comparing the importance of associated factors at each level.

2.3. Multimedia Interaction Design and Fiber Art

The intermingling of spatial design and interactive concepts is conveyed mainly through the presence of space and communication with the audience, such as sound, light, flavor and other sensory stimulation of the audience to increase the subject of interaction with the space of the exchange of information. Negroponte believed that multimedia can switch from one medium to another at will and say the same thing in different ways; Huang Mingfen pointed out in his book "New Media and Western Digital Art Theory" that multimedia integrates different types of information in a unified mode and produces complex psychological reflections.

Fiber art is a modern name for the inclusion of linen, cotton thread, man-made fibers and other woven craft art, China as early as the pre-Qin period, there is the use of plant fibers made of clothing and grave goods appeared in the West's Tapestry (Tapestry) process, the industry is considered to be the origins of fiber art. With the advancement of industrial technology and the continuous exchange of different civilizations around the world, in the 1850s, fiber art integrated science and technology and other modern crafts, and became another important means for many modern artists to express their artistic philosophies.

3. Questionnaire survey on demand for public space on campus

3.1. Reliability and validity test

In order to gain an in-depth understanding of the potential needs of school students for campus public space, the author designed a questionnaire survey covering three dimensions, including spatial factors, personal factors, and willingness to participate, with a total of 13 question items. Through the analysis of the questionnaire data, school administrators are provided with strategies for designing campus public space to help campus ecological environment construction with sufficient scientific basis. In this practical investigation, three universities in Guangzhou (Guangzhou Academy of Fine

Arts, Zhongkai Agricultural Engineering College, Guangdong Second Technical Normal University) were selected as the object of investigation, the questionnaire was distributed through the WeChat questionnaire star network, a total of 604 questionnaires were collected, of which the valid questionnaires were 604, and the questionnaires had no missing data. The target of the questionnaire survey covers undergraduate and graduate students. SPSS 23 statistical analysis software was used to analyze the samples. As shown in Table 1, removing the non-scale question items in the questionnaire, reliability statistics showed that Cronbach's alpha was 0.850, the sample Cronbach's alpha coefficient > 0.8, then this questionnaire has a good reliability. kaiser-Meyer-Olkin was 0.737, the KMO value was > 0.7, and the Bartlett significance was 0.000. Then there is a good correlation between the factors and the sample has a good structural validity.

Table 1. Sample reliability and validity test

Reliability statistics		KMO and Bartlett test			
Clone Bach Alpha	Items	KMO Sampling suitability	Bartlett sphericity test chi square	freedom	significance
.702	8	.737	2712.107	28	.000

The gender in the question item and the 13th question through SPSS 23 for independent samples T-test, as shown in Table 2, independent samples T-test statement of the significance value (two-tailed) > 0.05, and the value of a certain difference, but the difference is not obvious, it can be inferred that there is no significant difference in the willingness to participate in the multimedia interactive game between male and female students, the spatial interactive factors of the degree of attraction of the classmates of different genders.

Table 2. Differential analysis of gender and participation in multimedia interactive games

		Levene's test of variance equivalence		Mean equivalence t-test	
		Significance		t	Degree of freedom
13. When the public leisure space on campus is equipped with multimedia interactive games, are you willing to participate in the games with unfamiliar students.	Assuming equal variance	.896	.344	.490	602
	Equal variance not assumed			.490	599.194

3.2. AHP Analytic Hierarchy Process

Categorizing the questions in the questionnaire, as shown in Figure 3, the factors affecting the design of this program include 3 level 1 indicators, which divides the reference elements for decision-making on the design of campus public space into the following 3 elements, each of which contains 2 nodes:

(1) Spatial factors: Functionality contains facilities and equipment that meet the needs of space users, such as street lights, tables and chairs. Artistic is to consider whether the space has a sense of design and formal beauty.

(2) Interactive factors: Multimedia facilities and equipment for interaction between people and space with interactive installation art as the carrier. The greening facilities are perfect, and people are in harmony with the natural environment.

(3) Activity factor: to meet the needs of personal leisure and relaxation, taking into account a certain degree of privacy. It can provide venues for social activities such as group building.

Combine the indicators and analyze the weights of three different programs, which are Program 1: Space factor is the main factor, taking into account the interaction factor and activity factor. Scenario 2: Interaction factor is the main factor, taking into account both spatial and activity factors. Scenario 3: activity-based factors, taking into account both spatial and interactive factors. And through the analysis software yaahp to generate the 9-scale rating scale for experts.

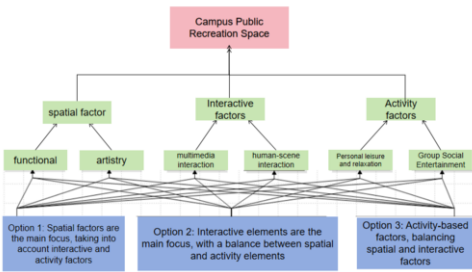


Figure 3. Hierarchy of Campus Public Recreation Space Factors.

Four experts rated this, including a master's tutor from the design school of a university in Guangdong Province, a project manager from a spatial design company, and a researcher from a provincial architectural institute. The weighted arithmetic mean algorithm of the expert judgment matrix was derived through the analysis software Yaahp group decision-making and passed the consistency test. The analysis resulted in the highest weight value of Option 2, which prioritizes spatial artistry and takes into account interactive and activity factors. It can be seen that in the campus ecological environment design need to focus on the space in the space can meet the needs of student group activities, whether it is easy for students to organize activities and the interaction between space and human factors for space planning and design.

3.3. Summary of this chapter

Analyzing the questionnaire data, 51.4% of students preferred indoor space and 48.6% preferred outdoor space when choosing a place to socialize. In terms of outdoor choice, 46.45% of students preferred outdoor space with good greenery and 36.36% chose sports. There is no significant difference between gender and education level on ecological environment space interaction and personal willingness to participate. Students of different grades and genders preferred to relax in public spaces on campus,

showed interest in multimedia interactive games, and were motivated to interact with strangers. After the AHP weighting analysis, the solution that combines artistic, interactive and activity factors is the most popular. Therefore, when designing campus public leisure spaces, it is necessary to focus on artistic atmosphere, group activity needs, easy organization and interpersonal interaction to meet students' needs.

4. Practices and summaries

4.1. Combination of traditional craftsmanship and modern multimedia

The site of this project is the Zhuhai Campus of Zhongkai Agricultural Engineering College, which is a provincial key university with a history of over 90 years. It was founded in 1927 by the great patriot Mr. Liao Zhongkai and featured a practical department of sericulture at its inception. Integrating silk art into public art, empowering the campus ecological environment with a new form of interactive design through the skillful combination of multimedia is another focus of this research. With the development of new media art and the continuous progress of technology, visualization design based on multimedia art and human-computer interaction provides many possibilities for people to appreciate and understand art works (Wang Junping, 2018). As shown in Figure 4, in the process of exploring this topic, the designer collects data information such as voice and gesture of spatial participants through multimedia interactive software, and then generates real-time graphic images through interactive devices and computer software. (Xiang Rongcong, 2021) argues that in realizing human-environment interaction, the form of nonverbal vision can be used to construct multidimensional interactions between humans and space, environment and psychology.

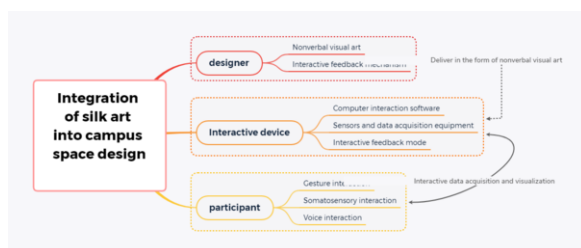


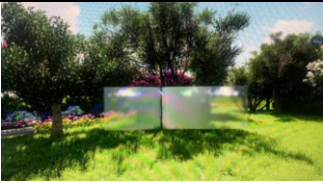
Figure 4. Silk art into space design.

4.2. Research on space model and design

This inquiry is based on the data obtained from the preliminary research and analysis with AHP hierarchical weight ordering to derive a scenario model that combines fiber art and multimedia interaction. The practice used the programming software of Processing (Casey Reas, 2019) in conjunction with HeavyM software for real-time interactive visualization. Processing is an open-source Java integrated development environment for new media art, visual design, and electronic art. Its purpose is to allow

artists to design computer images using code programming. And in the silk fiber art into the space design, the installation uses silk silk cloth as an element, repeated arrangement, through the suspension so that it is suspended in the space, due to the silk cloth its transparent frosted texture, the computer simulation algorithm, in the space can be generated between the translucent flexible boundary. Finally, the details and structure of the scene model are generated by computer, and the generated model is placed in the simulated scene to verify its feasibility. As shown in Table 3, the silk fiber art has simple shapes and a strong sense of form. In terms of spatial function and interaction design, the visual graphics generated in real time based on sound data collected on site or built-in music data can provide students with a variety of scene types, which not only inspires students to participate, but also makes the campus culture more colorful.

Table 3. Space simulation usage scenarios for different needs

Virtual Presentation Chart		
		
Team building	Sports	
		
Performance	Speeches	

4.3. Practice and summary

4.3.1. Location

Using the social research methods, field research, structured observation and structured interviews, recording and randomly interviewing the audience participating in this practical research, observing their interactive behaviors, and finally summarizing using the inductive method. (Feng Xiaotian, 2018) The interactive equipment models were placed in two public places in Zhongkai Agricultural Engineering College, namely the first floor of the Art Building and the first floor of Yingdong Building, as shown in Figure 5. Figure 6 shows that there is a pedestrian walkway on the first floor of the Art Building.



Figure 5. Map of two public space sites.

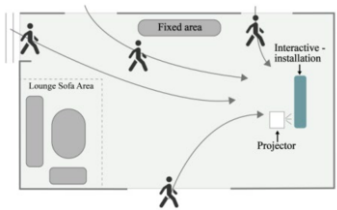


Figure 6. Map of the ground floor of the Arts Building.

4.3.2. Data collection and analysis

This data collection consisted of 7 days of observation of 331 people interacting with the device to varying degrees. During this time, the author observed pedestrians coming and going on each day, including field notes and interview transcripts, taking photographs where possible, and interviewing 10 randomly selected students. Installations were presented for varying lengths of time, depending largely on the duration of the observer's observations or interviews, and two sites were observed at different times on weekdays and weekends, with a focus on the level of willingness to interact among passing passers-by. Ten participants were randomly selected for interviews and two of them are described specifically below.

Interview 1: First year postgraduate student, Thursday afternoon, Art Building

The time was at 3:50 p.m. The student was going to submit her materials and walked from the first floor to the ground floor, she came down the stairs and saw the installation, walked straight towards it and took the initiative to ask about the way the installation interacted. The interview took 7 minutes and the interview photo is Figure 7. During the interview, the student stated that she had never been exposed to sound visualisation public art installations on campus before, only at art exhibitions. After experiencing it, she stated that the installation was interactive and experiential, and was very much in favour of adding similar installations to campus spaces that could promote a sense of community and shared experiences among students.

Interview 2: Second year postgraduate student, Saturday morning, Yingdong Building

It was 11:30 AM when a student was heading to the dining hall. Exiting the elevator, the student noticed an installation and observed it from a distance briefly. The observer invited him to engage with the installation and conducted a 4-minute interview. The student, not an art major, expressed curiosity about the computer setup and its purpose. He shared his desire for a similar installation on his campus, creating a public space for relaxation and communication. He hoped for guided interactions to enhance the immersive experience. The installation garnered attention, but initial interaction needed encouragement to increase willingness to engage.



Figure 7. Pedestrians interact with the installation.

During the author's observation period, 82.5 per cent of pedestrians were willing to interact with the device to varying degrees. Sixty-one per cent of the observation subjects were male and 39 per cent were female; 75 per cent of the pedestrians were in the 20s age group. The observation population consisted primarily of undergraduate students, graduate students, faculty, staff, and family members of faculty, 75% of whom were students; 63% were alone. Initial behaviours of pedestrian contact in

interactions with the device contained approaching cautiously, walking straight in, not paying attention, and seeing and not interacting. Figure 8 shows that 61.5% of the pedestrians approached cautiously, 21% walked right in, 11% did not notice, and 6.5% did not interact after seeing. According to the interaction observation form, the interaction level of the subjects was observed, and the interaction level was classified into five levels from 0 to 5. The observation results showed that 73.1% of the pedestrians had an interaction level of more than 3. Most of the pedestrians had never encountered similar devices before, and needed to be guided by an observer or to improve the guidance of the device so that they could understand the interaction more easily.

The author observed that students from our institution exhibit a higher inclination for interaction. The familiar environment creates a sense of relaxation, prompting them to be curious about novel elements and more willing to explore.

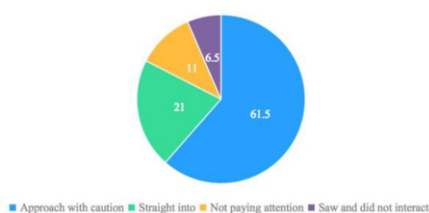


Figure 8. Initial behaviour of contact devices.

5. Conclusions

These two interviews provided insights into the subject matter, emphasizing the positive role of public art on campus in promoting a sense of community belonging, enhancing campus culture, and stimulating curiosity. First, in the first interview, students' interest in the multimedia interactive public art installation demonstrated the appeal of this interactive and experiential approach to campus students. Her perspective highlights the potential of public art to both create lively and interesting interactive experiences, thereby promoting a sense of community and shared experiences among students. A second interview with a second-year graduate student's curiosity and keen interest in public art installations further confirmed that even students who are not art majors are able to be attracted to public art. His desire to create a public space on campus for relaxation and interaction emphasized the positive impact public art can have on the climate of the campus environment. This example shows that public art can not only attract art majors, but also provide a vibrant campus environment for students from other majors.

The results of the frequency of participant interactions during the observation period showed that the majority of pedestrians showed a positive willingness to interact with the public art installation. This positive indication suggests that students are interested in this type of innovative design. However, the author also noted that a portion of the pedestrians needed guidance to better understand the interactive role. This suggests that we need to consider audience diversity when designing and installing public art installations on campus to ensure that students of all backgrounds and levels are able to participate in the interaction.

Considering the results of all interviews and observations, it is not difficult to find that public art has a non-negligible importance in the construction of campus ecological environment. When designing campus public art, the actual needs of students for campus space must be fully considered. By creating attractive and interactive art installations, it can effectively enhance the cultural atmosphere of the campus and stimulate students' curiosity and interest. The practical experience of the research process not only provides useful guidance for the innovative design of campus environments, but also brings brand-new possibilities for the future construction of campus ecological environments. It is concluded that by understanding students' needs and incorporating innovative and interactive elements into public art design, a solid foundation can be laid for the overall improvement of campus ecological environment. The results of this study provide strong theoretical support for projects in the same field, and provide a rich and feasible model for the combination of academic theory and practical operation in this field.

Due to the lack of equipment and technical means, the author is unable to well demonstrate my artistic thinking and expression ability in the field of artificial intelligence. The sound visualization model proposed in this paper is too simple. In the process of collecting sound data, the program is unable to subdivide the sound waves, frequencies, amplitudes and other elements in the sound, and is unable to make effective sound responses based on ordered and disordered sounds, resulting in poor visualization. I hope that I can be criticized and corrected by my teachers and related researchers during my graduate studies. Most importantly, I will continue to expand and supplement my related knowledge in my future research and try to make it more detailed and vivid.

References

- [1] Feng Xiaotian. *Social Research Methods*. Beijing: China Renmin University Press, 2018.4.
- [2] Benjamin Hirsch, Jason W.P. Ng. Education beyond the cloud: Anytime-anywhere learning in a smart campus environment, (*CITISIA*) , 2011.
- [3] C Gao, Y Wang. Research on the Interaction of Public Art in Campus Culture, *ICASSEE* , 2017.
- [4] Casey Reas. The Authoritative Guide to the Ben Fry Processing Language. *Electronic Industry Press*, 2019.
- [5] N Hasriyanti¹, A Zulestari², J Judhi² and P Ikayanti². Communal space design as student interaction in polnep campus, *IOP*, 2018.
- [6] SL Han. Improving mental wellbeing on college campuses through participatory art installation, *Department of Architecture* , 2016.
- [7] SM Sharif et al. Students empowerment in campus sustainability through art installation project, *JOURNAL OF BIMP-EAGA REGIONAL DEVELOPMENT* , Vol. 3 No. 1 (2017).
- [8] Shen Jie, Lin Shiqi. Research progress of landscape architecture through design (RtD). *Landscape Architecture*, 2019, 26 (7): 51-56.
- [9] Wang Junping. Research progress and application examples of music visualization. *Performing Arts Technology*, 2018(05): 11-16.
- [10] Xiang Rongcong. Psychological healing of abstract art from a new perspective of abstract art. Functional Exploration. *Central Academy of Fine Arts*, 2021.
- [11] YA Talgatovna, MG Dzhuparbekovna. Typology of open public spaces in the structure of a University campus, *European science*, 2020.