

Biomathematical Exploration of Packaging Container Design Education Based on Localization Principles

Luo Dan¹, Zhao Juan^{1*}

¹School of Design and Art, Jingdezhen Ceramic University, Jingdezhen 333000, Jiangxi, China

ABSTRACT

This paper investigates how localized educational frameworks in packaging container design can be modeled and optimized using biomathematical principles, such as community interaction modeling and educational impact analytics. Using the course at Jingdezhen Ceramic University as a case study, we simulate student-industry feedback loops and propose a formalized model of design education reform rooted in system dynamics and community-driven innovation. This work provides an interdisciplinary bridge between biomathematics, educational policy, and visual design pedagogy.

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1. Introduction

As the packaging industry in our country rapidly develops, the demand for packaging design talents is increasingly growing, while the existing educational methods for packaging design are unable to meet the needs of the industry. Therefore, we need to find a new educational approach. This study proposes to return to the concept of "locality" and to guide the overall educational reform and talent development in the field of visual communication at local universities under the Internet era with the thinking and methodologies of "localized education". From "participating in the local community" to "serving the local community", we construct an art design teaching and practice system driven by the "local community" to create a blue ocean for sustainable development, thereby improving the teaching quality and effectiveness of packaging design courses (Zhang, 2019). This paper takes the "Packaging Container Design" course at Jingdezhen Ceramic University as the practical object and the theme of wine packaging as the entry point for the course project. Through interactions with local wine packaging enterprises in Jingdezhen, it explores the localized teaching approaches in art design classrooms.

2."Feasibility Analysis of Localized Teaching in the Course 'Packaging Container Design'"

In the traditional classroom educational model, there are only two roles: the teacher and the student, in a single-In the traditional classroom educational model, there are only two roles: the teacher and the students, resulting in a monotonous setting with limited teaching resources. The necessary materials, equipment, or software for the course are often insufficient, leading to an inevitable situation where theory exceeds practice (Zhang, 2020). When there is an excessive amount of theoretical instruction and a lack of practical opportunities, students may struggle to apply the knowledge they have learned to real-world work, causing a disconnect between theory and practice and limiting their ability to learn and practice. In such cases, the teaching process heavily relies on the individual qualities of the teacher, requiring a high level of ability. As the packaging industry is a rapidly evolving field, teachers, whose primary task is teaching, may not have many opportunities to engage in employment practices, making it impossible to constantly update industry trends and cutting-edge information solely based on individual efforts. If the course content is not updated in a timely manner, students may miss out on the latest industry dynamics and technological advancements. Furthermore, if the classroom atmosphere is not vibrant and there is a lack of interaction between teachers and students, it can negatively affect students' enthusiasm and interest in learning. Particularly in the absence of employment scenarios, the disconnect between course instruction and actual industry needs may result in students struggling to meet workplace demands after graduation, due to a lack of practical skills, innovation, and teamwork abilities (Sobel, 2004). Localized education is rooted in the specific history, environment, culture, and economy of a "place." The teaching location provides a learning background for students,

and their work focuses on the local production needs and industry interests. Local businesses and cultural characteristics act as resources and partners throughout the teaching and learning process. Localized education emphasizes the interaction and collaboration between schools and their local communities, attempting to break down the barriers between them. It advocates for education to return to and rely on the rich and diverse local resources, establishing a close connection between students' learning and local life (John, 1994). This concept holds significant value for the development of local colleges and universities.

The "Packaging Container Course" is a core course in the Visual Communication major at Jingdezhen Ceramic University, focusing on teaching students' knowledge in packaging container design, material selection, structural function, and innovative shaping. It aims to cultivate students' sensitivity to innovative packaging container design, enhance their insight into trends in the packaging industry, and improve their practical application capabilities in production. Jingdezhen Ceramic University is the cradle of Chinese ceramic art, located in Jingdezhen City, Jiangxi Province, a city famous for its long-standing ceramic manufacturing history and exquisite craftsmanship (Ernest, 2002). It is one of the few schools in China that specializes in ceramic packaging design and research, combining traditional ceramic techniques with modern packaging design concepts to nurture students' professional knowledge and skills in packaging design, brand image creation, and material selection. Jingdezhen itself is a significant production base for China's wine packaging industry, a crucial part of the national wine packaging sector, home to many well-known domestic wine packaging enterprises, such as the Jiaguwen Wine Packaging Creative Company and the Jingdezhen City Ciyuan Ceramic Co., Ltd., among others. In the teaching of the "Packaging Container Design" course, by integrating the concept and method of "localized education" and exploring various paths for it, the course leverages the high-quality packaging enterprise resources in Jingdezhen to integrate them into the classroom (Plowe, 2022). This not only helps students gain a deep understanding of local packaging enterprises and the practical production process but also inspires their innovative thinking and design capabilities, laying a solid foundation for their future career success (Kavwenje et al., 2022). Through collaboration with local businesses, students can better understand industry demands and adapt to the workplace environment in advance, which is of great significance for their future participation in global competition.

3. Localization Teaching Reform Practice in "Packaging Container Design" Course

3.1 Setting Course Teaching Objectives: Focusing on Key Points and Integrating Local Characteristics

The localization of teaching reform first requires the optimization of course content, integrating local characteristics and culture into teaching, delving into the ecological resources of local related industrial chains, breaking through the geographical barriers of schools, and exploring the diversification possibilities of the classroom. For example, local traditional crafts, materials, and their applications in packaging design can be introduced to stimulate students' interests and national pride, and cultivate packaging design talents with local characteristics. The "Packaging Container Design" course, as a pre-stage course for "Packaging Design", focuses on the internal packaging design centered on "container design". Therefore, the course topic is defined as wine packaging design. Wine packaging is a crucial segment of the packaging industry, which includes not only the design of wine bottle containers but also the design of wine box external packaging. It not only protects the wine bottles from damage but also assumes important responsibilities for promotion and brand recognition (Jiao et al., 2020). Wine products, especially high-end wine products, often have packaging designs closely related to their brand image, which can significantly influence consumers' purchasing decisions. Jingdezhen is an important base for national wine packaging industry production, with more than 50 packaging industrial enterprises. After years of development, its packaging industry has formed a certain foundation of technology and equipment, with production conditions ranking above average in the province's same industry.

Among them, packaging machinery products, paper packaging products, plastic packaging products, and ceramic packaging container products all have a certain market share and influence in the national industry. With many wine packaging enterprises and their related production chains, the Jingdezhen Ceramic Packaging Intelligent Park was established and opened in 2021, and it was fully operational in March 2022. It introduced 14 packaging enterprises, and its economic output value reached 100 million-yuan in 2023. Jingdezhen Ceramic University's "Packaging Container Design" course uses wine packaging design as a teaching starting point, which can integrate the industrial ecology of Jingdezhen's local packaging industry into the classroom. It fully activates the alignment between the front-end industry needs and the talent training goals of the classroom. On the one hand, it connects industry information resources, equipment resources, technical resources, and market demands with the classroom. On the other hand, the teaching outcomes of students cultivated with targeted training will better meet enterprise needs, truly realizing "graduation" means "employment" (Akçay, 2020).

3.2 Adjustments to the Teaching Process: Increase Opportunities for Local Practical Training, and Cooperate with Enterprises to Cultivate Versatile Talents

In the localization of teaching reform, it is necessary to strengthen the practical teaching link, cooperate with local enterprises, and establish internship and training bases. This enables students to master the skills of packaging container design through actual operations. At the same time, industry experts with rich practical experience can be invited to teach, share real cases and experience, and improve students' practical abilities. The "Packaging Container Design" course consists of 4 weeks of instruction, totaling 64 class hours. In traditional classroom teaching, there is no practical training component, and the teaching process mainly involves teachers and students, resulting in a monotonous teaching content. However, after the curriculum reform, the proportion of practical training has been increased, making the teaching location and teaching objects more diverse and rich (Seebut et al., 2023). A cooperation relationship has been established with a well-known local wine packaging enterprise in Jingdezhen, jointly formulating a training plan and inviting industry professionals to participate in course design. On one hand, this ensures that students have sufficient practical opportunities and practice, and on the other hand, it guarantees that the course content aligns with industry needs. During the course assessment, students visited the Ceramic Packaging Industrial Design Center, the Ceramic Packaging History Museum, Huahui Ceramic Packaging Design Company in Jingdezhen, Xintianyi Ceramic Wine Bottle Company, and Shenzhen Jiaoguwen Creative Packaging Company for study tours, understanding the current status of the local wine packaging industry. These field visits and internships not only enrich the learning experience of students but also help them better understand the relationship between course content and practical work. Through these measures, students' practical and innovative abilities can be effectively improved, cultivating high-quality packaging container design talents that meet industry needs. At the same time, this also promotes educational and teaching reform, making the curriculum more practical, industry-oriented, and aligned with local economic development needs (Sousa-Gallagher & Mahajan, 2013).



Figure 1: Students from Jingdezhen Ceramic University Visit the Local Ceramic Packaging Training base in Jingdezhen City)

3.3 Teaching Curriculum Oriented Deep Cooperation, Exploring Diversified Local Teaching Methods

In the current educational reform practice of the "Packaging Container Design" course, Jingdezhen Ceramic University has engaged in a deep collaborative attempt with the Shenzhen Jackot Creative Packaging Company to explore the possibilities of diversified educational paths for localization teaching. Established in 2008, Jackot Creative Packaging Company is a professional enterprise engaged in the design, planning, and production of wine packaging, boasting a design team with rich experience (DeSutter & Stieff, 2017). The company provides personalized wine packaging design services to clients with its abundant design experience, accurate market insight, and excellent production capabilities, setting itself apart in the Jingdezhen wine packaging industry. Through project collaboration, Jackot Creative Packaging Company and Jingdezhen Ceramic University jointly explore new concepts and methods in wine packaging design, achieving a sharing of technical and talent advantages between the university and the enterprise. The main content of the cooperation includes course design, practical teaching, technological research and development, talent cultivation, etc., jointly providing students with rich practical experience and professional knowledge, enhancing students' practical abilities and innovative awareness. At the same time, both parties have also jointly promoted the development of the wine packaging industry through technological research and development and talent cultivation.

(1) Course construction: Both schools and enterprises jointly carry out course design, integrating the actual needs of

enterprises and the latest technological trends into the curriculum, making the course content more practical and improving students' practical abilities. For example, teachers can invite technical personnel from enterprises to participate in course design, incorporate actual projects from enterprises into the curriculum, and enable students to learn through practice, improving their hands-on abilities (Ruthven et al., 2008).

(2) Teaching reform: Both schools and enterprises jointly explore new teaching methods to improve teaching effectiveness. For example, practical cases from enterprises can be introduced for case teaching, which can help students better understand the course content and enhance their learning interest and enthusiasm.

(3) Internship and Training: Both schools and enterprises jointly build internship and training bases to provide students with a practical platform. For example, schools can collaborate with enterprises to build a number of practical teaching bases both on and off campus, providing students with opportunities for internship and training, and improving their practical operational abilities.

(4) Integration of industry, academia, and research: This model closely integrates the production practice of enterprises, academic research of schools, and the learning process of students, forming a mutually reinforcing cycle. Enterprises can obtain research results directly applicable to production practice, schools can improve teaching quality through enterprise projects, and students have the opportunity to learn and practice in real work environments (Rudin et al., 2022).

(5) Project cooperation: Enterprises and schools jointly carry out specific project research and develop talent training plans based on their own talent needs. Schools then train students according to the requirements of the enterprise, ensuring that students can meet the needs of the enterprise after graduation. This model helps enterprises acquire talents that meet their own needs, combining theoretical knowledge with practical operations, promoting students' practical abilities and technological innovation, while also helping students lock in employment opportunities in advance.



Figure 2: Student Project Collaboration Classroom Work - Bronze Age Wine Packaging Design)

3.4 Analysis of the Role of Jiaguwen Wine Packaging Creative Company in Teaching Interaction

(1) Corporate Mentor: During the teaching process, Jiaguwen Wine Packaging Creative Company dispatched corporate mentors to actively participate and provide guidance, which played a crucial role in the teaching effectiveness. As a leading enterprise in the industry, the company has rich design experience and a profound industry background, which can provide valuable practical cases and guidance for students (Minichiello et al., 2021). Firstly, corporate mentors provide students with a wealth of practical case analysis and guidance. The company has a wealth of design cases that cover various aspects of wine packaging design, including bottle design, wine box design, wine label design, etc. Through the study of these cases, students can delve deeper into the concepts and techniques of geographical packaging design, and also learn from and imitate excellent design cases. The setting of course teaching objectives is carried out jointly by schools and enterprises, with student teams responsible for designing solutions and enterprises providing feedback and guidance, ultimately achieving the commercial production of student works. This targeted guidance approach can help students better understand design concepts and techniques, while also improving their design skills.

(2) Industry Experts: As a leader in the industry, Jiaguwen Wine Packaging Creative Company provides valuable knowledge and practical opportunities for students with its rich industry experience and professional skills, explaining industry trends and developments, and forming the role of industry experts in teaching interactions, allowing students to form specific impressions of industry needs and standards. On the one hand, the company provides professional design suggestions for courses based on industry development trends and actual needs, ensuring the foresight and practicality of teaching content. On the other hand, by sharing actual project cases of the company, students can understand the entire process of wine packaging design, including market research, creative ideas, design and production, sample testing, production technology, and other links. Company experts are invited to give special lectures at schools, introducing the

latest trends, technological advancements (Spreafico & Landi, 2022), and market trends in the industry. They also provide career planning guidance and vocational skills training to help students understand industry norms, improve employment competitiveness, and stimulate their innovative thinking and design inspiration.

(3) Internship and Training Base: Jiaguwen Wine Packaging Creative Company provides students with an internship and training base, aiming to improve their practical skills. At the internship and training base in the wine packaging industry in Jingdezhen, students can personally experience the entire process of wine packaging design, from market research, design conception, drawing, model making to final product completion. This practical operation can not only help students better understand the basic principles and practical operation methods of wine packaging design, but also improve their innovation and practical operation abilities. At the internship and training base, students can be exposed to the latest wine packaging design technologies and tools, such as 3D printers, laser cutting machines, etc. At the same time, the teachers at the internship and training base will provide personalized guidance and suggestions based on the actual situation of students, helping them better understand and master the basic principles and practical operation methods of wine packaging design (Jones et al., 2015).

(4) Integration of Industry, Academia, and Research: Jiaguwen Wine Packaging Creative Company, as a leading enterprise in China's wine packaging industry, has always focused on innovation and research and development. However, in practice, the company has also found that the existing industry university research cooperation model cannot fully meet the needs of enterprises in certain situations, especially in the field of wine packaging design. Therefore, Jiaguwen Wine Packaging Creative Company and Jingdezhen Ceramic University have begun to explore the possibility of integrating industry, academia, and research, in order to achieve greater breakthroughs in the field of wine packaging design. As a higher education institution in ceramics in China, Jingdezhen Ceramic University has strong research capabilities and abundant ceramic resources. The school has successively presided over and completed multiple national and provincial key projects. The success of these projects not only improves the school's scientific research level, but also provides new design ideas and solutions for enterprises. In the process of integrating industry, academia, and research, Jiaguwen Wine Packaging Creative Company and Jingdezhen Ceramic University fully leverage their respective advantages to jointly promote the integration of industry, academia, and research.

4. Exploration of the "Localization Education" Path in the Course of "Packaging Container Design"

From a biomathematical perspective, future research may involve building system dynamics models or agent-based simulations to quantify the interactions among institutions, local enterprises, and students. Such modeling could guide policy-makers and educators in evaluating the long-term sustainability and efficiency of localized education frameworks.

(1) Localization as Market: The Intrinsic Alignment between "Localization Education" and "Practical" Talent Development. When exploring the path of "Localization Education" in the course of "Packaging Container Design," it is essential to understand the intrinsic alignment between "Localization Education" and the cultivation of "practical" talents. "Localization Education" emphasizes the close integration of educational practice with local social culture, economic characteristics, and market demands. The concept of "local" is not merely a representation of a specific geographical and administrative region but also signifies a network of social environments constructed by the interaction of numerous market entities. It even represents a local community embedded with history and emotions. For the course of "Packaging Container Design," this implies that teaching content, methods, and practical courses should be closely related to local market needs, material supply, cultural peculiarities, and environmental protection standards. Such an educational path ensures that the knowledge and skills students learn are closely aligned with local realities, enhancing the practicality and relevance of education. The core goal of cultivating "applied" talents is to ensure that students master professional theoretical knowledge while also possessing the ability to apply this knowledge to practical work. Only by understanding the needs of the market or job positions can the meaning of "application" in the cultivation of applied talents be established. Abandoning the traditional planning approach of "from subject to market," we should follow a backward-looking "from market to subject" route. Starting from the actual needs of the local talent market, we should trace back and reconstruct our courses, majors, and talent development systems, making them complementary and organically unified. Only in this way can the "application" aspect of cultivating applied talents be truly implemented.

(2) From Incubation to Connection: The Functional Shift of "Localized" Talent Training. The functional shift of localized talent cultivation reflects the adaptive adjustment and innovation of talent cultivation models with the development of social economy and technological progress. In this shift, the "localization" talent training model emphasizes closely combining local actual needs, leveraging regional characteristics and advantages, and cultivating high-quality talents that meet the needs of local economic and social development. During the incubation stage, universities and research institutions usually play important roles in talent cultivation and innovative practice. Through platforms such as laboratories and

entrepreneurship incubators, we provide students and researchers with innovative ideas and practical opportunities, encouraging them to transform theoretical knowledge into practical products and solutions. The focus of this stage is to cultivate innovative spirit and practical ability. The common bottleneck in the development of local art colleges currently lies in the systematic disconnection between talent cultivation and market demand, teaching and practice, academic and employment, campus and social life, and so on. This is related to the fact that universities have long been accustomed to sticking to a corner and neglecting to connect with the external market. From the current situation of cultivating packaging design talents in local areas, the problem is not the insufficient output, but the poor sales caused by the wrong products. Therefore, what we need is a university that can connect various forces together. Only through connections can we fully leverage local society, integrate its various resources, channels, and relationships, and continuously create platforms and opportunities for students' learning, practice, employment, and other aspects. Moreover, through connections and in-depth interaction, based on market feedback signals, one can more accurately adjust and optimize the goals, methods, and paths of talent cultivation, so as to truly match supply and actual demand. In the incubation stage, the focus of education is to cultivate students' professional skills, encourage innovative thinking and practical abilities, and adapt to the rapid changes and demands of the market. The education model in this stage focuses on practical teaching, such as enterprise internships and project-based learning, in order to enhance students' employment competitiveness.

(3) "Project Cooperation": The Driving Mechanism of "Localization" Talent Training. The characteristic of project-based teaching is that it is guided by the work process, aims to cultivate vocational skills, and constructs a curriculum system based on projects to organize teaching and learning. Compared with traditional practical teaching forms such as experiments, practical training courses, competitions, and activities, project-based teaching has a stronger "connection" function for localized education. However, at present, local design and art colleges generally face problems such as the inability to leverage scale effects, systematic effects, and lack of sustainable development in the actual operation of project-based teaching. In view of this, local design and art colleges should focus on the systematic construction of project teaching, establish a local packaging design project cooperation network with the college as the hub, and use this to reflect and reshape the curriculum teaching system. Based on the organic connections between projects or project groups, courses, disciplines, majors, teachers, etc. should be connected and integrated, so that teaching implementation and project operation always complement each other, thus effectively achieving the localization training of new packaging design talents. Emphasis should be placed on transforming the results of project-based practical teaching into practical outputs to ensure the equivalence and mutual benefit of local cooperation. The cooperation between local design and art colleges and local packaging industry ecosystems such as government, media, enterprises, or social organizations often falls into a situation of "big thunder and small raindrops", where the tiger starts and the snake ends. The root cause is that there is inequality in relationships and interests, making it difficult to maintain the enthusiasm and enthusiasm of local stakeholders to participate. This reminds local design and art colleges to organically embed the daily business and interest demands of local industry entities in planning and designing project content, goals, and processes, and to be able to solve practical business problems or obtain practical benefits through projects, thereby increasing their enthusiasm and willingness to continue participating. Local design and art colleges need to make corresponding adjustments and optimizations to their teaching systems in order to provide effective support for the operation of project-based teaching systems, and establish an "innovative ecosystem" of knowledge production with significant characteristics of "multiple subjects, levels, forms, nodes, and multilateral interactions". The college, teachers and students, and stakeholders in the local packaging design market need to be fully accommodated, and through positive interaction, it will become a symbiotic and prosperous local education community.

5. Funding

Research topic on teaching reform at the university level of Jingdezhen Ceramic University in 2022 (Research on the Localization Path of Art and Design Education in Local Universities from the Perspective of "Internet plus" Taking the Visual Communication Major as an Example) TDJG-22-Y28, Jingdezhen Ceramic University.

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