Exploring Intelligent Technology-Enabled Innovation in Design Education: A Practice-Based Analysis of an Interdisciplinary Workshop Teaching Model for Integrated Innovative Design in Cultural Communication

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Abstract: Against the backdrop of the global integration of intelligent technologies and education, this study examines the implications of the needs of cultural inheritance and development for the cultural communication and technology-enabled dissemination missions of design education. It identifies two principal objectives: transforming cultural elements into teachable design content through the introduction of additional traditional art courses, and constructing digital communication scenarios through virtual reality (VR) and artificial intelligence (AI) technologies. The study focuses on three dimensions through which intelligent technologies empower design education. First, in teaching practice, VR and augmented reality (AR) are used to create immersive practical training environments, while big data analytics support personalized learning. Second, within the curriculum system, new courses such as "Generative AI Design" are introduced to promote the integration of emerging technologies with traditional design. Third, in faculty development, a competency framework encompassing technological tools, interdisciplinary collaboration, and cultural communication is established, together with the introduction of intelligent teaching platforms. By examining the connotations and value of integrated innovative design for cultural communication and analyzing relevant practices in China and abroad, this study provides a detailed account of the implementation process, practical outcomes, reflections, and improvement strategies associated with the interdisciplinary workshop teaching model. The findings indicate that this model is of considerable significance for cultivating highly qualified professionals in innovative design for cultural communication. Although several challenges remain, targeted improvements may enable the model to better serve cultural communication and educational innovation, while advancing the dissemination and development of local culture.

Keywords: Intelligent Technologies; Design Education; Cultural Communication; Interdisciplinary Workshop; Teaching Model

1. Introduction

The global integration of intelligent technologies into education is reshaping the educational landscape. In the United States, educational technology initiatives have been implemented to promote the integration of intelligent technologies into K–12 and higher education, with the aim of enhancing students' digital literacy and innovative capabilities. The European Union has likewise actively developed intelligent education programs to strengthen the global competitiveness of European education. Intelligent technologies have created new possibilities for education, including personalized learning, virtual teaching environments, and intelligent educational management[1]. Relevant educational development policies have also emphasized the need to strengthen practice-oriented teaching and innovation and entrepreneurship education in design programs, thereby promoting closer alignment between design education and industry needs.

Meanwhile, with the rapid socioeconomic development of China and the continued growth of cultural confidence, the cultural industries have become an important pillar of the national economy. The demand for design professionals has become increasingly diverse and advanced,

posing new challenges to existing talent cultivation models in design education[2,3]. In the context of globalization, the influence of cultural communication has assumed increasing importance in international exchange. Integrated innovative design for cultural communication combines local traditional cultural resources with contemporary design and intelligent technologies to develop cultural products with distinctive local characteristics and enhance the international communication and influence of local culture[4]. Cultural and creative products developed by the Palace Museum provide a representative example. Through innovative design and the digital dissemination of cultural elements associated with the Palace Museum, these products have brought cultural relics to life and attracted global attention to traditional Chinese culture, demonstrating the effectiveness of integrated innovative design for cultural communication[5].

Against this background, an in-depth examination of intelligent technology-enabled innovation in design education, particularly the application of an interdisciplinary workshop teaching model to integrated innovative design for cultural communication, is of considerable practical and strategic significance. Such an investigation can contribute to the cultivation of highly qualified professionals in innovative design for cultural communication, promote the prosperity of cultural undertakings and industries, and support the achievement of national cultural strategic objectives.

2. Implications of Cultural Inheritance and Development for the Cultural Communication Mission of Design Education

Against the broader background of integrating cultural inheritance with education, design education should establish mechanisms for the in-depth integration of traditional cultural elements into contemporary teaching systems. This integration should be incorporated throughout moral education, cultural knowledge education, arts and physical education, and social practice, while extending across early childhood education, basic education, vocational education, higher education, and continuing education. At the curricular level, it is particularly important to systematically introduce core courses in areas such as the history of traditional art, the aesthetics of traditional craftsmanship, and the interpretation of folk culture. Such courses can not only guide students in conducting an in-depth examination of the meanings embedded in traditional patterns, systems of color symbolism, and the logic of materials and craftsmanship, but also transform the underlying cultural and spiritual essence of local traditional cultural resources into a design language that students can perceive and apply. This transformation can be achieved through a progressive instructional sequence comprising theoretical interpretation, element deconstruction, and innovative transformation, thereby establishing a solid knowledge foundation for subsequent cultural innovation in design[6].

Through these courses, students can develop a deeper understanding of the meanings and appeal of traditional culture, examine elements such as traditional patterns, colors, and materials, and acquire the design language associated with traditional culture, thereby laying a foundation for subsequent innovative design practices. For example, in a course entitled "Traditional Patterns and Their Application in Contemporary Design" offered by a design school, instructors guide students in analyzing the cultural connotations and symbolic meanings of traditional auspicious patterns and encourage them to apply these patterns to contemporary design. The resulting works combine distinctive characteristics of traditional culture with contemporary aesthetic values.

From the perspective of cultural communication, design education should place particular emphasis on developing students' ability to innovate cultural communication through intelligent technologies. The rapid development of the Internet, new media, and related intelligent technologies has substantially transformed the methods and channels through which culture is communicated. Design education must therefore respond to these developments by guiding students in using digital media, virtual reality, social media platforms, and other technologies to undertake innovative design for cultural communication [7]. For example, virtual reality (VR) can be used to construct 360-degree panoramic models and spatial interaction systems. High-precision three-dimensional data on cultural heritage can be acquired through laser scanning, while motion-capture technology can be employed to

reconstruct the operational processes of traditional crafts. By wearing VR headsets, audiences can examine the details of cultural artifacts and experience traditional production processes within virtual environments.

The algorithmic recommendation mechanisms of social media platforms can also be employed to tag the visual elements and cultural narratives of cultural and creative products. Content distribution strategies can subsequently be optimized through the analysis of user behavioral data. For instance, to respond to Generation Z's preference for short-form video communication, cultural narratives can be presented through short videos produced using motion graphics and immersive sound-design techniques. This approach can increase the reach of a single piece of content by a factor of three to five, substantially expanding the scope of cultural communication and improving its capacity to reach younger audiences. In one case, design students at a university produced short videos on local traditional culture and disseminated them through new media platforms. The vivid content and innovative forms attracted considerable attention and effectively promoted local culture.

In response to the evolving needs of cultural communication, the professionals cultivated through design education should be capable of facilitating the participation of local culture in international exchange and enhancing its international reach and influence[8]. Design education institutions should therefore engage in exchanges and collaboration with international universities and cultural organizations and jointly undertake relevant projects and activities. Through international cooperation, students can develop an understanding of the cultural characteristics and design concepts of different countries, learn advanced cultural communication technologies and practices, and produce cultural works that combine an international perspective with distinctive local characteristics. These experiences enable students to demonstrate the appeal of local culture on international platforms.

For example, some design schools have collaborated with institutions in other regions to organize cultural and creative design workshops. Focusing on cross-regional cultural exchange, students have used intelligent technologies to develop innovative designs. Their works have attracted considerable attention at international exhibitions, promoted interaction and integration between local culture and the cultures of other regions, and advanced the international communication and development of local culture. Such practices are of substantial practical significance for strengthening cultural soft power and enhancing international cultural competitiveness [9].

3. Multiple Pathways for Intelligent Technology-Enabled Innovation in Design Education

3.1 Intelligent Technologies Drive Innovation in Design Teaching Methods

First, intelligent technology-assisted instruction represents a key manifestation of the integration of intelligent technologies into design education. Intelligent teaching platforms integrate extensive educational resources and provide students with diverse learning materials. Virtual reality (VR) and augmented reality (AR), for example, can be used to construct immersive design-learning environments. In architectural design education, VR enables students to intuitively experience the spatial configurations and atmospheres of architectural works in different styles. This allows them to develop a more accurate understanding of scale, proportion, and spatial relationships in architectural design, while stimulating design inspiration and innovative thinking[10]. The intelligent question-answering functions embedded in intelligent teaching platforms also enable students to obtain timely responses to their questions, thereby improving learning efficiency.

Second, the planning of personalized learning pathways constitutes an important innovation through which intelligent technologies empower design education. Big data analytics can be used to collect and analyze data concerning students' learning behaviors, individual interests, learning preferences, and levels of knowledge acquisition, thereby enabling the development of customized learning pathways. In a graphic design course offered by a design school, for example, an intelligent learning system analyzed students' performance in color theory, graphic design, and layout design. Students who demonstrated weaknesses in color coordination were provided with instructional videos, case analyses, and

targeted exercises relating to color combinations. By contrast, students who performed well in graphic design were assigned more challenging design projects and supplementary learning materials[11]. Such personalized learning pathways accommodate individual differences among students and enhance both their motivation and learning outcomes.

Third, in practical teaching, the Rhode Island School of Design (RISD) has offered a cultural and creative product design course supported by intelligent technologies. Instructors use intelligent teaching tools to present exemplary cultural and creative product designs from China and other countries. AR technology enables students to examine product details from multiple perspectives and gain an understanding of the associated design concepts and production processes. At the same time, an intelligent learning analytics system tracks students' performance in creative ideation, design communication, and market research, and subsequently develops personalized plans for improvement. During the ideation stage, the system recommends cultural elements and creative resources based on students' interests and individual strengths. During the design communication stage, students who require additional support in software operation or hand-drawing techniques are provided with targeted tutorial videos and practical exercises[12]. After one semester, students' design works demonstrated substantial improvements in innovation, cultural content, and market adaptability, and received multiple awards in design competitions. These outcomes demonstrate the effectiveness of intelligent technologies in promoting innovation in design teaching methods.

3.2 Intelligent Technologies Reshape the Design Education Curriculum

The development of intelligent technologies has prompted the continuous renewal of curriculum content in design education. On the one hand, courses relating to intelligent technologies, such as artificial intelligence in design, fundamentals of digital media technology, and big data analytics and its applications in design, should be introduced to enable students to understand the principles and application methods of intelligent technologies and apply them to design practice. In artificial intelligence design courses, students learn to use AI algorithms to generate design concepts and optimize design proposals, thereby overcoming the limitations of conventional approaches to design thinking.

On the other hand, intelligent technological components should be incorporated into conventional design courses. In graphic design courses, for example, intelligent layout generation and intelligent image recognition and processing can be added to the existing instruction in hand drawing and graphic design software. Intelligent layout software can rapidly generate multiple layout alternatives according to specific design requirements and optimize their visual effects. Intelligent image-recognition technologies can assist students in extracting visual elements from images and creatively recombining them, thereby expanding the expressive forms and creative possibilities of graphic design.

In terms of curriculum structure, intelligent technologies are facilitating the transition of design education toward interdisciplinary and modular forms of organization. Interdisciplinary courses establish an ecosystem for knowledge integration by dismantling conventional disciplinary boundaries. The course "Cultural Communication and Intelligent Interaction Design," for example, breaks down the traditional divisions among design, communication studies, and computer science and establishes a three-dimensional teaching framework comprising theoretical integration, technological empowerment, and contextual implementation.

At the theoretical level, the course integrates audience segmentation theory from communication studies, the principles of emotional design from design studies, and the principles of human-computer interaction from computer science. At the technological level, it introduces the Unity 3D development platform, eye-tracking equipment, and big data analytics tools to guide students through the complete practical process, from user-needs modeling to interactive prototype development. User-needs modeling may, for instance, involve the use of Python web crawlers to collect social media data concerning cultural consumption. At the application level, the course incorporates local cultural intellectual property into authentic project contexts.

For example, a student team at a university developed an application entitled "Intangible

Cultural Heritage at Your Fingertips" for the traditional craft of Miao silverwork. The application used AR-based virtual try-on technology to create a virtual integration of traditional jewelry and contemporary clothing. An accompanying HTML5 interactive story wall reconstructed the logic of cultural narratives through animated illustrations and audio guidance. Following the implementation of the course, 78% of the interdisciplinary projects completed by students were successfully transformed from initial concepts into demonstrable prototypes, while 32% attracted expressions of interest from cultural enterprises for potential incubation. These outcomes substantially enhanced students' problem-solving abilities and innovative practical competence in complex cultural communication contexts[13,14].

A modular curriculum structure organizes course content according to students' learning needs and interests. One design school, for example, established four curriculum modules: foundational courses, professional core courses, extension courses, and practical courses. The foundational module covers fundamental design theories and basic knowledge of intelligent technologies. The professional core module comprises courses corresponding to different specialist areas. The extension module offers elective courses such as artificial intelligence art and cultural and creative industry management. The practical module develops students' practical and innovative capabilities through project-based practice and internships.

3.3 Intelligent Technologies Enhance Faculty Capabilities in Design Education

Intelligent technologies provide extensive resources and tools for improving the teaching capabilities of design educators. Intelligent teaching platforms integrate a large number of teaching cases, academic papers, and design tutorials, enabling instructors to select appropriate materials according to their teaching needs and enrich course content. When presenting cases of innovative design for cultural communication, instructors can use such platforms to obtain recent examples from China and other countries, thereby helping students understand emerging developments in the design industry.

Intelligent technologies also provide a range of instructional tools. Intelligent courseware-authoring tools can be used to produce interactive teaching materials, while instructional video-editing tools can improve the quality of educational videos and make teaching content more engaging and appealing. In terms of professional development, intelligent technologies provide educators with additional opportunities for learning and research. Instructors can participate in intelligent technology training programs and academic lectures through online learning platforms, update their knowledge structures, and acquire an understanding of emerging technologies and design concepts. Many universities and educational institutions offer online courses in areas such as artificial intelligence design and digital media technology applications, allowing instructors to undertake independent professional learning[15].

Big data analytics can also assist instructors in identifying research topics and emerging trends in the design field, while intelligent literature-retrieval tools can improve research efficiency. To respond to the teaching requirements of the intelligent era, educators must transform their pedagogical roles from transmitters of knowledge into guides and facilitators of student learning. Intelligent technologies enable students to obtain extensive amounts of information through digital networks. Educators should therefore guide students in evaluating, selecting, and effectively using such information, while fostering independent learning abilities and innovative thinking.

In classroom teaching, instructors can formulate open-ended questions and guide students in using intelligent technologies to conduct research and analysis, while encouraging them to develop their own interpretations and solutions. Educators must also strengthen their ability to apply intelligent technologies and develop proficiency in the use of intelligent teaching tools and software. Universities and educational institutions should therefore enhance faculty training by regularly organizing courses and teaching seminars on the educational application of intelligent technologies.

Experts in intelligent technologies may be invited to provide training on topics such as AI-assisted design tools and the application of virtual reality in teaching. Instructors should also be provided with opportunities to engage in

practical activities and share their teaching experiences. These measures can improve educators' ability to apply intelligent technologies and enable them to integrate such technologies effectively into design teaching[16].

4. The Central Role and Practical Exploration of Integrated Innovative Design for Cultural Communication in Design Education

4.1 The Connotations and Value of Integrated Innovative Design for Cultural Communication

Integrated innovative design for cultural communication takes culture as its foundation and involves the identification, organization, and interpretation of diverse cultural resources. Cultural symbols, values, historical narratives, and other cultural elements are incorporated into design practices, thereby endowing design works with substantial cultural meaning. At the same time, technologies such as big data analytics, artificial intelligence, and virtual reality can be employed to overcome the temporal and spatial limitations of conventional design, broaden the channels of cultural communication, and facilitate the efficient dissemination and extensive sharing of cultural content. Immersive cultural experience spaces represent one such form of technology-enabled cultural communication.

Participation in such design projects is of considerable significance for students. For example, when developing a design project themed around Silk Road culture, students are required to conduct in-depth research into the cultures, arts, and religious traditions of the regions along the Silk Road. This process broadens their cultural horizons, strengthens their understanding and acceptance of cultural diversity, enriches their cultural knowledge, and cultivates their awareness of intercultural communication.

Integrated innovative design for cultural communication also provides students with extensive opportunities for creative exploration and encourages them to move beyond conventional approaches to design thinking. In the design of cultural and creative products, students can employ intelligent technologies to integrate traditional culture with contemporary technology. For example, a student may use three-dimensional printing technology to combine traditional ceramic craftsmanship with contemporary form design, thereby creating distinctive ceramic cultural and creative products and demonstrating the capacity for design innovation.

Such projects also contribute to the development of students' problem-solving and teamwork abilities. In authentic projects, students are often required to address complex cultural communication needs and design challenges by integrating knowledge and resources from multiple disciplines. In a cultural heritage digitization and preservation project, for instance, design students may collaborate with students from computer science, history, and other disciplines to undertake digital data acquisition, organization, and related tasks. This interdisciplinary process effectively strengthens students' ability to solve complex problems and collaborate within multidisciplinary teams.

4.2 Practical Cases of Integrated Innovative Design for Cultural Communication in Design Education

The Rhode Island School of Design (RISD) has been at the forefront of integrating intelligent technologies into design education and has demonstrated a range of innovative practices in curriculum development, teaching models, and talent cultivation. In terms of curriculum design, RISD has actively introduced courses related to intelligent technologies, including "Artificial Intelligence and Design Thinking" and "Digital Fabrication and Design Innovation." These courses deeply integrate intelligent technologies with specialist design knowledge and provide students with opportunities for interdisciplinary learning.

In the course "Artificial Intelligence and Design Thinking," students not only study the fundamental principles and algorithms of artificial intelligence but also examine how AI can be used to extend design thinking. They apply machine-learning algorithms to generate design concepts and use AI-based data analytics to investigate user needs, thereby producing designs that are more innovative and user-oriented.

With regard to teaching methods, RISD combines project-based learning with practice-oriented instruction to make full use of the advantages offered by intelligent technologies.

In an intelligent interactive product design project, for example, students use intelligent hardware development tools and interaction design software to design and produce innovative interactive products. During project implementation, VR and AR technologies are used to present and test product prototypes. These technologies allow students to simulate user scenarios in advance, collect user feedback, and continuously optimize their designs. This teaching model enables students to acquire intelligent technological skills through practice and improves both their practical competence and their ability to solve real-world problems.

RISD also maintains close collaboration with technology companies and research institutions through industry–university–research projects, providing students with opportunities to engage with emerging technologies and authentic design projects. Students participate in design projects undertaken in collaboration with companies such as Google and Apple and apply intelligent technologies to address practical design problems. Through these experiences, they enhance their professional competence and innovative thinking.

At the same time, RISD encourages students to undertake elective courses across disciplinary boundaries, thereby promoting the integration of knowledge from different fields and cultivating interdisciplinary thinking and teamwork skills. Design students may, for example, take courses in computer science and psychology and subsequently apply knowledge from these disciplines to their design processes. This approach enables their design works to demonstrate greater scientific rigor and a stronger concern for human needs.

The University of the Arts London (UAL) has also developed distinctive approaches to integrating intelligent technologies into design education. In terms of technological application, UAL has established advanced intelligent design laboratories equipped with three-dimensional printers, laser-cutting machines, AI-assisted design software, and other advanced facilities and tools. These laboratories provide students with an effective environment in which to undertake practical activities in intelligent product design and digital media art.

Within digital media art programs, students use AI-based image-recognition technologies and machine-learning algorithms to analyze extensive collections of artworks and extract distinctive features of artistic styles. They subsequently apply these features to the creation of new artworks, achieving an effective integration of artistic practice and intelligent technology.

UAL's curriculum responds closely to contemporary developments and emphasizes the cultivation of design capabilities appropriate to the intelligent era. The university offers courses such as "Intelligent Design and Innovation" and "Data-Driven Design," which guide students in using intelligent technologies to support design innovation. In the course "Data-Driven Design," students learn how to collect, analyze, and apply data in design decision-making. By examining user behavior data, market data, and other relevant information, students can develop a deeper understanding of user needs and market trends and consequently design products that are better aligned with market demand.

The university also emphasizes the development of critical thinking and innovative awareness. Students are encouraged to reflect critically on conventional design concepts and methods and to use intelligent technologies to explore emerging areas of design and new forms of creative expression.

In terms of teaching methods, UAL adopts a diverse range of pedagogical approaches to stimulate students' interest in learning and strengthen their innovative capabilities. Industry experts and professional designers are invited to deliver lectures and workshops, enabling students to remain informed about recent industry developments and emerging technologies. For example, designers from Apple may be invited to deliver lectures on intelligent product design and share the company's design concepts and professional experience, allowing students to understand leading industry standards and developmental trends.

UAL also undertakes international exchange and collaborative projects that provide students with international learning and communication opportunities. Students may participate in exchange programs and collaborative design workshops with internationally recognized institutions. Such experiences broaden their international perspectives and enable them to learn about the design concepts and methods employed in different countries and regions.

5. The Interdisciplinary Workshop Teaching Model: An Innovative Practice Integrating Intelligent Technologies and Cultural Communication

5.1 Implementation Procedures and Methods of the Intelligent Technology-Enabled Interdisciplinary Workshop Teaching Model

5.1.1 Interdisciplinary theme identification

Instructors determine workshop themes by considering emerging trends in cultural communication, societal needs, students' existing knowledge, and their interests. In the context of the rapid development of intelligent technologies, the selected themes should respond closely to contemporary needs in cultural communication. One possible theme, for example, is "Using Intelligent Technologies to Support the International Communication of Traditional Culture."

Big data analytics tools can be employed to collect and analyze information on current cultural communication topics, research trends, and market demands, thereby providing an empirical basis for theme identification. For example, an analysis of the download volumes of culture-related applications and the popularity of cultural topics on social media may reveal that international audiences demonstrate considerable interest in local traditional crafts and folk cultures while showing a preference for digital and interactive forms of communication. On this basis, the broader theme may be further refined as "Innovative Design for the International Communication of Local Traditional Crafts Based on Intelligent Interaction Technologies."

5.1.2 Team formation

Conventional disciplinary boundaries should be transcended by encouraging students from design, communication studies, computer science, foreign languages, and other disciplines to form interdisciplinary teams. Intelligent matching algorithms can be used to optimize team composition based on information concerning students' professional skills, personal interests, and previous project experience.

For example, one university employs a self-developed intelligent team-formation platform. Students enter their personal information and preferred project areas into the platform, which then uses algorithmic analysis to recommend suitable team members for each project. This approach improves both the efficiency and the quality of team formation.

Team members should clearly define their respective roles and responsibilities within the project. Design students are responsible for the visual appearance and interaction design of cultural and creative products. Communication studies students undertake communication strategy development and audience analysis. Computer science students are responsible for developing and applying intelligent technologies, such as mobile applications and virtual reality exhibition systems. Foreign-language students undertake the translation of cultural content and facilitate intercultural communication.

5.1.3 Project implementation

Students use intelligent design software, including Adobe Creative Suite and Sketch, to support creative ideation and design communication. AI-assisted design tools, such as generative AI design platforms, can also be used to broaden students' design thinking. By entering keywords associated with cultural elements and specifying design-style requirements, students can obtain creative references and preliminary design proposals that support the further development of their ideas.

Computer science students may develop AI-based cultural content recommendation systems that deliver cultural communication content to users according to their browsing histories, interests, and preferences. VR and AR technologies can also be employed to create immersive cultural experience environments. In the project "Innovative Design for the International Communication of Local Traditional Crafts," for example, students developed a virtual exhibition hall in which users wearing VR headsets could experience the production processes of traditional crafts in an immersive manner.

Intelligent project management tools, such as Trello and Asana, can be used to monitor and manage project progress, task allocation, and team collaboration in real time, thereby supporting the orderly implementation of the project.

5.1.4 Presentation of project outcomes

Students may present their project outcomes in a variety of forms, including cultural and creative product exhibitions, cultural communication events, and online presentation

platforms. Intelligent presentation technologies can be employed to enhance the effectiveness of these presentations. For example, three-dimensional holographic projection can be used to demonstrate the spatial and visual characteristics of cultural and creative products, while interactive digital display screens can allow visitors to select cultural content and explore it in greater depth.

Experts in cultural communication, corporate representatives, and members of the public may be invited to evaluate the project outcomes. Intelligent evaluation systems can collect assessment data from the evaluators and conduct quantitative analyses of the innovation, cultural content, and market feasibility of the outcomes, thereby providing students with objective and comprehensive feedback.

During a project presentation event at one university, for example, an intelligent evaluation system collected comments and assessments from more than 200 evaluators. Students subsequently used this feedback to refine their project outcomes and improve both their quality and practical applicability.

5.2 Practical Outcomes and Reflections on the Interdisciplinary Workshop Teaching Model in Integrated Innovative Design for Cultural Communication

5.2.1 Practical outcomes

An in-depth analysis of numerous interdisciplinary workshop projects in integrated innovative design for cultural communication demonstrates the considerable effectiveness of this model in developing students' interdisciplinary capabilities. One example is an "Intelligent Cultural Communication Innovation Workshop" organized by a university, which brought together students from design, communication studies, computer science, and other disciplines. During project implementation, students from different disciplinary backgrounds were required to mobilize their respective knowledge and skills and collaborate in completing cultural communication projects[17].

In the development of a promotional design proposal for cultural tourism, for example, design students initially focused primarily on visual aesthetics. After collaborating with communication studies students, they developed a deeper understanding of communication principles and began to evaluate their designs in terms of communicative effectiveness. They optimized the color schemes, arrangement of visual elements, and textual content of promotional posters according to the cultural backgrounds, interests, and preferences of different audience groups, thereby making the proposals more visually appealing and communicatively effective.

Communication studies students, who initially had limited experience in practical design, acquired fundamental design skills through the collaborative process. They learned, for example, to use design software for basic graphic production and layout design, enabling them to communicate information in a more visually impactful manner.

Computer science students integrated their technical expertise with cultural content in specific cultural communication contexts. For example, they developed an intelligent mobile guide application for cultural tourism promotion. Using location-based technologies and data analytics, the application provided visitors with personalized introductions to cultural attractions and recommended travel routes, substantially improving the user experience.

With the support of intelligent technologies, students successfully developed a range of innovative cultural communication products. In a project on the digital communication of traditional culture, students used VR technology to construct an immersive traditional cultural experience platform. They conducted detailed research into the performance forms, costumes, and props of traditional opera, as well as the procedures and spatial arrangements of folk cultural activities. Through technologies such as three-dimensional modeling and motion capture, they presented classic traditional opera performances and lively folk festival scenes to users in a vivid and intuitive manner.

When wearing VR headsets, users were able to experience the sensation of moving through time and space and being situated either in front of a traditional opera stage or within a folk cultural event, thereby directly experiencing the appeal of traditional culture[18]. The platform attracted a large number of younger users and substantially enhanced the effectiveness and influence of traditional cultural communication among younger audiences.

These innovative projects received awards in various competitions, including national

cultural and creative design competitions for university students, and gained considerable recognition from cultural enterprises and the wider public. Some projects, including the intelligent cultural tourism guide application described above, have been introduced into the market. They have created new sources of business growth for cultural enterprises, contributed to the development of local cultural tourism industries, and generated positive social and economic benefits.

5.2.2 Reflections on practice

Time management emerged as a significant challenge during the implementation of interdisciplinary projects. Such projects generally involve multiple stages, including preliminary research, technological development, and design integration. Students are also required to shift frequently among different disciplinary modes of thinking, including design thinking, algorithmic logic, and communication strategy. Consequently, excessive time may be devoted to the preliminary identification and interpretation of cultural elements, reducing the time available for subsequent technological implementation, testing, and refinement. A typical problem occurs when delays in requirements analysis result in rushed development work during later stages.

Intelligent Gantt chart tools may be introduced to support the dynamic planning of project tasks and milestones. A "disciplinary knowledge integration buffer period" may also be incorporated into the schedule to provide students with sufficient time to shift between disciplinary modes of thinking. At the same time, a rapid cross-stage review mechanism should be established to assess interim outcomes, correct deviations from the schedule, and improve the efficiency of time allocation.

In a workshop on the digital preservation of cultural heritage, for example, students were required to visit cultural heritage sites in several locations, consult extensive historical documents, and communicate with heritage conservation specialists and local cultural researchers during the preliminary research stage. These activities required a considerable amount of time. The subsequent organization, selection, and analysis of the collected materials were also time-consuming, leaving insufficient time for the critical stages of digital modeling and exhibition design.

The original project plan allocated two months to digital modeling. However, because of delays during the preliminary research stage, only approximately two weeks remained for this task. Team members consequently had to work under considerable time pressure. The resulting models lacked sufficient precision, while the exhibition design was completed hastily, substantially reducing the overall quality of the project.

Differences in disciplinary backgrounds also created barriers to communication. Students from different disciplines often differed considerably in their modes of thinking, working habits, and use of specialist terminology. During team collaboration, these differences could lead to ineffective communication, reduce team efficiency, and delay project implementation.

In the development of a cultural communication application, for example, design students adopted a user-centered approach and concentrated on the visual quality of the interface and the fluency of the interactive experience. They emphasized refined interface elements, harmonious color combinations, and simple operational procedures. Computer science students, by contrast, approached the project from the perspective of technological implementation and placed greater emphasis on the stability of the system architecture, the feasibility of individual functions, and the efficiency of data processing.

When discussing the design of the application's search function, the design students proposed that the search box should be visually prominent and creatively designed. The computer science students, however, were concerned that an excessively complex design would increase the difficulty of coding and place an additional burden on system performance. Ineffective communication prevented the two groups from reaching an agreement, resulting in repeated revisions to the design proposal. The design stage, which was originally expected to take one month, ultimately required two and a half months, causing a substantial delay in the overall project schedule.

5.2.3 Improvement strategies

(1) Strengthening time management

To address time management problems, project planning and progress monitoring should be strengthened. Before the project begins, team

members should jointly develop a detailed project plan. Time should be allocated scientifically and appropriately to each stage according to the project objectives and workload, and the specific tasks and expected outcomes of each stage should be clearly defined.

Advanced project management software, such as Trello or Asana, should be introduced to track project progress in real time[19]. A visual task-management dashboard can enable team members to review the overall progress of the project and the completion status of their respective tasks at any time.

A time-based early warning mechanism should also be established. Key deadlines should be determined in advance, and automated reminders should be configured. When a project approaches a predetermined deadline, the system should automatically send notifications to team members, helping to ensure that the project proceeds according to schedule and is completed on time.

(2) Addressing barriers to team communication

To address communication barriers in interdisciplinary teamwork, greater emphasis should be placed on team development and communication training. During the initial stage of team formation, various team-building activities, such as outdoor development exercises and themed exchange events, may be organized to increase mutual understanding and trust among team members and create a positive environment for collaboration.

Interdisciplinary communication training should be conducted regularly. Specialists from different disciplines may be invited to deliver lectures introducing the principal modes of thinking, research methods, and commonly used terminology within their respective fields. This approach can facilitate interdisciplinary knowledge exchange among students[20].

Communication-skills training should also be incorporated through case analyses, simulated exercises, and related activities. An effective communication mechanism should be established through regular team meetings in which communication procedures and rules are clearly defined and members are encouraged to express their views fully.

A communication coordinator may also be appointed. This role should be undertaken by a student with strong communication skills and a basic understanding of the disciplines represented within the team. The coordinator should facilitate communication among team members, resolve communication problems in a timely manner, and ensure the accurate and uninterrupted exchange of information throughout the project.

6. Conclusion

Against the backdrop of the rapid development of intelligent technologies and the continuous evolution of cultural communication, this study has examined multiple pathways through which intelligent technologies can enable innovation in design education, with particular emphasis on the interdisciplinary workshop teaching model for integrated innovative design in cultural communication. Practical implementation has demonstrated that this model is effective in developing students' interdisciplinary capabilities and facilitating innovative design for cultural communication. It has contributed to the cultivation of a large number of highly qualified professionals in innovative design for cultural communication and has supported the development of cultural undertakings and cultural industries. Nevertheless, the implementation process has also revealed challenges related to time management, teamwork, and interdisciplinary communication. Targeted strategies, including strengthening project planning and progress monitoring and enhancing team development and communication training, may further improve the teaching model.

Looking ahead, the continued advancement of intelligent technologies will create both new opportunities and new challenges for design education. It is therefore necessary to respond proactively to the transformative opportunities generated by these technologies, deepen innovation in design education, and continuously optimize the interdisciplinary workshop teaching model. These efforts can enable integrated innovative design for cultural communication to play a more prominent role in broader contexts, provide greater practical support for enhancing the reach and influence of cultural communication and the capacity for international cultural exchange, and facilitate the wider and more extensive communication and exchange of local culture worldwide.

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