RESEARCH AND PRACTICE OF DESIGN EDUCATION THROUGH "EMBODIED CO-CREATION BETWEEN UNIVERSITY AND ENTERPRISE"

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ABSTRACT
The “Intelligent Interaction Design” undergraduate program, established by the Ministry of Education in 2020, aims to cultivate high-level interdisciplinary talents proficient in both artificial intelligence and interaction design. Integrating cyber-physical systems, human-machine collaboration, and consumer experience, the program emphasizes the necessity of practical platforms for students to acquire real-world skills and engineering experience. This paper identifies key areas for improvement in the curriculum, such as scientific teaching plan design, integration of coursework with experimental practice, and optimization of university-enterprise cooperation models. It explores the relationship between embodied teaching and engineering practice, highlighting the importance of constructing embodied learning scenarios based on educational objectives. The “embodied modules” of design education is proposed to achieve learning embodiment through observation, simulation, and dialogue, supported by a well-proportioned curriculum system. The study suggests establishing on-campus workshops in collaboration with industry partners as a key strategy. These workshops facilitate project-based learning, fostering an environment of active embodied practice. By forming “embodied modules” throughout undergraduate to master's levels, the program aims to enhance students' craftsmanship spirit and effectively prepare them for the rapidly changing demands of intelligent interaction design and interdisciplinary fields.

Keywords: Intelligent Interaction Design, Embodied Education, Co-creation, Design Workshop

1 INTRODUCTION

The “Intelligent Interaction Design” undergraduate program, newly established by the Ministry of Education in 2020, aims to integrate cyber-physical systems (intelligent agents), human-machine (environment) collaboration, and consumer experience. It focuses on cultivating high-level interdisciplinary talents in “Artificial Intelligence + Interaction Design.” Therefore, similar to many other disciplines, education in this major requires not only a solid theoretical foundation but, more importantly, effective practical platforms. These platforms enable students to rapidly and solidly learn real skills through hands-on experiences during their university years, accumulating engineering experience.

To achieve this goal, there are many aspects worthy of research and improvement in the construction. These include the scientific design of teaching plans, the reasonable integration of course learning and experimental practice, significantly increasing practical projects for students, expanding the coverage of embodied experiences, reasonably customizing “experience packages” for different grade levels, and optimizing the university-enterprise cooperation model. Therefore, systematically and scientifically planning a teaching system based on embodied practice, building practical platforms for students at all levels, enhancing students’ embodied experiences, and improving the quality of talent cultivation have become important issues in the construction of the new major.

2 RESEARCH ON EMBODIMENT AND ENGINEERING EDUCATION

Numerous scholars have conducted in-depth research on students' cognitive patterns and practical teaching models using embodied theories, constructing learning contexts that align with real-world applications based on these theoretical foundations.

2.1 Research on Embodied Teaching and Cognition

Embodied education emphasizes the leading role of the "body" in education, characterized by "situationality," requiring a focus on process-oriented and experiential teaching [1]. It specifically requires teachers and students to perceive the environment through various bodily senses, forming personal experiences and metaphors to achieve cognitive learning outcomes [2]. Cao Ruixia and Gao Jing proposed a knowledge cognition logic that integrates "body–emotion–situation," allowing students to experience, think, and understand in specific contexts to enhance their core competencies [3]. Du Ermin [4], Meng Sugang and Zheng Xiuzhen [5] focus on the important role of creating situations in embodied teaching, particularly proposing five steps for immersive learning from an embodied perspective [4]. Song Yaowu and Cui Jia further constructed an "Interactive Constructivist Learning Process," achieving the goal of embodied learning through the integration of observation, simulation, and dialogue [6]. It is evident that constructing embodied scenarios based on learning objectives and tasks is an important direction for practical teaching reform.

2.2 Research on Engineering Teaching Models

Hou Jianjun et al. proposed a T-shaped educational platform model [7], dividing courses into different modules and conducting teaching activities through four levels: basic practice, engineering cognition, comprehensive practice, and innovative practice. Xiao Zhen adopted various teaching methods, introducing university-enterprise cooperation projects and academic research projects into the classroom, practicing the educational concept of "Humanism + Design + Technology + Business + Culture," and integrating enterprise and school resources to establish an online interaction design "micro-major" [8]. Ma Hui proposed specific implementation methods in teaching for studio simulation construction, skill training simulation, writing simulation, and environment simulation [10]. These teaching reform attempts align with the "highest level" of engineering education concepts proposed by Olin College of Engineering in the United States and are "engineering education" concepts worthy of reference.

It can be seen that building an embodied experience environment where students shift from passive to active—workshops—is one of the key tasks that new programs need to study and emphasize in depth. There is a close relationship between embodied teaching and engineering practice, which is an important component in constructing an interactive design learning process. To achieve this goal, we must first scientifically analyze and adjust the content of courses in mathematical and physical foundations, disciplinary foundations, professional foundations, and specialized courses set by the new major, focusing on the connection points between each course content and its embodied practice components. We should scientifically and organically integrate various practical components such as ideological and political practice, course practice, enterprise internships, project practice, scientific research training, and innovation and competitions into course teaching. Secondly, we need to establish on-campus workshops closely cooperating with enterprises, guided by project implementation, inviting enterprise mentors into the school, and establishing a beneficial university-enterprise cooperation model that takes teaching as the main line, workshops as carriers, students' active embodied practice, and enterprise benefits. On this basis, forming different "embodied modules" that fully run through the design training content from undergraduate to master's stages, while considering the teaching needs of cross-major and interdisciplinary intersections, is essential.

3 MECHANISM FOR ESTABLISHING THE "INTERACTIVE CONSTRUCTIVIST LEARNING PROCESS"

The "Interactive Constructivist Learning Process" emphasizes that students achieve the goal of embodied learning through the integration of observation, simulation, and dialogue, which first relies on the scientific proportioning of the curriculum system and the overall support of the cultivation plan. Under the backdrop of the rapid iteration of artificial intelligent technology, the construction of the

Intelligent Interaction Design major is gradually maturing through exploration. It fully leverages the technical advantages of engineering universities and the strong logical thinking abilities of students, highlighting a technology and creative core guided by design thinking. It constructs a professional cultivation mechanism where "Artificial Intelligence+" user experience serves as the base, and intelligent products, intelligent interaction, and digital space echo each other:

1. **Intelligent Interaction Direction**: Focuses on "using artificial intelligence technology to explore and gain insights into new design application scenarios, and exploring interaction forms under future human-machine collaboration."
2. **Intelligent Products**: Focuses on "software and hardware collaborative information product design; revolution and innovation of cloud design production methods."
3. **Digital Space**: Focuses on "productivity revolution and cultural digital experience empowered by extended/augmented reality technology."

These three directions not only inherit the traditional advantages of the major—user experience and human-computer interaction—but also cover potential future trends such as design application scenario exploration, cloud design, and cultural digital experiences. This constructs an overall framework for subsequent course chain development and touchpoint identification.

Based on the framework of the Intelligent Interaction Design major's cultivation plan, 47 related courses (including the graduation project) are divided into five course chains: ICT—Professional Course Chain, Design Thinking—Human-Machine Experience Course Chain, Intelligent Product Course Chain, Intelligent Interaction Course Chain, and Digital Space Course Chain. The first two chains are the foundation of the entire curriculum system, supporting the Intelligent Product, Intelligent Interaction, and Digital Space course chains from both ends of "AI+ (Artificial Intelligence Technology)" and "UX (User Experience Design)," which are also the three professional directions (see Table 1). Thus, the Intelligent Interaction Design major forms a cultivation approach of "artificial intelligence technology assisting scenario exploration and productivity revolution, and user experience design empowering creative practice."

Table 1. Course Chain of the Intelligent Interaction Design major

<table>
<tr><th colspan="3">ICT—ICT Professional Course Chain</th><th rowspan="17">Graduation Project （7/8）</th></tr>
<tr><td>ICT</td><td colspan="2">Introduction of ICT (1), Introduction to Computing and Program Design (2)，Introduction to Artificial Intelligence (2)</td></tr>
<tr><td rowspan="4">ICT professional</td><td colspan="2">Data Structures and Algorithms (2), Methods of Scientific Computing (2)</td></tr>
<tr><td colspan="2">Fundamentals of Machine Learning (3), Databases and Backend Applications (3)</td></tr>
<tr><td colspan="2">Computer Graphics (4), Deep Learning (4)</td></tr>
<tr><td colspan="2">Computer Vision (5), Natural Language Processing (5), ICT and Design (5)</td></tr>
<tr><th>Intelligent Product Course Chain</th><th>Intelligent Interaction Course Chain</th><th>Digital Space Course Chain</th></tr>
<tr><td>Design Graphics (3)</td><td>Digital Visual Communication Design (2)</td><td>Digital Scene Design (6)</td></tr>
<tr><td>Design Representation (3)</td><td>Web Interaction Design (3)</td><td>VR/AR Design (6)</td></tr>
<tr><td>Intelligent Open-source Hardware (4)</td><td>Fundamentals of Animation and Video (3)</td><td></td></tr>
<tr><td>Practice of Intelligent Open-source Hardware (4)</td><td>Interaction Design Prototyping (3)</td><td></td></tr>
<tr><td>3D Digital Modeling Design (4)</td><td>Mobile Interaction design (5)</td><td></td></tr>
<tr><td>Fundamentals of Design Engineering (4)</td><td>Web Application Development (5)</td><td></td></tr>
<tr><td>3D Intelligent Digital Creation (5)</td><td>Collaborative Design Practice (6)</td><td></td></tr>
<tr><td>Product Design Prototyping (5)</td><td></td><td></td></tr>
<tr><td>Design Semantics (5)</td><td></td><td></td></tr>
<tr><td>Intelligent Product Design with Human-Machine Integration (5)</td><td></td><td></td></tr>
</table>

Human-Machine Experience	Human Factors Engineering Experiment (4), Data Statistics and Analysis (4), Fundamentals of User Experience Evaluation (6), Product Experience Design (6)	
	Digital Image Processing (1), Composition Design (2), Infographics Design (2), Human Factors Engineering (4)	
Design Thinking	Design Psychology (5), Service Design (7)，Digital Photography (7)	
	Fundamentals of Interaction Design (1), Design Thinking (1), Design History (2)	
Design Thinking—Human-Machine Experience Course Chain		

* The semesters when the courses are offered are indicated in parentheses after the course names.

4 CONSTRUCTION OF UNIVERSITY-ENTERPRISE CO-CREATION WORKSHOPS

The structuring of course chains lays a solid foundation for in-depth university-enterprise cooperation. Although fully implementing industry-education integration in teaching practice to test the actual cultivation effect will take time, university-enterprise joint course workshops have been organized on a small scale from lower grades to higher grades, from “basic experience” to “result incubation,” covering the Intelligent Product Course Chain, Intelligent Interaction Course Chain, and Digital Space Course Chain. Preliminary, it forms a 4-level “embodied modules” of design education – experiential basis, advanced learning, engineering embodiment and design implementation – sharing the similar thoughts with Olin College of Engineering (see Table 2). In practice, actual projects are introduced, and students are encouraged to team up with enterprise designers, fully integrating the industry experience of enterprise designers with students’ creative enthusiasm. Through a mix of online and offline methods, a “dialogue-interactive” embodied co-creation atmosphere is created for teaching practice. The main collaborations include:

Table 2. “Embodied Modules”

Course Chain		Embodied Modules	Key Points
ICT—ICT Professional Course Chain		**experiential basis**	• Experience design process. • Reverse-analysis of design motivations. • Experimental improvements.
Intelligent Product Course Chain		**advanced learning**	• Problem solving ability. • Prototyping skills. • Connecting to market.
Intelligent Interaction Course Chain		**engineering embodiment**	• Deeply engagement of product development. • Embodied practice package of engineering. • Interdisciplinary Collaboration.
Digital Space Course Chain		**design implementation**	• Co-creation of university and enterprise. • Application of intellectual properties and design awards. • Design implementation and entrepreneurship.

4.1 Experiential Basis – Reverse Engineering Training Camp

The university and Beijing JIANG Design Studio jointly held a “Reverse Engineering Training Camp,” foucsing on training students’ basis of intellectual product design, and conducting physical disassembly, measurement, reverse analysis, improvement attempts, and 3D printing verification of mature products (see Figure 1). Leveraging the rich practical experience of enterprise designers, first-year university students are guided to experience product form, material, and color; understand structural design features and assembly principles; reverse-analyze product positioning and functional design motivations; and encourage students to rethink new application scenarios and carry out experimental improvements. This allows lower-grade students to experience the entire process of product design, cultivating good design habits and ways of thinking.

4.2 Advanced Learning: BUPT–Li-Ning University-Enterprise Joint Course

In 2024, combining the university-wide second-year general education course “Design Thinking,” the Intelligent Interaction Design major’s courses “Human Factors Engineering” and “Data Statistics and Analysis,” cross-disciplinary design and development teams were organized. On one hand, using enterprise pre-research topics to connect the chain of user needs investigation, ergonomics analysis, circuit prototype development, and design solution exploration, training students from different majors in problem discovery and problem-solving abilities. On the other hand, enterprise designers convey industry knowledge to students in practice, completely changing the “behind closed doors” conceptual design training mode, and selecting projects with implementation potential to carry out in-depth R&D cooperation with enterprises.

4.3 Engineering Embodiment: BUPT– Thyseed Design Workshop

From 2022 to 2024, two intelligent product design workshops were jointly held with Thyseed, relying on six undergraduate courses belonging to the Intellectual Product Course Chain: “Design Semantics,” “Design Representation,” “Human Factors Engineering Experiment,” “3D Digital Modeling Design,” “Product Design Prototype,” and “User Experience Evaluation Basics.” Enterprise pre-research projects were introduced into the classroom, with frontline designers providing primary guidance throughout (see Figure 2). Students deeply engaged in the entire product development process from industry interpretation, needs decomposition, solution design, circuit development, human factors analysis, structural design, material and process, prototype assembly, peripheral design, to patent application, forming an “Intelligent Product Design” engineering embodied practice package. The workshop’s works applied for a total of two invention patents, six utility model patents, and two design patents; won 16 competition awards including the Silver Award of the American MUSE Creative Awards, the European Product Design Award, and the Second Prize of the Milan International Design Week Chinese University Design Discipline Teachers and Students Excellent Works Exhibition.

Figure 1. lecture of the training camp

Figure 2. discussion of the design workshop

(4) Design Implementation: BUPT–Xinhua News Agency Joint Practice

From October 2023 to February 2024, BUPT and Xinhua News Agency’s Technology Bureau conducted a cross-major and cross-grade joint course, creating AI-generated content (AIGC) animations/videos and H5 pages around the theme of “Spring Festival.” A total of 11 tutors from both university and enterprise, and 99 students from majors including Internet and New Media, Intelligent Interaction Design, and Digital Media Art, jointly created eight short animations. Three of these works were launched on Xinhua News Agency's official platform during the 2024 Spring Festival, receiving over 4 million views. This joint course combined four courses: “Media Convergence” (Internet and New Media major course), “Design History” and “Digital Visual Communication Design” (Intelligent Interaction Design major courses), and “Creative Image Research” (Digital Media Art major course), attempting cross-major and cross-grade course linkage. It initially practiced the “Intelligent Interaction Design (AIGC)” progression from engineering embodiment to design implementation, and then to result incubation practice package, achieving good teaching effects in the field of digital space (see Figure 3).

(5) Design Implementation: BUPT–Ant Financial “Ant Design Joint Innovation Challenge”

Completely breaking professional and disciplinary boundaries and targeting the goal of teaching achievement incubation, Ant Financial, together with BUPT, Beijing Institute of Technology, and

Jiangnan University, held the "Joint Innovation Challenge." Three tracks were set up around Ant Financial's business characteristics: "Green Claims," "Ant Wealth," and "Intelligent Service Innovation (Voice)." Relying on the undergraduate course "Professional Internship" (part of the "Joint Practice" course in the new training program), after the preliminary presentations, enterprise designers and students formed teams to deeply refine the design schemes. They repeatedly won international top design awards, including the 2024 Red Dot Design: Best of the Best Award, two 2024 iF Design Awards, the 2024 IDEA Finalist Award, and the 2023 Good Design Award, truly realizing the co-creation of future consumer scenarios between universities and enterprises (see Figure 4).

Figure 3 animation screen design assisted by AIGC

Figure 4. AntSure GreenPost Insurance

5 "EMBODIED CO-CREATION BETWEEN UNIVERSITY AND ENTERPRISE" DESIGN TALENT CULTIVATION MODEL

Through the redesign of the professional cultivation plan and the construction, exploration, and continuous improvement of co-creation workshops, leveraging resource advantages and long-term mechanisms, and engaging in deep cooperation with more top enterprises, we have explored relatively stable product design and training directions and developed interdisciplinary and cross-major integration projects. This has gradually formed a university-enterprise co-creation operation model characterized by teacher leadership, student self-management, flexible timing, and demonstrative effects.

Based on industry-education integration, by creating embodied practice environments corresponding to four modules and constructing a design talent cultivation model, we have not only overcome the limitations of traditional teaching systems by applying advanced cognitive education theories throughout the knowledge chain and progressive practice links but have also developed practical structures of "embodied modules" according to local conditions. Progressing from experitial basis, advanced learning, engineering embodiment to design implementation, we have enhanced students' "craftsmanship spirit," providing a new approach for aligning with industry leaders and cultivating high-quality young talents.

At the same time, by constructing a co-creation teaching model of industry-education integration, leveraging enterprise resources to link courses and practical teaching components, and building training camps and workshops to form hierarchical ability cultivation—where university teachers and enterprise mentors jointly guide training camps and co-create with students in subsequent advanced workshops—we enable students to adapt to the rapid changes in the demand for intelligent interaction design talents and interdisciplinary talents amid industrial upgrading and transformation, meeting the urgent need for shaping compound talents in the future.

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