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Study on the Construction and Verification of CDIO Teaching Model Based on AI Virtual Scene Data Feedback

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Abstract: Combining the characteristics of the course "Comprehensive Training of E-Commerce Live Streaming," this paper embeds the CDIO (Conceive-Design-Implement-Operate) method into the live streaming training process, carries out the virtual scene "e-commerce live streaming" course design and project-based teaching reform that integrates teaching training with learning effects, and establishes a set of cross-professional student live streaming training procedures guided by the CDIO engineering method. The training results show that the CDIO practical teaching model supported by data feedback plays an important role and significance in improving students' learning effects, and also provides some new experiences for integrating engineering thinking into the construction of new liberal arts.

Keywords: CDIO; Teaching model; Construction and verification

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1. Research background

In the digital intelligence era, people need to master not only good technical knowledge but also a series of skills and knowledge in personal development, interpersonal communication, professional competence, and product and system construction [1]. Global technological progress is challenging and reshaping the traditional paradigm of pedagogy [2], and the CDIO (Conceive-Design-Implement-Operate) model has become one of the new methods in higher education [3]. The 2024 National Education Work Conference proposed to comprehensively improve the quality of independent talent cultivation and strengthen the training of outstanding engineers and top talents in basic disciplines [4]. Therefore, actively integrating engineering thinking is the need of the times. The CDIO teaching model is a talent cultivation model that takes engineering competence as the core and focuses on students' ability development. It not only defines the knowledge and skills that engineers should possess but also includes the process of conceiving, designing, implementing, and operating in enterprise and social environments. One of the key concepts of CDIO is to integrate personal skills and attitudes into practical training, systematically construct the thinking of the product lifecycle [5], and promote interdisciplinary teaching and active learning. In the general trend of the transformation of new liberal arts, the combination of theoretical

teaching and practical training is crucial. The development of educational technology has also promoted the "absent" education of new liberal arts, extending the educational space from a physical form to a virtual form, and forming a new educational ecology of interaction between virtual and real. This puts forward new requirements for college teachers' educational concepts, teaching methods, and teaching effects. Therefore, it is very necessary to introduce the CDIO system of engineering education concept to specifically guide practical teaching in the special training of e-commerce live streaming.

2. Introduction to the CDIO model

In October 2000, four universities—Chalmers University of Technology, KTH Royal Institute of Technology, Linköping University, and the Massachusetts Institute of Technology (MIT)—launched an international cooperative project. This project primarily emphasizes the education of fundamental engineering knowledge in the context of Conceive-Design-Implement-Operate (CDIO) for real-world systems and products, aiming to improve undergraduate engineering education in Sweden, the United States, and globally. The main objectives of the CDIO model are to educate students to: master solid fundamental technical knowledge; lead the development and operation of new products and systems; and understand the importance and strategic value of their future work [6]. Rapidly changing technological and social demands require our curriculum development to move toward sustainable technology directions. It is necessary to explore more suitable innovative educational models and propose a CDIO system adapted to the context of our professional courses. The CDIO model's teaching philosophy integrates the cultivation of personal competence, attitudes, and interpersonal skills into teaching and practical training programs through clear plans, with learning achieved by constructing processes and systems.

2.1. Integration of the CDIO model and practical training courses

The e-commerce live streaming practical training process is divided into several stages, including market analysis and research, general plan demonstration and design, live streaming script design, system assembly and debugging, user and after-sales analysis, and on-site system demonstration in the laboratory. Each team member's performance is evaluated through peer assessment and teacher evaluation. To achieve good live streaming results, each step in the process is timely adjusted and improved based on real-time data, enabling students to understand that the application of e-commerce live streaming is an iterative and continuous improvement process (**Figure 1**).

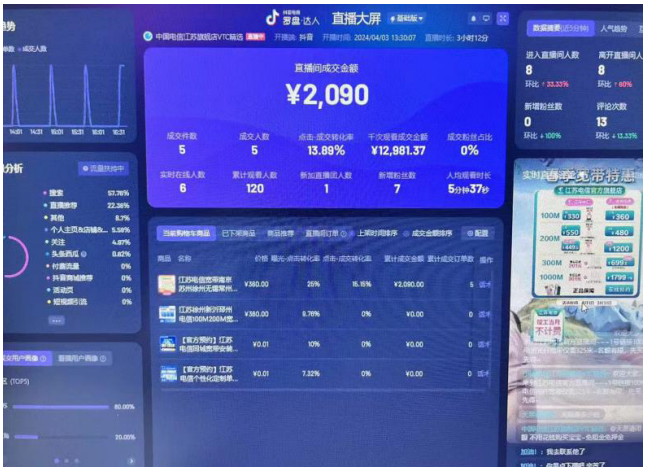


Figure 1. Display of live streaming real-time data

2.2. Practical training teaching framework

The live streaming practical training covers the basic knowledge and abilities required for e-commerce live streaming on Douyin. This training is composed of eight members, who are required to design the complete e-commerce live streaming process, from the start of the live stream to the sale of goods. The main control device is the e-commerce live streaming software. The specific practical training framework is shown in **Figure 2**.

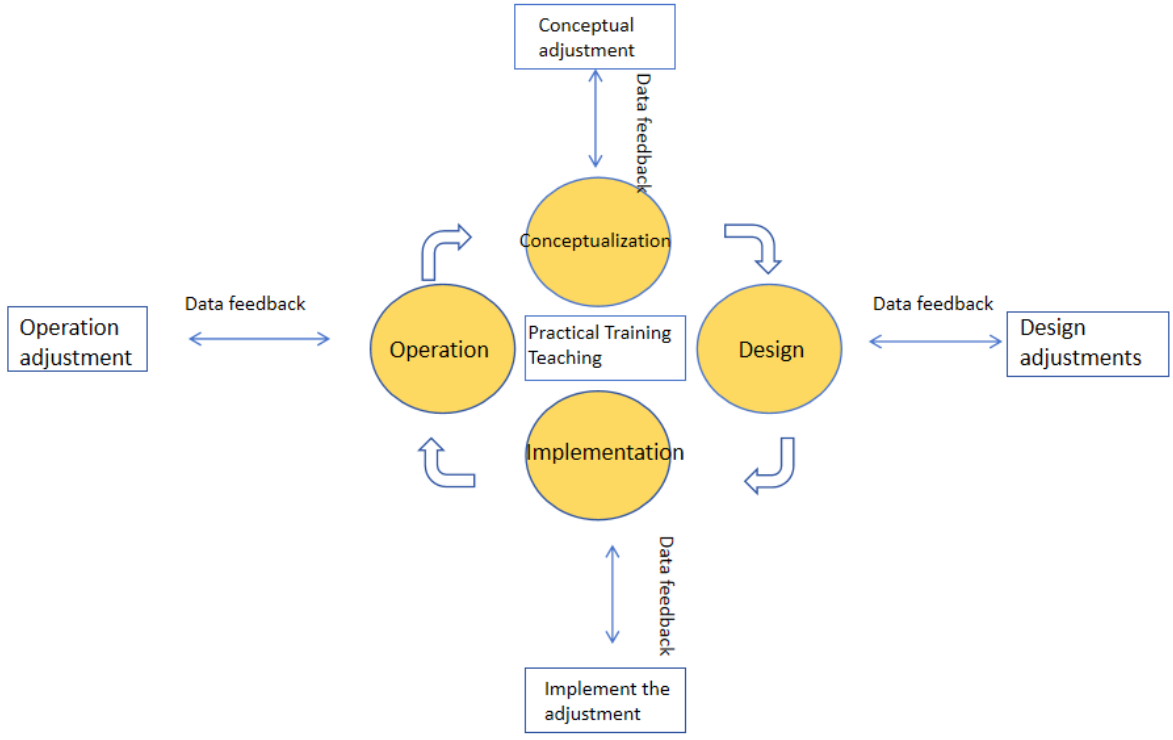


Figure 2. Practical training model with engineering competence as the core

2.3. Explanation of the four stages of CDIO in practical training

2.3.1. Conceive stage

First, review basic e-commerce live streaming courses, such as the basic concepts, models, and processes of e-commerce, to provide a macro theoretical framework for live streaming sales. Second, learn the characteristics, trends, and operation strategies of new media to adapt to live streaming as a new media form. At the same time, understand the basic principles, technologies, and platform rules of live streaming, master effective sales methods and negotiation strategies to improve the product promotion effect during live streams, and participate in conceiving the design of the entire process of current live streaming commodity sales.

2.3.2. Design stage

Apply the learned knowledge to the Douyin live streaming process. This stage requires designing all links of e-commerce live streaming sales and continuously optimizing and iterating each link process to meet sales volume requirements. The specific design work includes: planning video content; writing live streaming scripts; preparing product inventory; debugging technical equipment; operating the live streaming account; and iterating based on data feedback.

2.3.3. Implement stage

In the implementation stage, it is necessary to transform design concepts into practical operations. The specific practical processes are as follows:

(1) Establish a live streaming team: Recruit anchors, assistant anchors, operation personnel, customer service personnel, etc., and clarify their respective responsibilities.

(2) Scene setup and equipment testing: Set up an attractive live streaming scene with high-definition cameras, microphones, lighting equipment, etc., and test the stability of the live streaming platform.

(3) Script writing and traffic-driving plans: Prepare scripts for opening, product introduction, interaction, promotion, and ending to ensure the fluency and coherence of the live stream.

2.3.4. Operate stage

In the operation stage, attempt to solve various problems arising in the live streaming process to cultivate problem-solving skills and teamwork ability.

2.3.4.1. Warm-up opening

The anchor warmly welcomes the audience, introduces themselves and the live streaming theme, and emphasizes the preferential activities and benefits of this live stream.

2.3.4.2. Product display and introduction

Display and introduce the product's features, functions, usage methods, and advantages in sequence.

2.3.4.3. Interaction

Interaction includes off-site operation interaction and online audience interaction. At the same time, lottery draws, Q&A activities, etc., are carried out to increase audience participation.

2.3.4.4. Promotion drive

Comply with Douyin rules and combine limited-time offers, discounts, full reductions, free gifts, and other activities to stimulate audience purchases.

2.3.4.5. Purchase guidance

Provide clear purchase guidance, such as links and order steps.

2.3.4.6. After-sales service

Handle issues such as audience returns, exchanges, and complaints to maintain a good brand image.

2.3.4.7. Data analysis and feedback

Analyze live streaming data (such as number of viewers, sales volume, conversion rate, and audience retention time), collect audience feedback, summarize experience and lessons, and provide a data basis for improving the next live stream.

3. The specific practice of the CDIO model in e-commerce live streaming

3.1. Construction of an embodied learning environment

3.1.1. Theoretical basis: Situated cognition theory

Situated cognition theory holds that the essence of learning is a process in which individuals participate in practice and interact with others and the environment. Situated learning is a design process that summarizes learning conditions and accelerates learning, as well as a process for individuals to develop practical activity capabilities and improve social skills. It embodies the characteristics of situated learning, authenticity, guidance, practicality, inquiry, reflectivity, negotiability, motivation, and initiative [7].

3.1.2. Practical basis: Construction of an embodied learning environment

The embodied learning environment refers to a learning environment with multiple embedded features (mind embedded in the brain, brain embedded in the body, and body embedded in the environment) established under the integration of body and mind, and the unity of subject and object based on the embodied cognition theory. It mainly consists of physical environment, resource support environment, social and cultural environment, and emotional and psychological environment. Different from traditional cognitive theory or modern cognitive science, embodied learning emphasizes the important role of the learning environment in the process of changes in students' individual cognitive structures [8]. The specific implementation site of this project is located in the E-commerce Live Streaming Space of the XR Virtual Laboratory, School of Journalism and Communication, Nanjing Xiaozhuang University. The detailed physical environment support is shown in **Figure 3**.

Figure 3. Live streaming training laboratory

3.2. Practical training under the CDIO model

The practical training content involves introducing relevant broadband products in the official live streaming room of China Telecom Jiangsu Flagship Store. Adopting the CDIO model, this training emphasizes comprehensive curriculum-based practice to promote interdisciplinary active learning among students. It is composed of eight students from different majors, who are required to design the complete e-commerce live streaming process and achieve certain sales results. The specific implementation period of the project is from March 25, 2024 to April 30, 2024. Practical teaching sessions for the eight interdisciplinary students are held on Monday, Wednesday, and Friday afternoons from 13:30 to 16:30, and on Saturday and Sunday afternoons from 14:00 to 19:30. The project lasts for a total of five weeks, with one instructor each from the cooperative company and the college providing guidance to the students.

Throughout the training, students gain an understanding of the iteration and continuous improvement process of e-commerce live streaming, and experience various issues arising in e-commerce operations, including equipment debugging and use, training on makeup and clothing (with emphasis on not wearing green), adjustment of live streaming scripts (familiarization with product content + welfare distribution + operation interaction methods + user interaction methods), and replacement of live streaming room patches. See **Figures 4–6**.

Figure 4. Training Douyin live streaming room

Figure 5. The current situation of the first Douyin live broadcast

Figure 6. Adjustment of ad placements in the live streaming room

3.3. Specific competency training process: Taking communication as an example

Communication is a fundamental skill trained in projects. Whether within the project team or with clients, communication skills are developed by presenting ideas and solutions to each other or clients, thereby acquiring technical communication capabilities [9]. The widespread application of information and communication technologies has made virtual communication gradually become the primary communication method in organizations. Compared with traditional face-to-face communication, virtual communication features cue filtering, geographical dispersion, and asynchrony [10], which greatly reduces the constraints of social norms during communication between parties, but may also lead to interruptions in the communication feedback process.

During project execution, specific communication methods are divided into verbal communication, camera communication, and online-offline collaborative communication, etc. At the start of a live stream, the product link is first introduced, and the advantages of telecom broadband (product advantages) are promoted simultaneously. Special attention should be paid to user comments, and one-on-one communication should be carried out with users. During the live stream, it is more important to introduce product functions based on user needs and actual scenario conditions (single person, two people, family, office, etc.), while identifying benchmark accounts and imitating their language systems. In terms of collaborative communication, operation team members need to reply to questions promptly, maintain the popularity of the comment section, and

help the Douyin platform attract traffic for views and consumption. Throughout the live stream, the language system needs to be proficient; in particular, various interactive languages such as dialects, nicknames, and colloquialisms should be used alternately. Hosts also need to pay attention to the use of extreme words when broadcasting, and operators should roll out some interactive text in the comment section.

4. Training effect evaluation

This training focuses on evaluating indicators related to the completion of actual tasks. A self-assessment tool related to the CDIO standards was selected, with some linguistic revisions made to adapt the standards to the current teaching and training environment.

4.1. Assessment scale tool

The CDIO training effect assessment scale includes five overall statements related to CDIO standards. For each statement, different levels of statements are provided in the table, and respondents are required to answer on a scale of 1 to 5 [11], where 1 represents "strongly disagree" and 5 represents "strongly agree" (see the attached scale).

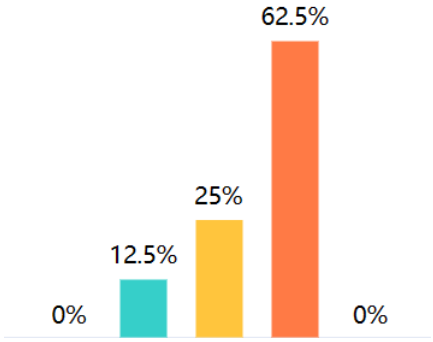
4.2. Teaching and training effect evaluation

In the assessment process, five dimensions of training objectives were designed, namely:

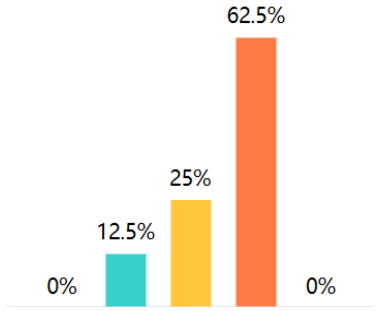
(1) Teamwork: This ability enables the team to have a certain degree of innovation; (2) Communication skills: Compiling detailed scripts to ensure the fluency and coherence of the live stream; (3) Personal professional skills: Students can flexibly apply skills learned in previous courses, such as online store setup and decoration, image processing, web production, and network construction; (4) Project conception and planning: Mastering knowledge and processes related to e-commerce live streaming and its related businesses, such as planning, design, and operation; (5) Specific design and implementation: Using basic knowledge of e-commerce live streaming operations to carry out content operations, activity operations, and customer operations to ensure live stream effects. The specific results are as follows (**Figure 7**):

Regarding teamwork and communication skills: 62.5% of students believed they had mastered these two skills; In personal professional skills training: 62.5% of students believed that their understanding of professional skills had improved through practical training; Students' understanding of project conception and planning capabilities, as well as specific operation and implementation capabilities, also improved after training, with an average improvement rate of 37.5%. Notably, regarding teamwork and communication skills, students did not believe that these abilities could be transferred to other projects after training. However, 25% of students believed that project planning capabilities and specific operation and implementation capabilities were transferable.

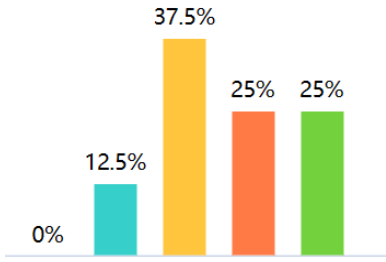
According to the radar chart of training effectiveness (**Figure 8**), it is suggested that this training course should align with the trends of e-commerce live streaming, adopt a "virtual-driven-real" approach, and customize CDIO growth channels. For example, the course can be divided into project planning orientation (focusing on personal abilities) and project operation orientation (focusing on teamwork). Meanwhile, during project practice, the project process should be monitored to help students plan their own knowledge, skills, and competencies, laying a solid foundation for their future graduation projects and careers.



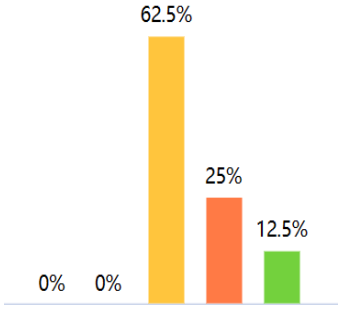
(1) Teamwork ability



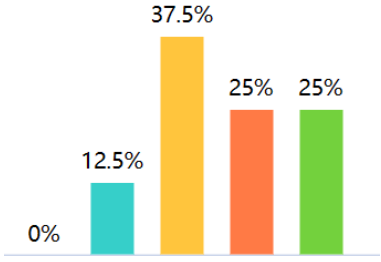
(2) Communication skills and abilities



(3) Personal professional skills



(4) Project concept planning ability



(5) Specific operational implementation capabilities

Not applicable. This skill is not required for the project.
Your understanding of this skill has improved...
Your comprehension of this skill has enhanced...
You have learned to use this skill very well.
You can apply this skill to other...

Figure 7. Visualization of training effect data

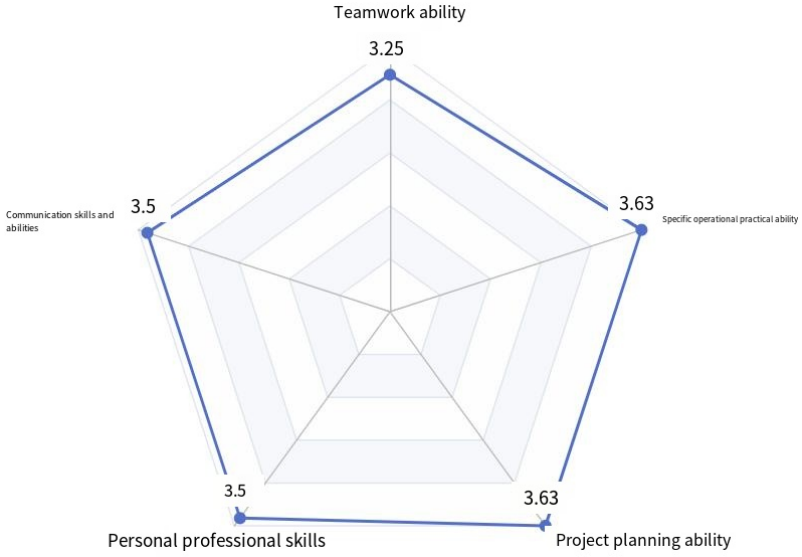


Figure 8. Radar chart of training effects

5. Conclusion

This paper explores the construction of a data-driven CDIO training concept system for e-commerce live streaming through training examples, clarifies the course construction direction for cultivating students' abilities at different levels, and represents a beneficial attempt to integrate engineering thinking into liberal arts training teaching, which is conducive to cultivating students' innovative awareness and comprehensive quality. In the current environment of continuously developing new productive forces, the exploration of data-driven training models is indispensable. The CDIO teaching and training method integrates technology and digital education into new liberal arts teaching and training, strengthens the relationship between liberal arts education and the industry, and also serves as an exploration and practice of training teaching under the guidance of the concept of industry-education integration.

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Disclosure statement

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