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Basic Courses of Design Major Based on the ADDIE Model: Shed Light on Response to Social Trends and Needs

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Abstract: Social innovation leads to more diverse methods for design education, which helps design education response to social trends and needs. Social change has brought about the transformation of teaching objects for design education courses, which can provide the public with more opportunities to recognise and understand design. Through the introduction of the ADDIE (analysis, design, development, implementation, evaluation) model in teaching design pattern through social innovation, this paper explores the system design construction of a design education course. Using the teaching practice for the course “Three-dimensional Composition” in the product design major at Tianjin University of Technology as an example and relying on a process of analysing, designing, developing, implementing and evaluating, this paper launches a design plan for design education courses. Students’ learning satisfaction is used to measure the course design, and the latest course works of applied research results in 2020 will be displayed to show students’ self-confidence and satisfaction after class. The research described in this paper attempts to construct the teaching design of design courses based on the ADDIE model. It is intended to analyse the multi-dimensional connection of design education: meeting the expectations of college students seeking to acquire design knowledge and social experience, cultivating students’ interest, and enhancing their design achievement and confidence. Moreover, this paper seeks to shed light on ways to reform design course teaching so that the design education results are more in line with the needs and expectations of the times and society.

Keywords: social innovation; design education; ADDIE model; teaching practice; course design; learning satisfaction



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1. Introduction

1.1. Research Background and Motivation

Time to change design education [1]. Moreover, it gets a new approach in which everyone can participate in design. Meanwhile, we need to rethink the role of design and designers, as well as cultivate new knowledge and skills that can better serve our modern world. We also need to prepare for constructing a sustainable, resilient social culture and new civilisation [2].

Design education has ushered in many changes and challenges in the context of social innovation. Designers must pay attention to organisational structure and social issues [1]. Design education is already an instrumental force among business and business schools and is a highly desired skill among employees [3]. Over time, the requirements and opportunities for design have expanded dramatically. The most valuable elements of the designer’s perspective and process, however, are seldom taught [4]. Design discipline faces current and ever-changing global challenges, which, when successful, leads to development and adaptation to the field. The change in the demands for design personnel requires design education to make the corresponding changes and transformations to suit the challenges of the time [5]. Design education must ensure that course content and delivery is relevant to

the needs of industry [6]. Chinese design education has experienced three discrete stages of rapid expansion, development and discipline transformation [7]. Design education combines technological change, social transformation and international competition to meet the needs of society. It results in the cultivation of innovative national strategy and industrial development [8]. Successful design education needs the participation of colleges, teachers, students, industry organisations, enterprises and the public. As such, through the reform of design course teaching in design colleges, socialized design education is continuously promoted.

Today, “social innovation” often occurs via the popularisation of smart devices, the Internet of Things, Virtual Reality, 5G networks, and Artificial Intelligence, as well as the improvement of urban public cultural facilities, the extensive construction of urban commercial complexes and the spurt of self-media development. Social innovation provides more opportunities for design education; as such, design education has been transformed by social trends. Various social changes, such as the improvement of public awareness of design and increased demand for design in the industry, have promoted the transformation of design education. Social change has brought about the transformation of teaching objects for design education courses, so that more people have the opportunity to understand the design and, at the same time, it has expanded the voice of designers in social development. With regards to classroom teaching, however, the teaching objects are students in school; as such, traditional design education lacks opportunities to communicate with society, enterprises and industries. It is therefore difficult for teaching results to be evaluated by society.

The present research uses social innovation to make use of collaborative design and participatory design [2]. Through the five stages of the ADDIE teaching model analysis (i.e., analysis, design, development, implementation and evaluation) [9], we explore the design foundation of basic design courses. The ADDIE model is applied to the foundation of basic design courses, and the course design evaluation is carried out based on students’ learning satisfaction through the implementation process of course teaching. One 2008 case study was conducted to test a course design in art design education by applying the ADDIE model and measuring learning achievement [10]. The ADDIE teaching model was applied to the design education course to understand the integration of practical ability cultivation within the design discipline and concerning industrial development in response to social demand. It was further used to analyse the course objectives and students’ needs throughout the course design process. Reasonable application of social transformation and technological change was brought about by various media, industry associations, other social organisations and the use of social network platforms. Meanwhile, it makes full use of social resources to organise professional teachers, complete course design, and develop, implement, and conduct course design evaluations to achieve the goal of cultivating compound innovative talents in design education.

1.2. Research Purpose

The present research uses as an example of the teaching practice of the course entitled the “Three-dimensional Composition” course within the product design major at the Tianjin University of Technology. We aimed to develop and implement a course design based on the ADDIE model. During the autumn semester of 2018, the ADDIE model was applied to the sophomore course of product design. We attempted to use social media, collaborative innovation teaching based on cross-professional teachers, the online MOOC (Massive Open Online Course) platform [11,12], industry association networks, public works design exhibitions and other diversified design course designs. We further attempted to develop a design education course based on the ADDIE model to achieve multiple connections with design education, meet the design knowledge acquisition and social experience goals of college students, and try to contribute to the promotion and application of design course teaching.

The purpose of this study is: (1) design a course according to the ADDIE model; (2) evaluate the effect of the course design through learning satisfaction; (3) summarise the application methods of the ADDIE model.

2. Literature Review

2.1. Social Innovation

Nearly 50 years ago, in *Design for the Real World*, Papenek proposed improving social balance through a new design agenda [13]. Social innovation is distinctive both in its outcomes and in its relationships, because it often leads to new forms of cooperation and collaboration [14].

Social innovation results not only in the rapid development of the social economy, but also in changes to human lifestyles that penetrate all aspects of life. In the context of social innovation of “mass entrepreneurship and innovation by all people,” the public is full of enthusiasm for product innovation and industrial innovation. At the same time, the demand for experience and participation in design is also becoming stronger [15]. Social innovation design is a form of design that combines social resources and public service. It can be applied to social organisations and the internet to help solve various social issues and promote social development [16]. Socially responsible design and need-induced design are important for training design talents in higher education. Students in the design department should be aware of the potential impact of their professional activities and make positive contributions to global communities [17]. With the process of social innovation, the public pays more attention to the creation of a social design culture [18,19]. In this way, everyone can design and redesign their existence [2].

In the context of social innovation, design education is increasingly a field that impacts the general public. From living quarters to schools, online courses to self-media sharing, design art exhibitions to commercial cultural facilities, design can reflect the cultivation of aesthetics in society and promote public participation in design. In turn, design can respond to the needs and desires of society. Design education has gradually evolved into a model built on the social network, which is, essentially, a design education for the general public. Through government guidance, media promotion and public participation, it can enhance the overall sense of design identity and design innovation. It aims to improve the degree of social innovation and development to promote industrial improvements through the cultivation of aesthetics and design skills. Design education starts with the education of the young to cultivate design interest and popularise design knowledge through educational media. It also extends the learning environment through the concept of Community-Based Education and Service, and results in educating the general public through public cultural facilities [20,21].

2.2. ADDIE Model

The ADDIE model of instructional design is a five-step process to developing iterative learning and training activities. ADDIE stands for analysis, design, development, implementation and evaluation, the five stages of the teaching process. In 1978, Branson used ADDIC (analysis, design, development, implementation, control) as interservice procedures for Instructional Systems Development for different branches of the U.S. military [22,23]. The ADDIE model was later adapted and applied to teaching design, where it was equally useful and practical [24].

Analysis refers to the analysis of objectives, objects, contents, requirements, resources and tools of teaching design at the beginning of teaching design. Teaching analysis enables us to match the contents of teaching design development of the teaching activities and needs and, ultimately, achieve good results. Content design, including teaching methods, field, process and time planning of the teaching course, ensures proper interaction and organisation of the various stages of teaching implementation. Development uses modern information and training platforms to provide the content of teaching courses and process needs to promote teaching results. Implementation refers to the stage of practical applica-

tion of course teaching, the necessary supporting measures for the use of course teaching, the cooperation of teaching team, hardware facilities, teaching environment to achieve the purpose of teaching. During the evaluation stage, emphasis is placed on formative evaluation to make improvements to the teaching course, summary evaluation to describe learning satisfaction and outcomes. Evaluation is helpful for the systematic improvement of teaching courses and the revision of insufficient content. It is also the standardisation and value evaluation of teaching course. Generally speaking, the ADDIE teaching model is designed to provide systematic planning indicators for teaching designers to ensure the quality of teaching design results [7,25,26]. The ADDIE model has effectively created the process of teaching activities in higher education, and, meanwhile, it has provided a clear structure of teaching design to higher education teachers [27].

2.3. Learning Satisfaction

Learning satisfaction is generally used to measure learning outcomes in the learning environment (Piccoli, Ahmad, and Ives 2001). Scholar Gordon (2001) pointed out that learning satisfaction is a systematic process that helps to improve learning outcomes and allows learners to enjoy learning experiences [28,29].

In this study, learning satisfaction was considered to be the learning experience after the design of the course was updated based on the ADDIE model. The experience of learning, as well as whether individual learning needs and learning objectives were met, was analysed through a questionnaire about learning satisfaction.

Fujca-starck and Thompson (1994) studied adult learning satisfaction and learning activities using six aspects: course quality, atmosphere, teacher–student relationship, peer relationship, support system, and physical environment. Yu-Xiang (2002) divided learning satisfaction into six categories: learning environment, school administration, teacher teaching, course content, learning outcome and interpersonal relationship. Tongmiao (2011) claimed that learning satisfaction is divided into six aspects: teacher teaching, course identification, interpersonal interaction, social care, problem-solving, and self-realisation [30–32]. In keeping with Yu-Xiang and Tongmiao, this study divided learning satisfaction of a design education course into the teaching field, group, methods, achievements, goals and participation, as shown in Table 1.

Table 1. Analysis of learning satisfaction literature.

Source	Discourse on Learning Satisfaction	Research Object
Piccoli, Ahmad & Ives (2001)	Variables used to measure learning effectiveness in the learning environment	Student
Gordon (2001)	A systematic process that helps to improve learning outcomes and enables learners to experience learning	Student
Fujita-Starck & Thompson (1994)	Course quality, atmosphere, teacher–student relationship, peer relationship, support system, physical environment equipment	Adult Student
Huang Yu-Xiang (2002)	Learning environment, school administration, teacher teaching, course content, learning outcomes and interpersonal relationships	Community Student
Chang Tongmiao (2011)	Teacher teaching, course identification, interpersonal interaction, social care, problem-solving, self-realisation	College Students
Present study (2020)	Teaching field, teaching group, teaching methods, teaching achievements, teaching goals, teaching participation	College Students

3. Course Design Methodology

In keeping with the ADDIE model, this study divides the basic course design into five stages: course analysis, design, development, implementation and evaluation. This study takes a popular course in design education as an example, elaborating on its design process using the ADDIE model.

The course “Three-dimensional Composition” for product design majors at the Tianjin University of Technology is based on the teaching practice of the ADDIE model. As one of three basic courses of design, “Three-dimensional Composition” is scheduled for the second semester of college, and it is an important basic course for the construction of three-dimensional (3D) design thinking in product design. The course has existed in the Tianjin course catalogue for nearly ten years. Through this course, the interdisciplinary and multi-teaching model of “schools—enterprises, schools—industry associations, learning—exhibition” was established. Course teaching is based on the concepts of social innovation technology application, collaborative innovation, cross-border integration, and sustainability. The comprehensive course system was designed to meet the goals of design knowledge acquisition and social experience development for students, and tried to make some contributions to the teaching promotion and application of design courses, as shown in Table 2.

Table 2. Course design methodology.

Research Method	ADDIE Model Stage Steps		Course Design Content
	Course Analysis		The uniqueness of the course
			Student needs analysis
			Course design classification
	Course Design		The identity of course design participants
			Determination of course teaching structure
	Course Development		Construction of the course network platform
			Introduction of business issues

3.1. Course Analysis

3.1.1. Course Uniqueness

The “Three-dimensional Composition” course is a compulsory course for design majors at the Tianjin University of Technology, an optional course for other majors, and one of the core courses for those who specialize in product design at Tianjin. It is the main basic course for the study of 3D modelling. The course enables students to grasp the material characteristics of blocks, wires, plates and construction, as well as shapes and processing methods. It can also cultivate students’ spatial imagination, aesthetics, and creative thinking to lay a foundation for future courses in product design [33].

The course design uses the ADDIE method and focus group discussions to carry out the design process in two stages. In the first stage, the design of the course’s teaching model is explored through the ADDIE model. In the second stage, analysis and focus group discussions are conducted in the form of a teaching meeting [34].

The teaching goals of the “Three-dimensional Composition” course are to expand and improve students’ imagination of shapes through the analysis of and research about the creation law of stereo form, to explore and cultivate students’ ability to create 3D shapes, and to improve the aesthetic and aesthetic abilities of abstract forms. All of these goals centre around laying a good design foundation for students to enter the professional field of design. After many years of teaching practice, it has been found that students with lower grades need to fully understand design, not just the teaching goals of the course. This course can help students to define learning goals in the future and cultivate professional interests. After many attempts and improvements, the course teaching has

been adopted through trade associations and the establishment of course websites, but it still lacks systematic course planning and design. After the introduction of the ADDIE model, the course design was planned comprehensively and systematically. The course aims to function with “art worker’s combination,” together with local industries; as such, students can better understand product creation and innovation based on market demand. School-enterprise cooperation in education results in social education and ultimately make the design course audience more extensive.

The teaching design combined with the ADDIE model divides teaching objectives of the course into five categories: material cognition, 3D modelling performance, creative ideas, creative performance, and evaluation of course outcomes, as shown in Table 3.

Table 3. Course objectives.

Phase Steps	Course Targets	Details
1	Material recognition	Knowledge and exploration of paper
2	3D modelling performance	Construction and implementation of three-dimensional structure
3	Creative ideas	Ideas for paper theme design
4	Creative performance	Performance of paper-fitting theme design
5	Evaluation of course outcomes	Exhibition of course achievements

3.1.2. Analysis of Students’ Needs

Before the start of the course, according to the relevant literature and experience summarized in teaching practice, a survey of learning needs was conducted for the members of seven classes in the 2017 product design major. The class meeting, assignment notices, and assignment collection in the class were completed by the monitor and study members, because they understood the needs of the student group and are representative. The survey was conducted in the form of a group discussion, focusing on the “Three-dimensional Composition” course involving people, objects, environment, teaching field, teaching teachers, teaching methods, teaching results and teaching objectives.

Through a seminar, the teaching team sought to understand the needs of the student representatives in each class, as shown in Table 4.

Table 4. Analysis of students’ needs.

Serial Number	Discussion Topics	Students’ Needs
1	Teaching Field	Expectations for the course’s online delivery platform
		Looking forward to the opportunity to teach in out-of-school enterprises
		Expect courses to be extended off-campus
		Expect more fields for design research
		Expect design materials to be taught outside the school
2	Teaching Staff	Expect teachers from different professional backgrounds
		Expect professionals from the enterprise to teach together
		Expect the involvement of cross-disciplinary teachers
		Expect teachers with an overseas background
3	Teaching Method	Expect more creative thinking guidance
		Expect a livelier classroom atmosphere
		Expect to have the opportunity to learn and extend after class

Table 4. Cont.

Serial Number	Discussion Topics	Students' Needs
4	Teaching Achievements	Expect less homework
		Expect the course results to be seen by more people
		Expect more people to learn about our courses
		Expect not to spend too much
5	Teaching Objectives	Expectation of design materials
		Expect an understanding of three-dimensional form
		Expect to be helpful for product design
		Expectations that can help the development of design thinking

3.1.3. Classification of Course Design

Design education driven by social innovation integrates the educational environment (school), industrial environment (industry), social environment (online), and social-cultural environment (cultural venues) of social innovation. Design education can further popularise design knowledge and improve people's aesthetic level to promote everyone to be designers and, meanwhile, can promote social innovation. Easterday (2018) divided social design education into four categories: (1) social innovation networks; (2) project-based learning; (3) studio-based learning environments; 4) network improvement community [20].

Given the teaching objectives and student needs in the course "Three-dimensional Composition," combined with the teaching methods and environment of design education, the courses are classified as shown in Table 5.

Table 5. Course Design Classification.

Course Design Classification	
Category	Form
Classroom teaching	School education environment
Online teaching	Network communication environment
Industry teaching	Industry environment
Show Teaching	Public venue environment

Classroom teaching in the school environment is a basic form of university education. Online teaching is a social inclusive education model under the development of MOOCs, and a social way of teaching and learning. Industry teaching is an extension of the teaching method based on Problem-Based Learning (PBL) [35], which was used in the project but is also commonly used in the industry so that the course and industry share a platform. Performance teaching is an extension of the course vision, with a variety of intersections with performance, display and interaction, so that students get a sense of design identity and at the same time improve their design communication.

3.2. Course Design

The course is designed around the teaching objectives and the needs of students through focus group discussions with the teaching faculty. Finally, the teaching mode of 3D design is determined.

3.2.1. Determine the Participants of the Course Design

The participants of the course design are composed of seven class teachers and three off-campus tutors. Ten teachers jointly developed and implemented the teaching course structure, as shown in Table 6.

Table 6. Basic information for teachers.

	Coding	Name	Profession	Teaching Tasks
School Teacher	Z_L	Z-Professor	Product design Design education	Course planning and teaching
	L_Y	L-associate professor	Product design Design Culture Studies	Course leader and teaching
	W_L	W- associate professor	Exhibition space design Design education	Courses
	L_Z	L-associate professor	Human factors engineering Smart product design	Courses
	Z_Q	Z-lecturer	Ceramic art design Public art design	Courses
	W_H	W-lecturer	Service design User experience design	Courses
	Z_X	Z-associate professor	Product design Service design	Courses Author of this article
	Z_H	Professor Z	Costume show Image design	Costume Tutor
Off-campus Teacher	Q_S	Professor Q	Fashion design	Costume Design Instructor
	X_B	X Engineer	Mechanical design	Industry Mentor

The seven on-campus teachers graduated from different universities and have rich experience in product design, display design, service design, and many additional fields. They graduated from well-known institutions around the world, including Bauhaus Design Institute in Germany, Dongseo University of Korea, Renmin University of China, Hunan University, Jiangnan University and Tianjin Academy of Fine Arts. The teachers' educational background, professional situation and teaching time affect their teaching quality, content and impact. The seven teachers had an average of 13 years of experience. The rich teaching experience and diverse professional backgrounds of the professors played a positive role in the design and implementation of course teaching. The three out-of-school teachers were in three different fields, two were professors from Tianjin Normal University and Tianjin University of Science and Technology, and one was the head of the Tianjin Bicycle Electric Vehicle Industry Association. They conducted professional guidance and training on the design and performance of clothing in the course, and guided the application of on-site effects and the exhibition of trade.

3.2.2. Determination of Course Teaching Structure

The focus group discussion was conducted by ten participating teachers, both on- and off-campus, and a teaching conference was held in conjunction with the teaching goals and student needs. The course structure, themes, and arrangements were jointly determined. Through the summary and review of the previous years, the industry association proposed the project requirements for the Tianjin North International Bicycle and Electric Vehicle Exhibition. That company provided a social teacher to join the course teaching conference

and joined participating teachers in discussions about the course structure, as shown in Table 7.

Table 7. Transcript for teaching meetings.

Project	Teacher	Teaching Meeting Minutes
1	Z_L	Demand introduction of Industry Association and combination of production, learning and research
2	L_Y	Social education, design communication
3	W_L	Exhibition effect and presentation
4	L_Z	Theme determination, smart manufacturing, green, sustainable
5	Z_Q	Practical Teaching, Art and Technology, Art and Craft
6	W_H	Combination of online teaching, online education and offline education
7	Z_X	Cross-domain integration, integration of different professional knowledge
8	Z_H	The introduction of costume expertise
9	Q_S	The introduction of fashion design expertise
10	X_B	Requests for Tianjin North International Bicycle Electric Vehicle Exhibition

After focus group discussions, the teaching design framework for the course was established, as shown in Figure 1.

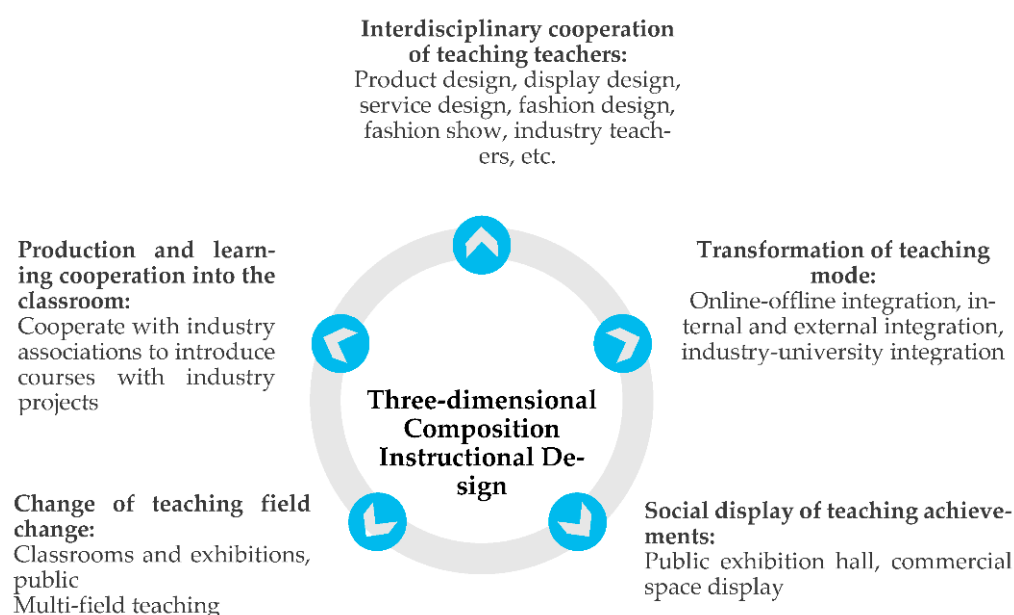


Figure 1. Instructional Design Structure of the Course “Three-dimensional Composition”.

- (1) Interdisciplinary cooperation of teaching teachers: combination of various professional fields.

Product design majors receive training with diverse educational content such as fashion design, fashion show design, exhibition design, stage art design, etc.

- (2) Transformation of teaching mode: offline education combined with online education.

The course network teaching platform is supplemented by the offline educational content and provides a learning and discussion platform. Through the platform, the

following were set up: professional introduction and teaching teams, course introduction and teaching documents, course and teaching videos, teaching and practice results of recent years, course teaching material data, design competition information and award-winning works, peer evaluation, teaching material and interactive columns (e.g., homework submissions and Q&As).

- (3) Production and learning cooperation in the classroom: the combination of university course education and industry alliance education.

The combination of the university course education and the trade association, together with the introduction of the resources of industrial associations, have had a positive impact on academic talent and industry. At the same time, it has realised a docking platform for academic course and corporate or industry needs.

- (4) Social display of teaching achievements

The teaching results of the course are produced at the campus and displayed to society. The course results are used to educate the public about design knowledge, and also to allow students to impart relevant knowledge learned in the course to the public. As such, the dissemination of design knowledge for social audiences is complete.

- (5) Change of teaching field: the combination of teaching displays in the school and social public exhibition spaces

Students and teachers take the coursework out of the classroom, participation in international exhibitions, displays in commercial spaces, and other external-facing exhibitions. Course teachings are brought to a public space and thus face more audiences.

3.3. Course Development

3.3.1. Construction of Course Network Platform

The course network platform, as a necessary component of the course network, was the foundation of the MOOC teaching and one of the responses to student needs. During the course, the network platform accumulated 2000 clicks. The settings of the platform included professional introduction and teaching team, course introduction and teaching documents, course materials and teaching videos, teaching and practice achievements of recent years, design contest information and award-winning works, peer expert evaluation and interactive Bulletin Board System (BBS).

The course videos and teaching practice results were the most-clicked columns on the website. The assignments and discussions provided in the interactive BBS and Q&A provided students with an after-school communication area.

3.3.2. Industry Association-Based Learning (IBL)

Tianjin is the most important manufacturing and export base of China's bicycle and electric vehicle industry [36]. Adhering to the principle of education for serving local industries, it actively serves the local industries. The course invites the Tianjin Bicycle and Electric Vehicle Industry Association to introduce industry needs based on the status of industry development. As such, the industry association introduces the teachers' resources and exhibition resources into the course. Using Tianjin North International Bicycle Electric Vehicle Industry Expo as the context, the course determined the theme of "Belt and Road-Green Manufacturing." It was agreed that the design consequences would be performed and displayed in the North International Bicycle Electric Vehicle Industry Expo.

4. Course Implementation and Evaluation

Course implementation and evaluation involved two stages, as in the ADDIE model. According to the design of an education course based on the ADDIE model, the course implementation stage is divided into two parts: the arrangement of course teachers and the arrangement of course teaching. Course evaluation includes a research sample, question-

naire composition and data analysis. Course design is evaluated by learning satisfaction, as shown in Table 8.

Table 8. Course implementation and evaluation.

Course Implementation and Evaluation	ADDIE Model Stage Steps	Course Design Content
	Course implementation arrangements	Course teacher arrangement
		Course teaching arrangement
	Course evaluation	Research sample
		Questionnaire composition
		Data analysis

4.1. Course Implementation Arrangements

According to the syllabus, the course has only 72 h in six weeks. However, we rearranged the whole course time according to the previous course design. According to the course design, the course is divided into three stages. The first stage is the teaching week of course planning. This stage takes a total of 72 h for six weeks in the course plan, mainly to complete the teaching and practice of the school courses. This stage consists of four focal areas: cognition (empathy), topic analysis (definition of problems), design conception (exploration of ideas), design presentation (design prototype) [37]. The second stage occurs after class training week. This stage mainly prepares and trains for the course verification and is also the transitional stage of the course. The third stage is social performance teaching week. This stage involves the demonstration of course products. The outputs of the course will be examined via the participation of the course works in the exhibition. At the same time, it is also the stage when outputs of the design education are displayed to the public.

4.1.1. Course Teacher Arrangement

During the 12 week teaching cycle, the course teachers participate in the whole process of guidance. W1–W6 is the teaching plan time in the syllabus, W7–W12 is the teaching time after class. According to the schedule for the three stages of the course, course teachers, costume design teachers, costume performance teachers, and industry association instructors were arranged at different stages of the course, as shown in Table 9.

Table 9. Course teacher arrangements.

Teaching Week	Lesson Plan Teaching Week						After-School Training and Teaching Week			Social Show Teaching Week		
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12
Course teacher	○	○	○	○	○	○	○	○	○	○	○	○
Costume teacher				○	○	○						
Performance teacher						○	○	○	○	○		
Industry Association	○			○		○				○	○	○

4.1.2. Course Teaching Arrangements

The whole course teaching arrangement is based on the ADDIE model. According to the three stages of teaching arrangement and course design framework and model, the course was arranged as shown in Table 10.

Table 10. Teaching arrangements.

Teaching Methods	Week Number	Week	Course Progress
Classroom teaching	1st week	Monday	Teaching of course theoretical knowledge, teaching and learning case introduction, textbook interpretation; Multimedia teaching, teaching schedule; Interpretation of outstanding work cases over the years.
Live teaching		Wednesday	Going to Tianjin Paper market to understand the types of paper materials and collect the composition of paper art materials Assignment: Collect ten different paper materials, sample 10 * 10 cm, and mount them on black cardboard.
Classroom teaching	2nd week	Monday	Course objective: 3D training and scenario design 1. Assignment 1: Paper survey, collection, display and exchange report 2. Assignment 2: 2D to 3D Subject: A piece of paper story “Thanksgiving” as the theme, to think about gratitude. A piece of A4 paper is used to make a three-dimensional greeting card, which is presented in the form of two-dimensional to three-dimensional transformation. There is no limit to the paper material and performance. After reviewing the homework, students are encouraged to give their work to “grateful” people.
		Wednesday	1. Assignment 3: Who am I Make a hat out of paper and express your own identity. May wear it on the head and walk around the classroom to complete the statement of “Who Am I”?
Online teaching	3rd week	Monday	Course website learning Complete the website hours and upload the learning experience report in the discussion area
Classroom teaching		Wednesday	Assignment 3: Who am I? Class catwalks and reports
Classroom teaching	4th week	Monday	Course Objectives: Three-dimensional thinking and the use of materials. Assignment 4: Experimental group project Topic: “One Belt, One Road-Green Manufacturing” Creative Paper Show With the theme of “One Belt, One Road-Green Manufacturing”, select national characteristics or green manufacturing industry elements along the Belt and Road to complete 1: 1 paper clothing design and production. A group of three members each completed one piece, and the group members acted as models to complete the catwalk performance
			Creative ideas and sketches
		Wednesday	Determine the design plan and prepare materials and tools

Table 10. Cont.

Teaching Methods	Week Number	Week	Course Progress
Design Workshop	5th Week	Monday	Course Purpose: Design Practice and Expression Design and guidance
		Wednesday	Course Purpose: Design Practice and Expression Design and guidance
	6th Week	Monday	Course Purpose: Design Practice and Expression Design and guidance
On-campus Open teaching		Wednesday	Reports and exhibitions
After-school Training and Teaching Week	7th–9th week		Stage performance training, booth design and construction
Social Show Teaching Week	10th–12th Week		1. Tianjin North International Bicycle Electric Vehicle Industry Expo (1) Opening Ceremony: Creative Paper Show (2) Exhibition scene: works exhibition and catwalk
			2. Exhibition of works in commercial space
Teaching Conference			Comprehensive evaluation and consideration of course performance

4.2. Course Evaluation

4.2.1. Research Sample

The course design of ADDIE model is evaluated by the evaluation of students' satisfaction with the course. Our research sample was selected from November 2018 to March 2019 during a study about student satisfaction with the "Three-dimensional Composition" course for second-year product design students at Tianjin University of Technology.

Based on the characteristics of user satisfaction research, the sample was selected as a representative sample for the analysis of student satisfaction in specific courses. In this study, the product design department of the Tianjin University of Technology was selected as the research sample. A total of seven classes and 140 students, 121 questionnaires were collected, 102 of which were valid.

4.2.2. Composition of Questionnaire

The questionnaire was scored using a five-point Likert scale [38]. The content of the questionnaire refers to factors affecting learning, as described by Urdan (1997), factors affecting job satisfaction, as described by Seashore and Taber (1976) and Jennifer and Gareth (2004), and factors affecting service-learning and achievement, as described by Eyler and Giles (1999). The questionnaire scale references are shown in Table 11 [39–42].

Table 11. Questionnaire scale reference.

Source	Questionnaire	Research Object
Urdan (1997)	Study motivation, work motivation, service motivation	Factors affecting learning
Seashore and Taber (1976) Jennifer and Gareth (2004)	Personal factors: including demographic variables, personality traits, situational personality (such as motivation, preference, value), temporary personality (such as anger), perceptual cognition and expectation, ability	Job satisfaction
	Environmental factors: working conditions, organisational environment, occupational nature, social environment, political and economic environment, etc.	

Table 11. Cont.

Source	Questionnaire	Research Object
Eyler and Giles (1999)	Learning cognition, learning achievement	Service-learning cognition and achievement
Chang Tongmiao (2011)	Teachers' teaching, course identification, interpersonal interaction, social care, problem-solving and self-realisation	Service-learning satisfaction
Present study (2020)	Teaching field, teaching faculty, teaching methods, teaching achievements, teaching goals, teaching participation	Course learning satisfaction

This study combined the theory of ADDIE course design model and the above analysis of learning satisfaction. The course learning satisfaction scale was divided into six topics: teaching field (teaching location, virtual and real space), teaching teachers (teacher background, teacher source), teaching methods (teaching means, course design arrangement), teaching achievements (form of work display), teaching objectives (course teaching objectives) and teaching participation (understanding of design, learning achievement and self-confidence). It had a total of 18 questions, each of which sought to measure and evaluate the degree of college students' satisfaction after participating in the ADDIE model teaching course, "Three-dimensional Composition."

Before the formal distribution of the questionnaire, seven class monitors and study committee members were pre-tested and provided feedback about where the questionnaire was unclear and where students might be confused. As a result of these discussions, the description of the course achievement promotion meeting and the cross-disciplinary teachers were explained in the questionnaire, as shown in Table 12.

Table 12. Questionnaire scale.

Course Design	Learning Satisfaction Scale
Teaching Field	01. Integration of online network teaching and offline course teaching
	02. Performance and display teaching of Industry Exhibition
	03. Performance teaching for the course achievement introduction meeting (hotel opening ceremony)
Teaching Staff	04. Teaching teachers in multi-disciplinary subjects
	05. Lectures to interdisciplinary teachers (costume design, fashion show)
	06. Teaching to teachers of industry associations
Teaching Method	07. Design creative guidance for teachers
	08. Teaching methods for teachers
	09. Course design arrangements for teachers
Teaching Achievements	10. Performance form of works
	11. Forms for exhibition of works
	12. Forms of interactive lectures on works and audiences
Teaching Objectives	13. Learning of material selection and application
	14. Understanding and shaping of three-dimensional form
	15. Fusion of creative performance and industry topics
Teaching Participation	16. Perception of design
	17. Sense of achievement in design
	18. Increased confidence in design

4.2.3. Data Analysis

In this study, 121 questionnaires were collected for data processing, 19 invalid questionnaires were deleted, and 102 valid questionnaires were finally analysed using SPSS statistical software (IBM, Armonk, NY, USA).

(1) Reliability Analysis (Cronbach's alpha)

Through analysis of the literature and expert discussion, a scale to measure students' learning satisfaction was obtained. The scale measures students' learning satisfaction with the course. After a Cronbach's alpha analysis, the internal consistency was high, indicating that the measurement of course satisfaction with this scale is reliable.

Kaiser–Meyer–Olkin (KMO) and Bartlett methods were used to verify the validity of the questionnaire. The KMO value of the questionnaire was 0.940, and the significance of the Bartlett spherical test was 0.000. Cronbach's alpha [43] was used to measure the reliability of the questionnaire. If the components that made up this construct are highly correlated, the alpha value is high. Cronbach ≥ 0.70 is considered to demonstrate high internal consistency [44]. The overall alpha coefficient of the questionnaire was 0.986. Therefore, these projects had acceptable reliability and validity for the topic of interest, and the samples were of sufficient size [45].

(2) Analysis of Questionnaire Data

After the analysis of the learning satisfaction questionnaire, the average score was 4.235, and students' overall satisfaction with course learning was high. The mean and standard deviation of constructs of students' learning through the course and the average score of each dimension were as follows: "Teaching Field" (M = 4.15), "Teaching Faculty" (M = 4.20), "Teaching Methods" (M = 4.25), "Teaching Results" (M = 4.29), "Teaching Objectives" (M = 4.27) and "Teaching Participation" (M = 4.26). See Tables 13 and 14.

Table 13. Mean and standard deviation of constructs.

	Construct	Participants	Mean	Standard Deviation
A	Teaching Field	102	4.15	1.070
B	Teaching Staff	102	4.20	1.056
C	Teaching Method	102	4.25	1.008
D	Teaching Achievements	102	4.29	0.995
E	Teaching Objectives	102	4.27	0.969
F	Teaching Participation	102	4.26	1.003

Table 14. Means and standard deviations of the items.

	Term Statistics		
	Mean	Standard Deviation	Participants
A1. Integration of online network teaching and offline course teaching	4.11	1.024	102
A2. Performance and display teaching of Industry Exhibition	4.21	1.093	102
A3. Performance teaching for the course achievement introduction meeting (hotel opening ceremony)	4.12	1.093	102
B1. Teaching teachers in multi-disciplinary subjects	4.23	1.033	102
B2. Interdisciplinary teaching (fashion design, fashion performance)	4.25	1.085	102

Table 14. *Cont.*

	Term Statistics		Participants
	Mean	Standard Deviation	
B3. Teaching to teachers of industry associations	4.11	1.052	102
C1. Creative design guidance for teachers	4.21	1.066	102
C2. Teaching methods for teachers	4.21	0.998	102
C3. Course design for teachers	4.29	0.960	102
D1. Form of performance of works	4.30	0.973	102
D2. Work exhibition form	4.32	0.956	102
D3. The form of interactive teaching of works and audience	4.25	1.057	102
E1. Learning of material selection and application	4.27	0.935	102
E2. Understanding and shaping of three-dimensional form	4.30	0.942	102
E3. Fusion of creative performance and industry issues	4.25	1.031	102
F1. Perception of design	4.26	0.943	102
F2. Sense of achievement in design	4.28	0.969	102
F3. Increased confidence in design	4.25	1.096	102

Item A1, online teaching and course integration teaching of online colleges (online and offline teaching), had a mean of 4.11, $sd = 1.024$. Item A2, performance and exhibition teaching of industry exhibitions (social teaching), had a mean of 4.2, $sd = 1.093$. Item A3, performance teaching (social teaching) of the course promotion meeting (hotel opening ceremony), had a mean of 4.12, $sd = 1.093$. The item with the highest learning satisfaction was item A2, which was in cooperation with course design and industry associations, teaching achievements and participation in industry exhibitions and opening receptions, extending teaching space to public convention and exhibition centres, commercial hotels, and linking online teaching to achieve O2O teaching integration.

In the teaching teacher's construct, item B1, the teaching for teachers with multi-professional background, was 4.23, $sd = 1.033$. For item B2, interdisciplinary teaching (fashion design, fashion performance) was 4.25, $sd = 1.085$. For item B3, teaching to teachers of industry associations, the mean was 4.11, $sd = 1.052$. Among them, item B2, which had the highest mean, reflects that students had the highest satisfaction with the interdisciplinary cooperation of the teacher team.

In the construct of teaching methods, item C1, design creative guidance for teachers in the classroom, had a mean of 4.21, $sd = 1.066$. For C2, teaching methods for teachers, the mean was 4.21, $sd = 0.998$. For C3, course design for teachers, the mean was 4.29, $sd = 0.960$. Among them, item C3 had the highest mean, indicating the highest satisfaction with the entire course design arrangement. It confirms the benefit of designing courses from the analysis needs theory in the ADDIE model.

In the construct of teaching achievement, item D1, for the performance form of the work, the mean was 4.30, $sd = 0.973$. For D2, the exhibition form of the work, the mean was 4.32, $sd = 0.956$. For D3, the form of interactive teaching of the work and the audience, the mean was 4.25, $sd = 1.057$. Among them, the item with the highest average score, D2, was also the highest score among the 18 questions. This result demonstrates students' needs for teaching achievements to be recognised by more audiences off-campus, which is a developing trend in education for design teaching and social education.

Under the construct of teaching goals, item E1, learning about the selection and application of materials, had a mean of 4.27, $sd = 0.935$. Likewise, E2, understanding and shaping of three-dimensional form, had a mean of 4.30, $sd = 0.942$. E3, the integration of creative performance and industry topics, had a mean of 4.25, $sd = 1.031$. The item with the highest mean was E2, the understanding and shaping of three-dimensional forms, which is also the core content of the course teaching goals. The students' high satisfaction demonstrates the achievement of the teaching goals of the course.

In the construct of teaching participation, item F1, perception of design, had a mean of 4.26, $sd = 0.943$. F2, sense of achievement in design, had a mean of 4.28, $sd = 0.969$. F3, increased confidence in design, had a mean equal to 4.25, $sd = 1.096$. The item with the highest average score, F2, shows that students had a high degree of satisfaction with design achievement after participating in the course, which is also one of the teaching purposes of junior design courses. It is of great significance for the future course teaching and career planning to cultivate students' interest in learning, enhance their design achievements and cultivate their self-confidence.

5. Discussion and Conclusions

5.1. Discussion

Through the application of the ADDIE model to course design and implementation, our research passed through five complete stages of the design process: analysis, design, development, implementation and evaluation [9,10]. Through this research process, we found that design courses carried out through the ADDIE model can be better based on the needs of students combined with social innovation resources. They can integrate cross-disciplinary teacher teams, industry project placement courses, social performance platforms, etc. to increase learning satisfaction. Continuous teaching discussions with the teaching team, in-depth cooperation of the industry association, and the student interest and confidence in the design profession have affirmed the course design. Besides the affirmation, the research on the ADDIE course design method used for the design course can be applied to other design teaching applications [1,2].

Through the application of the ADDIE course design to complete the teaching practice in the course, "Three-dimensional Composition," this paper compares the teaching method, teaching environment, evaluation, object and effect with the traditional teaching mode without course reform, as shown in Table 15. Through the application of the ADDIE model utilising social innovation, course teaching has changed significantly in many aspects [4–8]. With the change of information technology and students' learning needs, as well as the change of the design industry and social needs, design education must be changed in the course design [1].

Table 15. Comparison of traditional courses and ADDIE design courses.

Comparison of the Teaching of Three-Dimensional Composition Course with and without the ADDIE Approach		
	Traditional Teaching	ADDIE Approach to Social Innovation
Teaching methods	Teach in-person	O2O combined online and offline Course website re-learning, assignment submission and discussion
	Listening-style teaching	Participatory teaching Students, teachers, industry, industry, and the public participate in the course process, multiple interactions
	Lecture provided by product design teacher	Diversified teaching Multi-domain integration of design, performance, director, industry and other teachers
Teaching environment	In-school teaching	Social teaching On-campus exhibitions, off-campus teaching, performances, exhibitions

Table 15. Cont.

Comparison of the Teaching of Three-Dimensional Composition Course with and without the ADDIE Approach		
	Traditional Teaching	ADDIE Approach to Social Innovation
Teaching evaluation	Teacher evaluation	Overview Teacher evaluation, public evaluation, industry evaluation, exhibition evaluation, media evaluation, etc.
Teaching object	Course class	Social multiple groups Staff of different specialities, industries and the public, etc.
Teaching effect	Course cognition	Social communication

Through introduction of the concept of social innovation, this paper keeps the five stages: analysis, design, development, implementation and evaluation in the course of curriculum design [13–17]. These concepts are used in relation to the teaching field, teaching teachers, teaching methods, teaching achievements, teaching objectives and teaching participation. It also attempts to promote the application of other design courses and optimise the impact of the course [20,21].

5.2. Course Work

In the teaching of the Three-dimensional Composition course in 2020, we used the complete framework of this research. We involved students in the design of a course, one of which incorporates a three-dimensional presentation of the theme of fighting COVID-19. Another assignment is the paper clothing design with the theme of “One Belt and One Road”. Through the presentation of the new course, we saw the excellent work of the students, as well as their confidence and satisfaction when they stood on the stage, as shown in Table 16. I believe that is the meaning of our course design [4].

Table 16. Course work.

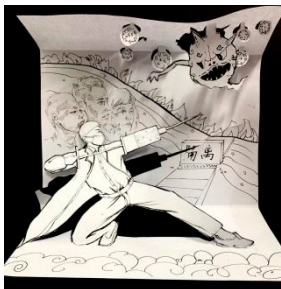

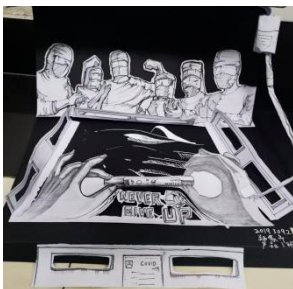

Student	Project 1	Project 2
A		
B		

Table 16. Cont.















Student	Project 1	Project 2
C		
D		
E		
F		
G		

Table 16. Cont.

Student	Project 1	Project 2
H		
I		

5.3. Conclusions

(1) Course adjustment

Course reform is a step-by-step teaching process, through the introduction of the ADDIE model of course design. We found that appropriate adjustments to the course schedule can maximise the impact of the course. The adjustment of the course time cycle requires the input of the school teaching management department. To adapt to the development of design teaching, future design courses should have a more flexible method of course planning [4–8]. This is exactly the limitation of course design, such as the overall arrangement of teaching plan time and extracurricular teaching time in this study. Course design lengthens the teaching time and increases more extracurricular teaching. It brings time problems to teachers and students in the second and third stages of course design.

(2) Teaching teambuilding

The formation of a teacher team will also be the limitation of course design, which will directly affect the success or failure of course design. Teaching faculty is the core of the teaching process. A teaching team with a reasonable professional background and stable team members is one of the driving forces for the continuous development and improvement of the course. In addition, increasing the value of the teaching team through the regular addition of new, social teachers can aid in achieving the goals of design education and social development.

(3) Construction of the social cooperation platform

A social cooperation platform is not only a bridge between school teaching and social needs, but also a difficult link in course design [15,16]. We found that, without industry association and cross-disciplinary teachers, the impact of the course will be reduced. The in-depth exploration of the social cooperation platform enables design courses to connect with society and have more opportunities to interact with social issues and achieve opportunities for public display. The teaching process is more open so that the public can better understand the design and set up a better social view for design education [46,47].

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