



OPEN ACCESS

EDITED BY

Mohd Farooq Shaikh,
Charles Sturt University, Australia

REVIEWED BY

Ipek Ek,
Yaşar University, Türkiye
Aizhan Akhmedova,
IEC Kazakh Leading Academy of Architecture
and Civil Engineering, Kazakhstan

*CORRESPONDENCE

Nianzu Liu
✉ liunianzu@zswu.edu.cn;
✉ 369823728@qq.com

RECEIVED 26 July 2025

ACCEPTED 21 October 2025

PUBLISHED 06 November 2025

CITATION

Liu N (2025) Teaching reform of bilingual
digital design technology in environmental
design.
Front. Educ. 10:1673560.
doi: 10.3389/feduc.2025.1673560

COPYRIGHT

© 2025 Liu. This is an open-access article
distributed under the terms of the [Creative
Commons Attribution License \(CC BY\)](#). The
use, distribution or reproduction in other
forums is permitted, provided the original
author(s) and the copyright owner(s) are
credited and that the original publication in
this journal is cited, in accordance with
accepted academic practice. No use,
distribution or reproduction is permitted
which does not comply with these terms.

Teaching reform of bilingual digital design technology in environmental design

Nianzu Liu*

Department of Environmental Design, School of Design, Art and Architecture, Zhejiang Wanli University, Ningbo, China

Digital design technology is a compulsory course offered by the School of Design, Art and Architecture of Zhejiang Wanli University since 2020. The course was applied for a bilingual course construction project in 2022. This article summarizes the changes in software used in the graduation projects of our school's environmental design major over the past two decades, the selection of design styles, and the relationship between them. From the selection of teaching content and the setting of student evaluation standards, this article proposes countermeasures and suggestions on how to introduce bilingual mode in teaching, attach importance to creative thinking training, multi-scenario teaching design and personalized education.

KEYWORDS

digital design technology, educational reform, internationalization, environmental design, bilingual curriculum

1 Introduction

The research process was funded by two distinct projects that were approved by the university. One such initiative was Zhejiang Wanli University's "Teaching Reform Research Project in the First Batch of the 14th Five-Year Plan." The objective of the present project was to facilitate a comprehensive understanding of the "Digital Design Technology Module" course within the broader context of talent cultivation for environmental design majors, with a particular focus on its significance and role in the local and international context. The objective of the initiative was to establish the theoretical underpinnings for the future development of talent cultivation programs, with a particular focus on three key areas: course design, credit allocation, and teaching format optimization. The other concurrently approved project was a course development initiative: the present document is a proposal for the development of a bilingual course at Zhejiang Wanli University. The course, titled "Digital Design Technology," is a two-year program that will include regular academic sessions dedicated to comparative studies. The project will evaluate student learning outcomes and overall educational effectiveness by contrasting bilingual teaching environments with traditional ones. This will determine the feasibility of expanding bilingual course development to other environmental design majors. These projects are integral components of Zhejiang Wanli University's internationalization initiatives within its academic curriculum.

The digital design technology module includes courses such as “Digital Design Technology,” (Jason and Vermillion, 2016) “Rendering Design,” and “Digital Morphogenesis Design”¹ (in preparation). The course group introduces design theories and methods around digital methods, and discusses the impact of the emergence of new technologies on traditional design concepts, methods, trends, etc. The course module includes required courses for lower-level students that introduce the basic theory of digital design technology; the upper-level section focuses on advanced applications of digital design. This group of courses used to be named after specific software names, such as AutoCAD, 3DsMax, etc. Digital design technology, introduced in 2015, still focuses on the introduction of design software and does not involve specific software names. The course will select one or more software based on the outline requirements and introduce them through project examples. 23-24-1² and 24-25-1 are the semesters in which the courses were offered. The teaching evaluation of students in grades 2022 and 2023 and teaching evaluation of supervisor have all improved compared to statistics before the teaching reform. During this period, the course team teachers were also selected for the excellent Ideological and Political Recommended Course in the 2023–2024-2 semester. The current digital design technology course module provides bilingual teaching for only one course, digital design technology. Three parallel classes in the same grade have the same requirements. The bilingual requirement undoubtedly poses significant challenges to students’ academic performance. For example, some students may not be able to answer questions in class because of their choice of Japanese as secondary language, while others may develop resistance and express it through class evaluations or other means. Whether the teaching effectiveness of the digital design technology course has improved in the past decade, and whether students can use digital design technology as a tool to freely express design concepts, is of great significance to the research of our school’s environmental design teaching system and talent cultivation program. In fact, after comparing and analyzing relevant data, the research team found some clues to prove that the past decade has not shown a sustainable ideal state. Under the increasingly complex graphic layouts, the design content is crescively hollow, and the design skills of students have not always improved with the technological progress. There may be deficiencies in course content design, teaching assessment and evaluation, and students’ classroom performance and learning motivation.

This article reports the results of a longitudinal, institutionally supported study of the digital design technology module in Zhejiang Wanli University’s Environmental Design program. We investigate (i) eighteen-year trends in rendering styles and software/toolchain choices in graduation projects, (ii) associations between these choices and learning outcomes in the module, and (iii) the feasibility and short-term learning implications

of bilingual delivery. Our goal is to derive evidence-based implications for curriculum design, assessment, and the staged integration of advanced modeling within a bilingual instructional environment. This article presents the findings of a research initiative conducted within Zhejiang Wanli University’s strategic framework for teaching reform and internationalization.

2 Research on teaching reform in digital design technology

2.1 Practice in developing digital design curriculum for environmental design programs in China

At the core of the environmental design profession is the capacity to generate concepts, undertake development and specify detail to create products and systems that optimize function and appearance. The profession has undergone enormous change in the evolution of digital design tools/media (Loy et al., 2015) that can be employed in the three main phases of the industrial design process of concept generation, development and specification. The non-digital/conventional techniques of designing are becoming computer-based (Malins et al., 2007) and digital tools are now vital to industrial design practice (Alcaide-Marzal, 2013).

Digital technologies enhance the design process by enabling remote interaction between designer and client (Lau et al., 2003) and members of a new product development team (Unver, 2006). They facilitate collaboration (Dreamson, 2017), allow effective modifications to concepts and facilitate the production of detailed, accurate and reliable objects (Pipes, 2007). Digital technologies enable designers to create complex products that would not be possible using conventional techniques (Shih, 2006). They assist in reducing the number of physical models/prototypes, which reduces time and cost to market (Ye et al., 2006). Computer-aided design facilitates efficiency gains (Chen and Owen, 1998) and gives students with limited drawing capability an opportunity to effectively communicate ideas (Hodgson, 2008). Furthermore, when graduates apply for their first design job, their ability in using digital methods has become an essential prerequisite skill (Lynn, 2006).

As the prevalence of digital tools started to increase, Yang et al. (2005) suggested reducing student training in conventional renderings and model making as the majority of job opportunities required applicants to have the ability to use 3D computer-aided design (CAD). Designers have changed their practices and expectations due to significant advances in digital technology (Oehlberg et al., 2009).

Environmental design is the use of artistic means, the indoor and outdoor space of the building two parts of the integration of transformation, the use of which can improve the comfort of the residents of the building, the daily life of the feeling has a great impact (Zhuoyu, 2023). The concept of environmental design is relatively broad, it includes the design of indoor environment, outdoor environment, and also includes architectural garden design. The development of information technology has had a profound impact on the way of human production, lifestyle, way

¹ Digital morphogenesis design is a type of generative art in which complex shape development, or morphogenesis, is enabled by computation. This concept is applicable in many areas of design, art, architecture, and modeling. The concept was originally developed in the field of biology, later in geology, geomorphology, and architecture.

² 23-24-1 refers to the first semester of the 2023–2024 academic year; 24-25-1 refers to the first semester of the 2024–2025 academic year; 2023–2024-2 refers to the second semester of the 2023–2024 academic year. The same notation applies throughout the text.

of thinking and so on (Gong, 2023), in this context, the digital transformation of environmental design is inevitably the future direction of environmental upgrading and development, and if the two can be organically integrated, it can effectively improve the level of environmental design and promote the overall progress of China's design industry (Shen and Yu, 2021).

Digital environmental design is through digital technology and creative expression, design and display of art works of a design approach. It combines art and technology, through digital media and interactivity, presenting a new form of art and experience (Posthumus et al., 2018). Digital environmental design is not only an extension of traditional design, but also an innovative way of expression, with high artistic value and cultural connotation. The significance of digital environmental design is to bring a new art experience and interactive participation for the audience, breaking through the restrictions of traditional art forms, so that the audience can interact with the art works in real time and participate in the creative process. At the same time, digital environmental design also provides designers with a broader creative space and possibilities, so that they can express more creativity and ideas through technological means (Jacobs and Leal, 2018).

2.2 Sample and methods

Teaching Reform Research Project in the First Batch of the 14th Five-Year Plan analyzed 2,201 graduation design projects from 18 cohorts spanning 2005–2006 to 2023–2024, statistically examining their presentation formats and architectural design styles, architectural design style here is defined as “a distinct type of architecture characterized by specific structural and ornamental features” (Poppeliers and Chambers, 2003). Student enrollment per cohort varied based on annual admission quotas, with an average of approximately 122 students per cohort. The statistical analysis examined whether a correlation exists between students' selection of digital design technology tools and their learning outcomes in the “Digital Design Technology” course. Why do we choose graduation works as the statistical object? Because the graduation project is usually scheduled in the last year of four years undergraduate study, also with a long-time span, the graduation process starts from theme selection and design proposal to oral defense, and because it is related to the graduation of students, usually, the work is relatively more complete and represents the highest level of the students during their study years at university. So, it is referential for the assessment of students' academic conditions during their school years.

122 student graduation design projects were statistically categorized by design style and software tools used for completion. The statistical process was independently conducted by the author and faculty members based on established criteria. Each project was counted once per classification. Design style statistics were categorized as: atypical; Classical Western; Classical Chinese; and modernity. These styles encompass all creative approaches. “Classical Western” refers to the architectural style and design of ancient Greece and ancient Rome; “Classical Chinese” denotes works employing traditional Chinese architectural or interior design elements; “modernity” signifies an interior design style characterized by a monochromatic color palette, clean lines,

minimalism, natural materials, and natural light; “atypical” refers to architectural styles not falling under the aforementioned categories. Software categories relied upon for design include: Collage; SketchUp+Vray/Lumion/Enscape; Hand-painted; 3DsMax+Vray/Lumion/Enscape; This classification encompasses all software usage scenarios.

2.3 Results and discussion: trend toward low-barrier toolchains

In recent years, due to the increasing number of software options available for digital design technology (Ceylan, 2024), students tend to prefer software that is easy to learn and use, and so-called “the lesser of two evils.” According to students' feedback, the main reasons include: avoiding the risks of software updates and replacements. For example, large professional software such as 3DsMax, Rhinoceros, etc. require more time to learn and master. If there is no special motivation to spend a lot of time and effort to master professional software knowledge, it is likely to be replaced by new content in the coming years. It is also important to note that the combination of Sketch Up and Enscape can produce good results, and the time saved can be used for other professional courses or internships.

Another trend is that more students majoring in environmental design will choose the collage style (O'Hara and O'Hara, 2016).

Collage style refers to the expression style that is more similar to cartoon (Moreira, 2025). Compared with the traditional photo-realistic rendering that expresses the real light and shadow effect, it is relatively easy to draw and modify, but the disadvantage is that it can only express the basic shape and space relationship of the design objects, and cannot display the realistic light and shadow, material or atmosphere of rendering. The style of collage is directly related to the choice of digital design software, and is more suitable for software that is easy to use, has relatively simple functions, and is flexible, easy to learn and use, such as Sketch Up. The disadvantage is that it cannot generate high precision curves and surfaces, and the generation of complex shapes requires external plug-ins. Of course, it is not impossible that large professional software will intentionally create a collage style through filters or other methods. According to the statistics of rendering styles for graduation works in our college over the past 18 years (Figure 1), the works adopted in collage style has been increasing year by year, even approaching 100% in recent years. Another phenomenon that accompanies the widespread choice of collage style by students is the increasing complexity of graphic layout of presentation board (Figure 2). Something just as location analysis, population analysis, route analysis, vegetation analysis, space analysis, material analysis, and conceptual sketches of the project are dazzling. However, upon closer inspection, it can be found that many contents may have poor relevance to the project itself when using templates, resulting in monotonous design schemes that avoid complex surface modeling³ and diverse style forms on design work itself.

³ Complex surface modeling refers to design proposals that necessitate the use of additional surfaces to achieve greater levels of detail within digital design software. Such designs are commonly found in traditional architecture, including Chinese and Western classical styles. In contrast to contemporary architectural trends, which prioritize simple forms or

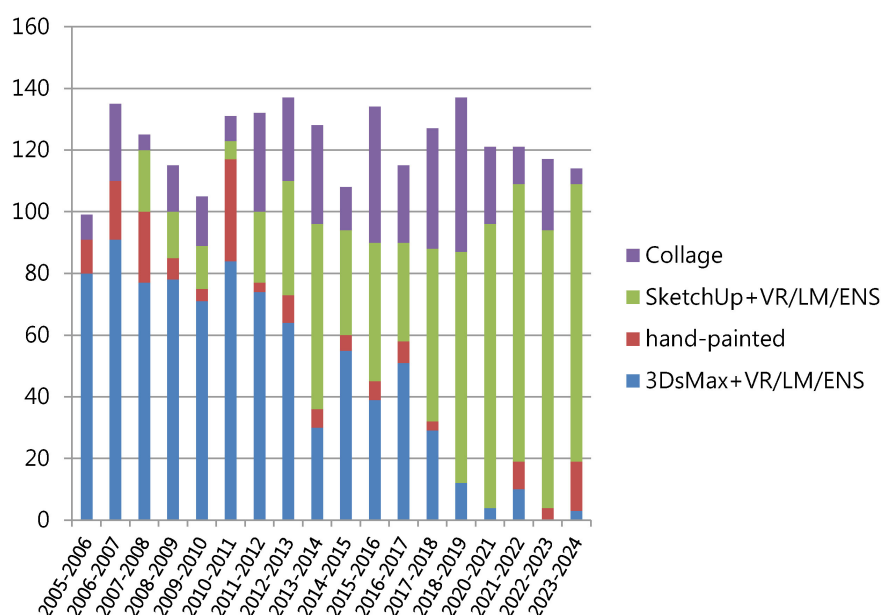


FIGURE 1

Statistics on rendering styles for graduation works of environmental design major at Zhejiang Wanli University. (When there are several stylistic features in a work, the statistics are based on the main style.)

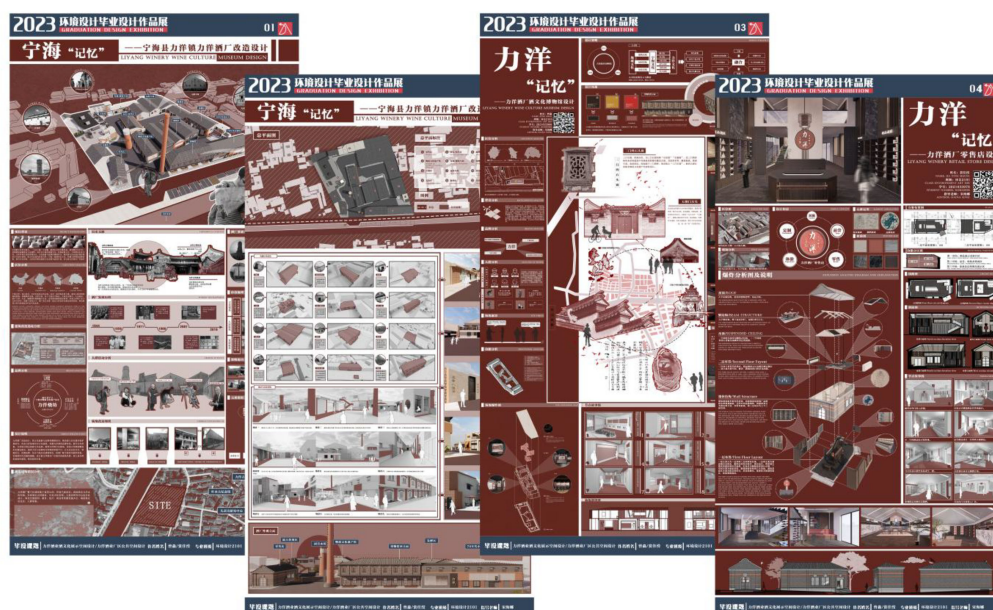


FIGURE 2

Zeng Miao and Shang Jiayingying's "Renovation design of the Liyang Winery in Ninghai Liyang County" is the excellent graduation design of the 2023 graduating class.

Figure 3 shows the statistics of complex surface modeling schemes selected for graduation projects in the environmental design major over the past eighteen years. It can be seen

functionality over intricate forms, complex surface modeling demands a higher level of modeling expertise and sculptural aptitude from students, thereby substantially broadening the range of design styles they can articulate.

that the peak is in the interval around the entering class of 2013, and then decreases year by year. This may be related to the teaching orientation at the time, as the diversity of students' conceptual designs was not positively correlated with the advancement of digital design technology. Why does the research group focus on complex surface modeling in design proposals? Due to the high requirements and difficulty of digital design skills for complex surface modeling, as well as the high

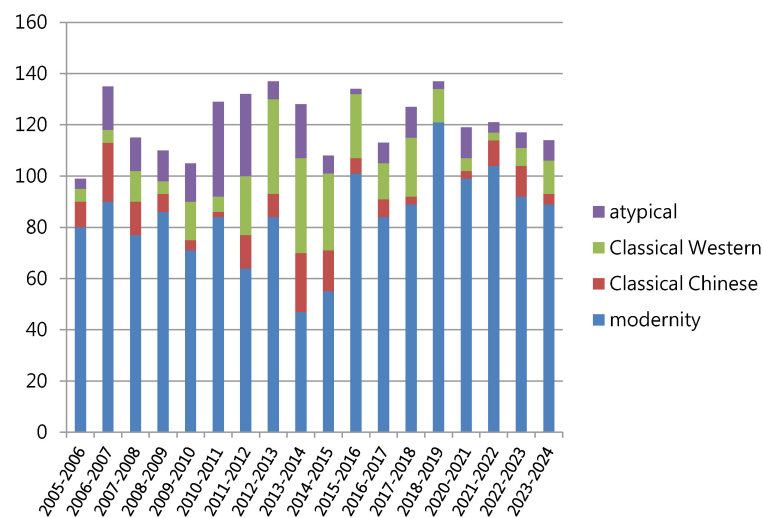


FIGURE 3

Style statistics of graduation design works of Zhejiang Wanli University's environmental design major. (If there are multiple design expression channels in the work, the statistics are based on the main design expression channels.)

constructional investment and cost, it represents an important development direction in the current environmental design field and has prospective significance. This is consistent with the creative and forward-looking spirit of higher education design programs for students worldwide. Encourage students to explore concepts without considering cost, especially in the conceptual design phase. In the talent training program, targeted courses such as “Conceptual Creative Design”⁴ have also been offered since 2012. This type of program requires students to first master advanced modeling methods such as NURBS surfaces, patches, polygons, etc., while also understanding and inheriting current digital morphogenesis design that imitates biological forms, classical European design represented by baroque, rococo and neoclassical styles, as well as structuralism, eclecticism, etc. But in reality, more students choose modernist and minimalist styles, which may be due to a preference for certain styles or a compromise with the technological barriers of digital design in reality. In an era dominated by digital design technology, design technology has, in turn, limited students' ability to create conceptual plans. It is common to hear students complain that they can think of something, but not able to present it using digital methods. From this perspective, the quality of the construction of digital design technology courses is of great significance to the establishment of the entire environmental design talent training system. Overall, students have an increasingly obvious tendency to seek quick success and immediate benefits in design, hoping to maximize their evaluation advantages by investing limited time and avoid spending time in some “inconspicuous” positions.

4 Conceptual creative design is a course in concept design offered to graduating students. Unlike other specialized design courses, which emphasize functionality, this course encourages students to create architectural design proposals that are feasible in the near future, possess exploratory value, and demonstrate forward thinking. This course was developed in response to the growing number of students selecting similar topics for their graduation projects.

From the data of the past 18 years, it can be seen that the performance in subject competitions was most outstanding throughout the entering class of 2006. Lei Jian, a student from the entering class of 2009, won the “IAIC Award” (ZJD, 2010) for his work “Mr. Lonely” lighting design at the 2008 Asia Pacific Interior Design Biennial Award; Li Wen’s “Coastal Church Construction Design” guided by teacher Chen Yi won the first prize in the 2009 China Interior Space Environment Art Design Competition (Figure 4). According to feedback from their teachers, the award-winning students have a strong interest in professional learning and will actively explore from conceptual plans to design and production. As for the work itself, the application of digital design technology and imaginative conceptual creativity make it stand out (Figure 5). Eighteen years later, digital design technology has been advancing rapidly. In fact, creating various complex surfaces using various plug-ins in Sketch Up may be easier than in the past, but students' enthusiasm for learning in this area does not seem to have translated into more achievements. In recent years, there have been relatively few high-quality design award won by students, and the majority of students' work proposals and design difficulties are limited to the basic application of Sketch Up or other easy-to-use software just like Kujiale, a widely used unprofessional software in China. Although there are cases such as our outstanding alumnus Mao Yun winning the Alumni Gathering | Our school alumnus Mao Yun won the UADA 2022 Urban Design and Architecture Design Award Gold Award (n.d.) Urban Design and Architecture Design Gold Award (ZJD, 2010), it is still the result of years of deep professional cultivation after graduation. The career environment exerts a substantial influence on students' learning motivation and outcomes, occasionally in a detrimental manner (Benson, 2013). In recent years, the rapid evolution of digital technologies has presented significant challenges for educators teaching courses related to “Digital Design Technology.” The crux of the matter lies in the necessity to revise educational content and talent



FIGURE 4
Li Wen's "Coastal Church Construction Design" guided by teacher Chen Yi won the first prize in the 2009 China Interior Space Environment Art Design Competition.



FIGURE 5
Wang Peibin's digital morphogenesis design "Cell Tower" is the excellent graduation design of the 2013 Class.

TABLE 1 Rubric for participation grades.

	Strong	Needs development	Unsatisfactory
Listening	Actively and respectfully listens to peers, guest speakers, and instructor	Sometimes displays lack of interest in the comments of others	Projects a lack of interest or disrespect in the comments of others
Preparation	Arrives fully prepared with all assignments completed, with notes on readings, observations, and questions	Sometimes arrives unprepared or with only superficial preparation	Exhibits little evidence of having read or thought about the assigned material
Quality of contributions	Comments are relevant and reflect understanding of assigned text(s), previous remarks of other students, and insights about assigned material	Comments sometimes irrelevant, betray lack of preparation or indicate a lack of attention to the previous remarks of other students	Comments reflect little understanding of either the assignment or previous remarks made during the discussion
Impact on discussion	Comments frequently help move discussion forward	Comments sometimes advance the discussion, but other times do little to move it forward	Comments do not advance the discussion or are actively stifle it
Frequency of participation	Actively participates at appropriate times without dominating in a negative way	Sometimes participates, but other times is tuned out	Seldom participates and is generally not engaged OR over-participates to the point of dominating the discussion and not allowing others to comment

Participation grades for lectures, paper discussions, and labs will be determined using the following rubric. Class participation deserving an A (> 90%) will be strong in most categories; participation that is strong in some categories, but needs development in others will receive a B (80–90%); a grade of C (70–80%) reflects a need for development in most categories; a grade of D (60–70%) reflects unsatisfactory work in several categories; and F (< 60%) is unsatisfactory in nearly all categories. Lack of attendance when participation is expected will result in a 0 grade for participation.

development objectives in a manner that aligns with the rapidly evolving market environment.

3 Bilingual curriculum development for digital design technology

3.1 Practice in developing bilingual curriculum for environmental design programs in China

Bilingual teaching is the path and edifice to realize the international academic strategy of four types of higher education (Knight, 2004). In Western countries, it has a century-long history. At present, mature bilingual teaching models include Canada's immersive bilingual model and European school model, and a series of teaching theories, such as Cummins' threshold hypothesis, have been instituted (James, 1976). China's bilingual teaching was initially born from the School of Combined Learning in the 19th century during the era of the Westernization Movement. Bilingual teaching has become one of the essential methods to further deepen the reform of undergraduate teaching in China and advance the teaching quality in a holistic way.

The initial universities in China to undertake bilingual teaching of art and design courses are Tsinghua University, Anhui Jianzhu University and Northwest Normal University, which provide us with innumerable methods and experience in bilingual teaching. From 2008 to 2010, there were 503 bilingual teaching demonstration courses approved by the Ministry of Education and the Ministry of Finance of the People's Republic of China, of which art, humanities and social sciences accounted for 19 percent (Huang, 2014). Bilingual teaching of art and design is yet to be popular in China, and most colleges and universities are still in the exploration stage. In 2011, China's art and design major was

upgraded to the first-level discipline of "design" under the category of art. Environmental design (also known as "environmental art and design") is the largest major direction of talent training in art and design major (Lin, 2014). Thus, the discussion of bilingual courses in environmental design major is of referential significance for the construction of bilingual courses in art and design major. For instance, the Department of Environmental Arts of the School of Arts of Zhejiang University of Technology has provided a bilingual course "Study on Art and Design Literature," encompassing 8 topics such as international bidding documents (Yiwen, 2012).

3.2 Sample and methods

In the Bilingual sub-study, to effectively achieve the research objective and test the research hypotheses, nonequivalent pretest posttest control group design is utilized for the quasi-experimental research. Total 112 students in 4 classes are selected as the research subjects, where 2 classes (56 students) in the experimental group are proceeded bilingual learning and the other 2 classes (56 students) in the control group remain traditional teaching method of lectures. The 8-week instructional research is preceded for 360 h per week (total 2,880 h). Rubric for Participation Grades is as follows (Table 1).

3.3 Results and discussion

The investigation reveals that students agree with the assistance of bilingual learning in the subject learning. Particularly, the increasing learning time for students with bilingual learning relatively enhances the learning performance.

It relies on teachers matching with the class teaching to make good use of teaching strategies, according to the class climate

and create the learning situation for students being willing to use bilingual learning so that students bravely propose questions in the discussion and increase the online interactive learning with teachers. Integrating bilingual learning into class teaching does not simply benefit students, but teachers would also have different gains. In addition to the promotion of personal professionalism, teachers could perceive that students realize teachers' efforts and passion on teaching.

3.3.1 Students' classroom performance

3.3.1.1 Random questions in the classroom: student performance

During the promotion of digital design technology module teaching reform, the overall performance of some students in classroom random questioning was poor. Thirteen students were randomly selected to answer the questions in class. The problem is the knowledge just discussed in class, such as after teaching the TRIM command students need to choose the correct answer from a. To stretch an object b. To remove excess parts of objects c. To create a mirror image of an object d. To round the corners of an object, answering the question "What is the purpose of the TRIM command in AutoCAD?" There are fifty similar questions in the quiz bank that are consistent with the content taught in class. In a class of 24 students, five students performed well, seven students performed poorly, and one student performed moderately, others are not involved in this oral question test, wherein good performance refers to being able to answer questions correctly, moderate performance refers to having a lot of interference from the questions, for the relatively high difficulty students fail to answer correctly, and poor performance refers to students refusing to answer or not paying attention to the content in class for various reasons. Students must first understand the question and choose the correct answer based on the content taught in class. The students' performance is worse than expected, and the reason may still be due to language barriers.

3.3.1.2 Classroom PPT presentation part: student performance

The assignment book requires students to prepare a seven-minute presentation on the current state of digital design technology in the field of environmental design. The presentation will be scheduled in the later part of the course and will be completed in four sessions. Students' performance in this area will be incorporated into their regular grades. The project requires students to find a perspective that interests them, which could be an introduction to a particular software, a particular application case, or even a particular operational experience. The results are as follows: (1) Most students have the ability to gather information, discuss and report on specific topic. (2) Among the 24 students in 2023 cohort, there is a serious homogenization of content, with most of them staying in the conventional discourse on digital design technology, ignoring the teacher's requirement that the report content be limited to the field of environmental design when assigning the project. (3) Most students did not achieve the teacher's goal of finding their own interesting aspects to discuss the current state of development of digital design technology, but rather talked about it in a general way. This may be related to the lack of training in writing papers and other courses in the current pre-college courses for students who are not familiar with the conventional

writing requirements for papers or research reports. The reports are usually haphazardly elaborated from different aspects, and there is a lack of necessary logical relationships between the key points, with only scattered case studies. It is worth noting that four students in the PowerPoint presentation exceeded expectations and also received excellent grades in the final evaluation of the course. One of the students elaborated on the role of digital design technology in creating atmosphere and rendering environment in stage scenes, citing several cases of Hangzhou concerts they experienced; the other three students basically meet the requirements of PPT content and presentation in both Chinese and English. From the pronunciation and text preparation, it can be judged that this student values learning English and has a higher level than other students in the class. They should have the intention to study abroad in the future and have received relevant training. Another boy is one of the few in the class who has listed and explained the mainstream digital design applications currently available on the market and has gathered relatively complete information.

4 Suggested strategies

The main problems we students currently face include a lack of motivation to learn digital design technology and the mutual influence of students' learning states. As mentioned above, students are more inclined to use design software that is easy to master and hope to get good grades, which has led to the trend of fancy presentation board layouts, hollow and boring design schemes in recent years. It is necessary to correct the shortcomings of the existing evaluation mechanism and focus students' attention on the environmental design conception itself; in addition, language is still a long-term obstacle that some students find difficult to overcome. More patient and positive guidance through the design of learning situations may be a more suitable solution for students to spontaneously strengthen their learning motivation through observation. Specifically, it includes the following points:

4.1 Choice of teaching content

The main body of teaching content can only choose those software or mainstream basic applications in the market that students are likely to use in their future careers, and cannot choose content that may be eliminated by the market in the near future without market sedimentation. Because digital design technology is different from other basic courses, the teaching content of these courses is relatively stable. Digital design technology covers a large amount of teaching content, with rapid knowledge updates and iterations. However, a certain amount of class time can be set aside for students to report on the industry information they have learned outside of class, and studio design practice classes can be used to introduce students to AI, BIM parametric design, or programmable applications such as Grasshopper. These are current hot topics in digital design technology and are critical to students' future career choices or to gaining an edge in professional competitions. Teachers should help students screen and guide them to actively engage with new technologies that have significant and far-reaching implications. In response to the problem of students

avoiding difficult learning content such as advanced modeling, it is necessary for the curriculum to set strict requirements for teaching content, delegate teachers' control and initiative in the teaching process, avoid being constrained by unnecessary factors, and even test students' learning situation through examinations and other means.

4.2 Establishing evaluation criteria for students

It is necessary to adjust assessment weightings for conceptual depth or geometry complexity. To some extent, there is a phenomenon of teachers inflating students' scores in the current performance evaluation. The reason is that if teachers lower their scores, there is usually no good feedback in the final student evaluation, and it is better to have a "win-win" situation. It is necessary for courses within the digital design technology course group to require students to meet certain requirements in terms of the difficulty of their work through exams or assessments. Usually, teachers grade a particular course based on the evaluation within the class, and after the average grade meets the requirements of the Academic Affairs Department, each grade range is determined proportionally. This results in seemingly similar grades for each course, but in reality, the difficulty levels vary between courses. Students' performance in class should vary, and it is normal for students to perform poorly in some difficult courses. If this is not recognized, it can easily lead to phenomena such as students generally choosing less difficult programs but still getting good grades, as mentioned above. How to encourage students to choose more difficult software skills to meet the requirements of classroom tasks through the development of scientific evaluation standards in teaching is a topic worthy of research.

4.3 How to introduce bilingual mode in teaching

Although the pass rate of CET-4 and CET-6 for third and fourth grade students has been increasing year by year in recent years, in reality, there is still a gap between the requirements of bilingual classrooms and the ability to improve language proficiency in the short term. A feasible strategy is to differentiate the requirements for students according to their overall level: excellent students can have their requirements increased, while for students with poor performance, the language requirements can be appropriately reduced to avoid students developing resistance, to encourage students to communicate in English, and not to overly criticize students for language errors, which may dampen their enthusiasm for bilingual expression in class. In fact, the English language does not have too strict grammar restrictions.

It is necessary to introduce professional English courses in environmental design in future talent cultivation programs, such as our school's landscape major. With the increasing demand for students to continue their education and study abroad, professional English as a supplement to basic English is also a transition course between professional courses and basic courses. However, under

the current tight credit allocation conditions, it may be necessary to reduce the volume of other courses. It is also possible to consider establishing a mutual credit recognition program with neighboring schools—the first Sino-foreign cooperative university in China, the University of Nottingham Ningbo, to create a better language environment by taking advantage of its international teaching advantages.

4.4 Emphasizing the training of creative thinking

It is necessary to pay attention to the linkage design with surrounding courses in the digital design technology module, and attach importance to the training of students' creative thinking in the course design, so that students can understand computer-aided design as a tool for creative expression, rather than the purpose itself (Wang and Chang, n.d.). At the same time, such a linkage design is also conducive to reducing students' homework burden, which is especially necessary under limited class time. According to students' feedback, they often complain about having too much homework, and they may even complete assignments for other courses in one class, which affects the teaching effectiveness. When courses in the same period are interrelated and integrated, it not only allows students to understand the connections between courses, but also reduces the workload of each course. For example, furniture design students who have taken the prerequisite course can use computers to deepen their plans, refine furniture materials, and handle details in rendering classes; courses such as design drawing, decorative materials, and construction can use digital design technology courses to understand how construction drawing standards can be implemented in computer software.

4.5 Multi-scenario teaching design

Through forms such as self-directed learning and flipped classroom (Baeppler et al., 2014), students are encouraged to design learning content, explore learning methods, and present their learning results in class. In this section, we deliberately avoided the group discussion commonly used by other teachers and chose a format where one student in a group would report, instead allowing each student to report their learning outcomes within seven minutes on lectern. At the same time, the cultivation of learning motivation avoids hollow indoctrination about the importance of learning, but creates conditions for students to be exposed to industries and cutting-edge technologies. Only when schools provide students with scenarios and environments will students spontaneously make their own judgments. Previous studies have shown a significant difference in learning outcomes between students' self-directed learning mode and teacher-directed learning mode. About 47% of the samples in the teacher-led learning mode are in low-movement units, while this number is only about half in the student-directed learning mode. The student-led or teacher-led learning model has a high correlation with students' learning motivation and supports the expected value theory in specific contexts (Kulakow and Raufelder, 2024).

At the same time, the current studio model introduces corporate resources into the classroom and even imposes

mandatory limits on the proportion of external mentors that companies must meet in current audit evaluations. In practice, however, the quality of instruction provided by invited mentors varies due to current reward mechanisms, constraint mechanisms, evaluation mechanisms, and factors such as the mentor's sense of responsibility.

The current talent development plan should consider providing more opportunities for students to work in foreign landscape companies, interior design companies, industrial design companies, and other work environments. These types of companies may be relatively rare in Ningbo, but it is relatively convenient to use the resources of the Yangtze River Delta and Shanghai. Industry practice courses can be used to familiarize students with the bilingual work environment of well-known foreign-funded companies such as HBA, CCDI, SWA, EDSA, etc. For example, the Department of Environmental Design has established school enterprise cooperation relationships with top 100 Chinese interior design companies such as Zhejiang Fuhua Decoration Co., Ltd., it may consider establishing campus cooperation with these companies in the future to provide students with high-quality platforms for learning and practice.

4.6 Personalized education

The teaching requirements and methods for students should be diversified and tailored to their individual needs. Expected value theory has clearly demonstrated the differences between different incentive models. Students can be distinguished not only on the basis of different levels of motivation, but also on the basis of differentiated performance, such as high or low expectations of success, which is also beneficial for maximizing teachers' teaching efficiency (Kulakow and Raufelder, 2024). In addition, due to the different levels of students' intelligence, their individual growth experiences determine that they cannot perform consistently in their studies, and there must be both good and bad aspects. Teachers who adhere to the principle of educating and nurturing students should be responsible for each student's learning status, but they should also pay more attention to the timeliness and effectiveness of teaching, invest limited time and energy in students who have the greatest chance of success, and maximize the educational output.

5 Conclusion

This study aims to investigate the role of digital design technologies within the curriculum framework and assess students' learning outcomes in such courses. Research findings indicate that amid turbulent market and employment conditions, students exhibit passive coping strategies or even resistance toward their studies. To address this phenomenon, educational institutions should develop more pragmatic and flexible teaching approaches to stimulate student motivation. Concurrently, given the rapid technological evolution in contemporary design

practices, environmental design programs must prioritize cultivating design thinking and creative problem-solving skills in their curricula.

Overall, digital design technology provides a relatively inexpensive way for students to express their design intentions. Therefore, some thematic training in the course can be combined with prerequisite courses such as design expression to help students understand the importance of digital design technology as a design tool. Teachers can guide students more through the design of various teaching processes, stimulate their learning motivation, and be cautious about mandatory requirements. Even if there are rigid requirements that students must implement, attention should be paid to skills to avoid students developing resistance.

Talent cultivation is a complex project. Adjusting professional content based on students' learning status also requires objective, fair and effective evaluation of learning outcomes, which involves many interrelated factors, such as explicit and implicit. The college's policy guidelines should be formulated and adjusted on the basis of the actual teaching situation through research and visits to all parties involved in teaching and learning, identifying the core of the problem, seeking truth from facts, and trying to solve the current problems so as not to be misled by subjective opinions; At the same time, attention should be paid to maximizing the efficiency of teaching operations, rather than policy idling, avoiding frequent changes, and maximizing the avoidance of teachers and students being exhausted by dealing with various formalism; By studying the course positioning and characteristics of digital design technology module course through educational reform projects, as well as its interrelationships with surrounding courses, we can grasp the teaching rules and use rich teaching forms in the classroom to improve students' learning efficiency. With the reserve of teaching staff, we can guarantee the long-term and healthy operation of the course and even the profession.

In the initial section of this document, the determination of the style of a design piece is inherently subjective and cannot be fully quantified. A single work frequently manifests numerous stylistic elements; therefore, the selection of the predominant style may introduce a degree of statistical bias. Notwithstanding, the aggregate data pattern maintains its pertinence. Concurrently, the bilingual pedagogical approach employed in "Digital Design Technology" remains in its nascent stage within the Environmental Design program at our institution. The current state of affairs reveals two significant limitations: first, there is a paucity of teaching resources, and second, there is a marked deficit in student engagement. These limitations inevitably result in a restricted sample size. The approach that has been employed thus far has primarily involved observation, description, and experiential summarization. However, the process itself requires greater rigor.

Advancements in digital technology, particularly the integration of artificial intelligence (AI) concepts, continue to present significant challenges for this course type and the broader field of design studies. More rigorous research findings, relying on mixed-methods, controlled comparisons, longitudinal tracking, and the like, are particularly necessary to provide a theoretical foundation for ongoing teaching reform.

Data availability statement

The original contributions presented in this study are included in this article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

NL: Investigation, Supervision, Conceptualization, Validation, Methodology, Data curation, Software, Writing – review & editing, Visualization, Resources, Writing – original draft, Project administration, Funding acquisition, Formal analysis.

Funding

The author declares financial support was received for the research and/or publication of this article. This manuscript was a teaching reform research project of Zhejiang Wanli University and was funded by Zhejiang Wanli University.

References

- Alcaide-Marzal, J. (2013). An exploratory study on the use of digital sculpting in conceptual product design. *Des. Stud.* 34, 264–284. doi: 10.1016/j.destud.2012.09.001
- Alumni Gathering | Our school alumnus Mao Yun won the UADA 2022 Urban Design and Architecture Design Award Gold Award. (n.d.). *Online post*. Available online at: <https://zsw.zwu.edu.cn/a2/27/c4805a172583/page.htm> (accessed August 28, 2025).
- Baepler, P., Walker, J. D., and Driessen, M. (2014). It's not about seat time: Blending, flipping, and efficiency in active learning classrooms. *Comp. Educ.* 78, 227–236. doi: 10.1016/j.compedu.2014.06.006
- Benson, L. (2013). "CAREER: Student motivation and learning in engineering," 121st ASEE Annual Conference & Exposition, Indianapolis, IN.
- Ceylan, S. (2024). The contribution of digital tools to architectural design studio: A case study. *Ain Shams Eng. J.* 15:102795. doi: 10.1016/j.asej.2024.102795
- Chen, K., and Owen, C. L. (1998). A study of computer-supported formal design. *Des. Stud.* 19, 331–359. doi: 10.1016/S0142-694X(98)00002-7
- Dreamson, N. (2017). Online collaboration in design education: An experiment in real time manipulation of prototypes and communication. *Int. J. Art Des. Educ.* 36, 188–199. doi: 10.1111/jade.12079
- Gong, P. (2023). Landscape art design of public environment based on the concept of sustainable development. *Computer-Aided Des. Appl.* 21, 113–125. doi: 10.14733/cadaps.2024.S2.113-125
- Hodgson, T. (2008). Digital design – the potential of computer aided designing in design learning environments. *Des. Technol. Educ. Int. J.* 11, 10–17. doi: 10.24377/DTEIJ.article1124
- Huang, A. (2014). *Research on bilingual teaching evaluation*. Beijing: Central Compilation Press.
- Jacobs, R., and Leal, S. (2018). "Digital participation through artistic Interventions," in *Digital participation through social living labs*, eds M. Dezuanni, M. Foth, K. Mallan, and H. Hughes (England: Chandos Publishing).
- James, C. (1976). The influence of bilingualism on cognitive growth: A synthesis of research findings and explanatory hypotheses. *Working Papers Bilingual.* 9, 1–43.
- Jason, J., and Vermillion, J. (2016). *Digital design exercises for architecture students*. England: Taylor & Francis.
- Knight, J. (2004). Internationalization remodeled: Definition, approaches, and rationales. *J. Stud. Int. Educ.* 8, 5–31. doi: 10.1177/102831530326083
- Kulakow, S., and Raufelder, D. (2024). Examining different motivational patterns in individualized learning. *J. Sch. Psychol.* 102:101256. doi: 10.1016/j.jsp.2023.101256
- Lau, H. Y. K., Mak, K. L., and Lu, M. T. H. (2003). A virtual design platform for interactive product design and visualization. *J. Mater. Process. Technol.* 139, 402–407. doi: 10.1016/S0924-0136(03)00510-7
- Lin, G. (2014). Review and prospect of environmental design education. *Chongqing. Higher Architect. Educ.* 23:1. doi: 10.11835/j.issn.1005-2909.2014.05.001
- Loy, J., Canning, S., and Little, C. (2015). Industrial Design Digital Technology. *Proc. Technol.* 20, 32–38. doi: 10.1016/j.protcy.2015.07.007
- Lynn, D. (2006). "Automotive design education embraces the digital age," in *Proceedings of the Eastman IDSA National Education Symposium*, (Texas).
- Malins, J., Pengelly, J., and Marshall, J. (2007). "The post disciplinary digital practitioner," in *Shaping the Future: Proceedings of the 9th Engineering and Product Design Education International Conference*, eds E. Bohemia, A. Clarke, K. Hilton, and C. McMahon (London: Design Society).
- Moreira, S. (2025). *Rendering styles: Different techniques and how to achieve them*. Available online at: <https://www.archdaily.com/960434/rendering-styles-different-techniques-and-how-to-achieve-them> (accessed August 28, 2025).
- Oehlberg, L., Lau, K., and Agogino, A. (2009). Tangible interactions in a digital age: Medium and graphic visualization in design journals. *Artif. Intell. Eng. Des. Anal. Manufact.* 23, 237–249. doi: 10.1017/S0890060409000213
- O'Hara, L., and O'Hara, M. (2016). *Teaching art and design 3-11 (2016.08)*. London: Bloomsbury Publishing.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author declares that no Generative AI was used in the creation of this manuscript.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the author wherever possible. If you identify any issues, please contact us.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Pipes, A. (2007). *Drawing for designers*. London: Laurence King.
- Poppeliers, J. C., and Chambers, S. A. (2003). *What style is it? A guide to American architecture*. Hoboken, NJ: Wiley.
- Posthumus, S., Sinclair, S., and Poplawski, V. (2018). Digital and environmental humanities: Strong networks, innovative tools, interactive objects. *Resilience: A J. Environ. Human.* 5, 156–171. doi: 10.5250/resilience.5.2.0156
- Shen, Y., and Yu, F. (2021). The influence of artificial intelligence on art design in the digital age. *Sci. Program.* 1:4838957. doi: 10.1155/2021/4838957
- Shih, N. (2006). RP-aided computer modeling for architectural education. *Comp. Graph.* 30, 137–144. doi: 10.1016/j.cag.2005.10.014
- Unver, E. (2006). Strategies for the transition to CAD based 3D design education. *Computer-Aided Des. Appl.* 3, 323–330. doi: 10.1080/16864360.2006.10738470
- Wang, K., and Chang, Y. (n.d.). Cultivating artistic creativity: An experimental study of the teaching of exhibition design based on creative thinking training. *Design* 37, 91–94. doi: 10.3969/j.issn.1003-0069.2024.07.026
- Yang, M., You, M., and Chen, F. (2005). Competencies and qualifications for industrial design jobs: Implications for design practice, education, and student career guidance. *Des. Stud.* 26, 155–189. doi: 10.1016/j.destud.2004.09.003
- Ye, J., Campbell, R. I., Page, T., and Badni, K. S. (2006). An investigation into the implementation of virtual reality technologies in support of conceptual design. *Des. Stud.* 27, 77–97. doi: 10.1016/j.destud.2005.06.002
- Yiwen, Y. (2012). *Reflections on the reform of bilingual teaching of design art majors in colleges and universities*. Beijing: Decoration.
- Zhuoyu, G. (2023). The relationship between urban public space reconstruction and environmental design. *J. Civil Eng. Urban Plan.* 5, 49–53. doi: 10.23977/jceup.2023.050908
- ZJD (2010). *Zhejiang Wanli University*. China: Zhejiang Daily.