



Development and Application of CAD Intelligent Clothing Based on Web Teaching Platform

Lan Hu 

School of Art, Chongqing Technology and Business University, Chongqing 400067, China,
hulan216@163.com

Corresponding author: Lan Hu, hulan216@163.com

Abstract. In the current social environment, if the traditional teaching mode and teaching philosophy are still adopted in apparel CAD teaching, the teaching quality will be seriously affected and the students' learning initiative will be greatly limited. Now, in view of some problems in the current course teaching, we explore the new teaching mode of this course based on the background of information technology to provide some reference for the teaching of this professional course. In this paper, through some problems in the existing teaching of apparel CAD course, we explore the new mode of teaching the course under the background of information technology, which mainly has "release task" "tool learning" "pattern making". In this paper, we explore a new model of teaching in the context of information technology by examining some of the problems in the existing teaching of apparel CAD course, which is mainly composed of four aspects: "issuing tasks", "learning tools", "plate making" and "evaluation and discussion", to improve students' participation and enthusiasm, thus enhancing students' interest in learning, really improving their learning efficiency, effectively improving the teaching quality of apparel CAD course and providing some reference for the teaching of this professional course. The purpose of this study is to improve the quality of teaching and learning of the apparel CAD course and to provide a reference for the teaching of this course.

Keywords: CAD Intelligent Clothing; Network Teaching System; Computer Aided; Web Teaching Platform

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1 INTRODUCTION

So far, there are more than 10,000 sets of domestic and foreign garment CAD systems used by garment enterprises and garment-related colleges and universities, of which China's CAD system occupancy rate reaches 80%, and the country's top-scale garment enterprises are close to 50,000, and the penetration rate of garment CAD has reached about 20% [1]. The use of apparel CAD

style design system can make the performance techniques of apparel painting richer, and the drawing of pattern is fine, although the use of computer drawing is slightly artisanal, but the designer can make it flexible and changeable through his own expression [2]. Garment CAD pattern design system, using computer to draw paper pattern, can improve the accuracy, and it is more convenient and time-saving to repair and change the pattern. Garment CAD process system, mainly two major functions of pushing board and scheduling, uses the computer to design the sample and establish the image or data information in one module. According to results of Guo et al. [3], traditional men's Chinese clothing performance elements are summarized as plate buckle, lapel, stand-up collar, tonic, Ji pattern and so on. The main representatives can be seen in the Qing Dynasty's horse hanging and the Republic of Zhongshan suit. The modern men's new Chinese clothing requires the fusion of traditional national essence with modern fashion trend concept. In the research of Teng et al. [4], the style modeling requires the national flavor with Western international structure to create a harmonious and unified clothing modeling. In order to meet the modern dressing habits of people mainly take a comfortable fit "H-type" style, after the overall silhouette is determined, modern men's new Chinese design is reflected in the details of the style structure [5].

The collar adopts the representative stand-up collar structure of Chinese clothing, and the design of the stand-up collar seeks changes in the same way through various design techniques by Hong et al. [6]. The sleeves are mainly designed with continuous sleeves, and the sleeve pieces are connected with the body by the method of three-dimensional cutting and flat design under the condition of maintaining the structural balance; the lapels are designed with nostalgic lapels and decorated with the most common one-piece plate buckle in Chinese clothing. Now the designers, in order to be more in line with the positioning of modern new Chinese clothing, will also use a double layer off the collar lapel in the design of the lapel, such a combination of design, collar a pair of plate buckle, hidden the location of the button, the lapel can be decorated by embroidery to enter the tricky, also achieved very good results, highly favored [7]. In addition, modern men's new Chinese clothing in the design process to reflect the people-oriented thinking, integrated consumer groups' identity, body shape, activity needs and many other issues, had to consider an important design element of practical functionality. This thesis takes the continuous sleeve structure as a typical representative to study by Yao [8]. The traditional continuous sleeve structure has the distinctive feature of being able to use a whole piece of cloth to complete the front and back body and sleeve cutting, the front and back body and sleeve are symmetrically cut, the front and back body are cut continuously, the sleeve and body are planted continuously, the shoulder line and the middle line of the sleeve are not separated in a straight line, which is a typical flat modeling way. The entire body part and the sleeve part are wide and wide without saving the way to remove the extra amount. Clothes through the trial found that, because there is no design in the composition of the amount of thickness, too much loose volume into the thickness of the body, although the maximum amount of human arm activity is met, but the arm down, because the modeling structure and the human arm does not match, so that the gland under the gathering of more surplus to form a wrinkle, neither comfortable nor beautiful heart by Akhtar et al. [9]. In order to solve this problem, the basic sample of men's new Chinese top jacket designed in this paper improves the traditional one-piece sleeve structure by separating the front and back pieces of the garment, removing the surplus at the shoulder, and adopting the shield slant and shoulder sleeve slant that meet the human body's requirements for fit and movement, so that the one-piece sleeve is separated at the shoulder and sleeve seams to form two front and back pieces. The other parts of the basic sample are positioned according to modern dressing standards, using the basic formula to locate the outline and points of key parts before depicting them visually by Lee and Park [10]. With flipped classroom teaching, students can have a preliminary understanding of the new apparel CAD design knowledge by watching the teaching video released by the teacher in advance, which not only further changes the relationship between teachers and students in traditional teaching, but also helps to improve the communication efficiency between teachers and students, which greatly saves the time needed in classroom teaching [11].

The purpose of this paper is to address the relatively small number of current Chinese men's clothing enterprises and the lack of research on men's new Chinese clothing samples, which cannot realize the requirements of men's consumer groups for new Chinese clothing in terms of fit, movement and comfort, not to mention personalized requirements. In this study, we analyzed the parameters affecting the structure of the sample, determined the experimental plan, and made the experimental sample for objective evaluation. Thus, the optimal combination of parameters for the addition and release of men's one-piece sleeve Chinese tops is derived by using the method of data analysis. After determining the custom parameters, the basic paper sample is designed in combination with the CAD intelligent patterning system to realize the rapid design and automatic generation of garment samples. It solves the problem of how to carry out sample design efficiently and quickly, shortens the design cycle, and meets the rapid response of enterprises to market demand.

2 APPAREL CAD COURSE NATURE AND CONTENT

2.1 Course Content of Apparel CAD

After more than 40 years of continuous development, apparel CAD has gradually become standardized, intelligent and integrated, and has become an indispensable tool for apparel companies to make plates, while playing an important role in the process of apparel management, production and intelligence. Research shows that not only some large garment enterprises attach importance to the use of garment CAD technology, but also 90% of small and medium-sized garment enterprises have gradually begun to accept and apply garment CAD technology. The reasons for this are the unique advantages of apparel CAD technology, which are mainly reflected in the following points.

(1) Company management advantage clothing

CAD technology is a series of operations such as plate making, yardage, board pushing, etc., which can be named and saved directly on the computer after completion, making the paperless operation more convenient and quicker than the traditional paper-based manual drawing. In addition, the apparel CAD system can reduce the loss of talent flow, when the apparel enterprise encounters the relevant talent loss, its related structure data is still stored in the computer, will not disappear because of the loss of talent.

(2) The advantageous clothing of technical information of clothing enterprises

The CAD system is also very convenient for saving paper samples and other technical data, so you can directly modify, rename, and save them on the basis of the original one when you encounter a similar style. At the same time, the CAD system can be used to draw the structure of the diagram repeatedly to try, undo and other operations, without leaving any trace, and the operation is fast. Its technical advantages are also reflected in the process of placing and scheduling, manual placing and scheduling is very tedious, time-consuming and labor-intensive, but for the garment CAD system, you only need to enter the corresponding values, you can automatically place the code, scheduling, etc., the operation is convenient and fast, saving time, energy and materials.

(3) Production efficiency of the advantage of clothing

CAD systems can effectively shorten the product design and production cycle and greatly improve production efficiency compared to traditional ones. According to relevant statistics, the use of apparel CAD systems can effectively improve the utilization rate of fabrics, can significantly reduce the design cycle and production costs of apparel products, and can also save manpower or work space.

At present, the apparel CAD course is taught in the computer room of the college, and the teacher mainly explains the use and operation of the tools, and after the demonstration of one tool, students learn the corresponding tool. In general, the students' learning status is rather passive,

their motivation is not high, and the overall classroom atmosphere is not active. In the learning process, students with strong self-control can practice frequently with the tools they have learned, while some students with weak self-control start to desert after operating the tools once, resulting in unskilled operation of the tools and frequent mistakes in subsequent operations such as pattern making, placement and nesting, which can easily make students feel self-destructive and unfavorable to subsequent learning. From the introduction of the interface, the role of tools and the operation methods, to the drawing of the overall structure of the garment style, the placement of the code and the material, the teacher demonstrates the relevant tools and then the students practice the operation. Therefore, the learning task is relatively heavy, and in order to achieve the purpose of proficient operation of tools, students must practice repeatedly, and practice makes perfect. For students, the whole learning process is relatively boring and tedious, leading to a decline in students' interest in learning and lower learning efficiency.

By analyzing some problems in the teaching of apparel CAD course, and further researching on the basis of understanding students' learning characteristics, learning methods and the needs of relevant apparel enterprises, we explore a new mode of teaching apparel CAD course by combining information technology to realize the integrated teaching design of "teaching, learning, doing and evaluation". The implementation plan of the model is shown in Figure 1.

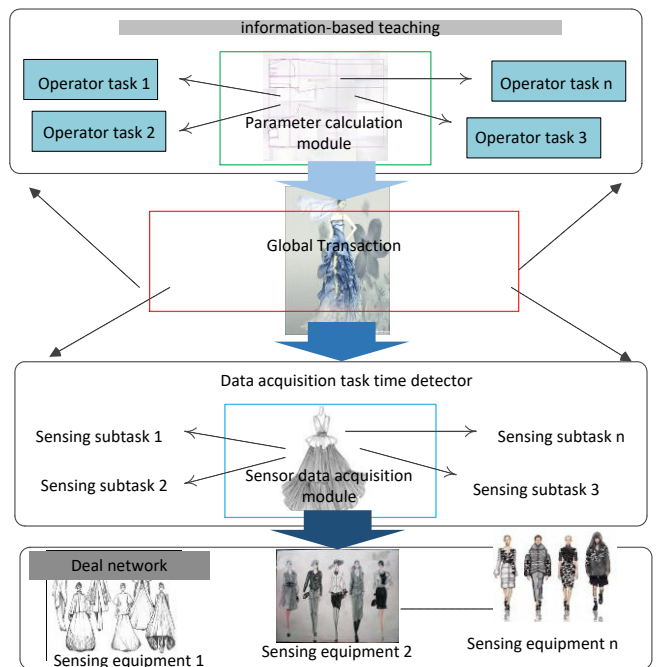


Figure 1: A new model of information-based teaching.

The teaching mode of the course under the background of informatization mainly includes "issuing tasks", "tool learning", "plate making operation demonstration", "evaluation discussion". The four aspects of "evaluation and discussion" are: the teacher releases the task, the students learn the tools and demonstrate the plate-making operation, and finally the teachers and students evaluate and discuss together, each of which uses information-based teaching methods. Firstly, the teacher releases the learning task with the help of the information technology teaching platform, for example, the task is released as "women's western skirt making", and then the final presentation effect is displayed to let students have an intuitive understanding of the final goal; secondly, the teacher communicates with students to make them understand more about the actual goal they

need to accomplish under the task and the corresponding knowledge they will get after completing the goal. Finally, the students are grouped together, taking into account their actual situation and abilities, as well as being informed of the time required to complete the task and the final evaluation method. Students analyze the tools to be used through task analysis and group discussion, and then enter the "tool learning" session to prepare for the final plate making task, improving the original fixed teaching model, increasing student participation and motivation, and thus improving the teaching outcomes. Students learn different tools and multiple functions of the same tool to gradually complete the established plate-making task, and during this period, they use the information technology teaching platform to demonstrate the operation, and further communicate and learn between students and teachers and between students and students, and students learn how to use different tools in apparel CAD by completing the plate-making operation, which is more effective. Some platforms automatically generate a playback function after the students' demonstration on the information technology platform, such as the Tencent Classroom software, so that other students can watch it again and again, and also have further evaluation and discussion, etc. In addition, the use of tools in the apparel CAD course is diverse, and students can learn more operational methods to achieve their goals through discussions. The above scheme provides a preliminary idea, which needs to be improved later according to the specific teaching activities in the course and the problems that arise during the teaching process.

2.2 Practical Training Conditions for Apparel CAD

In order to better ensure the effect of apparel CAD teaching, the flipped classroom teaching method should be reasonably introduced, and the course content should be designed more scientifically and reasonably, fully combining the main contents of apparel design and apparel drafting to further consolidate the students' software tools operation level, which can be reasonably introduced in the flipped classroom video content design, as shown in Figure 2, such as pushing board, punching board and material arrangement training content to ensure Students can better master the corresponding knowledge of apparel design and drafting process, and further help them understand the knowledge content corresponding to the apparel design profession in the process of practical operation of apparel CAD. In the process of apparel CAD teaching, the focus includes comprehensive practical training and basic theoretical knowledge, which needs to be fully combined with the students' own professional characteristics in the design of the flipped classroom to arrange the corresponding teaching content, to prevent the emergence of large span of courses or disconnected courses and other undesirable problems, and at the same time, fully combined with the limits of the course time, to develop a more detailed course plan. At the same time, a more detailed curriculum plan should be made, taking into account the time limit of the course, so as to allocate the practical time required for each teaching module of apparel CAD teaching in a scientific and reasonable way, so that the theoretical teaching can be better integrated with the practical teaching and further reflect the practical characteristics of the flipped classroom teaching method in apparel CAD teaching. In the actual teaching stage, teachers should also actively listen to the suggestions from other teachers and education experts to further promote the improvement of the flipped classroom curriculum, so as to better break through the time and space limitations of traditional teaching and steadily improve students' understanding of apparel design knowledge.

First of all, in the apparel CAD flipped classroom teaching, the most important thing is to improve the corresponding teaching hardware and equipment, the school should have a complete apparel CAD system equipment and training base to ensure that the flipped classroom teaching can be carried out better, while following the basic production standards of social enterprises, to ensure the normal operation of the overall system. In a mature system, CAM and ERP systems are available, with emphasis on digital instruments, computer equipment and cameras, and color printers and drawing instruments are among the output devices, as shown in Figure 3. The procurement of large modern equipment is based on the current economic situation.

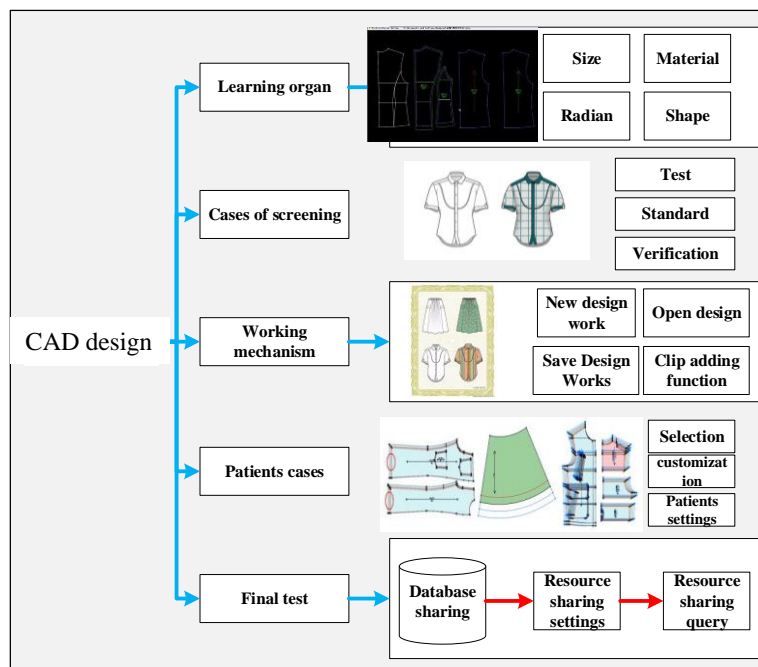


Figure 2: CAD-based classroom design.

In addition, in order to promote the application of the flipped classroom teaching method, it is necessary to establish a multimedia network classroom with strong functionality and optimize the learning process of apparel CAD, provide students with more excellent video learning materials and operating platforms, and use the local area network to better synchronize with the broadcast teaching, and steadily improve the quality of apparel CAD teaching; second, build On the one hand, we should build a software system for apparel CAD and update it according to the actual development of society; on the other hand, we should equip a professional team of teachers who can use their rich teaching experience to carry out flipped classroom teaching and steadily improve the effectiveness of apparel CAD teaching on the basis of combining theoretical knowledge and practical ability.

Second, in the flipped classroom apparel CAD teaching, should focus on cultivating students' own thinking habits and ways of thinking, in the current social background, there are a variety of apparel CAD technology, such as foreign Esteem and Liker, etc. Therefore, in the actual teaching process, teachers do not need to teach all the software to students, but should combine the main characteristics of the software, and use the flipped classroom approach to carry out targeted teaching. Therefore, in the actual teaching process, teachers do not need to teach all the software to students, but should combine the main characteristics of the software, and use the flipped classroom approach to carry out targeted teaching, in which at least two representative apparel CAD software should be selected, in the specific teaching process, one of the software should be explained in detail, and the other software should be arranged for students to carry out independent learning, the teacher should also give corresponding guidance at the necessary time, and guide students in the learning process, according to the differences between different software Secondly, to develop students' practical skills, in order to use the apparel CAD software more efficiently, students should have relatively strong operational skills, for example, in the teaching process of the punchboard module, students are required to create a 1:1 drawing in advance.

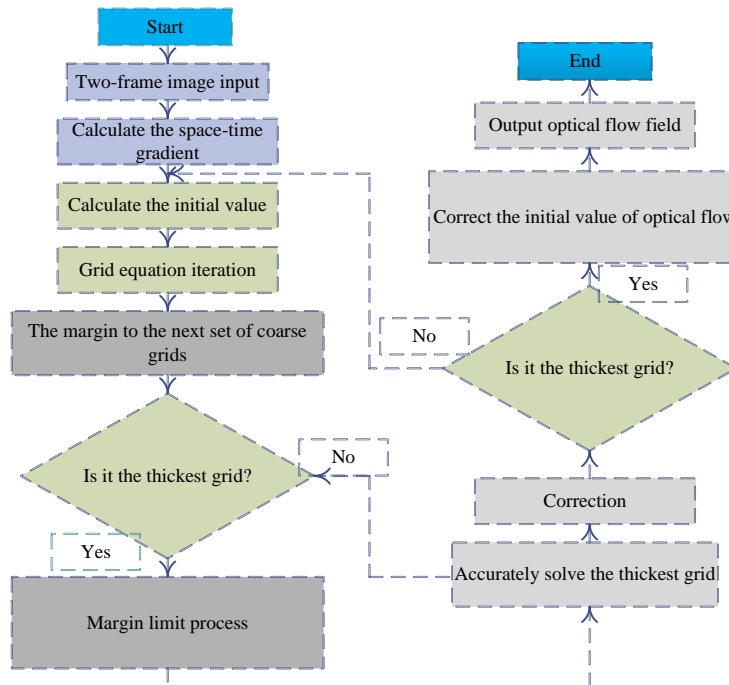


Figure 3: Flowing process of CAD teaching system.

For example, in the teaching process of the patterning module, students are required to make 1:1 paper samples in advance and use them as the basis to complete the patterning, while using the flipped classroom teaching method, students can understand the software used in advance, so that they can complete the corresponding learning tasks within the specified time, which not only allows students to think deeply about the advantages and differences between hand-made patterns and computer-drawn patterns, and write their own experience in operation. experience. In the actual teaching process, students can also be encouraged to use the CAD software to design garments better, which can bring the practical effects of the flipped classroom into full play.

3 WEB-BASED TEACHING CAD APPAREL DEVELOPMENT PLATFORM

3.1 Advantages of Apparel CAD

The use of apparel CAD software to assist in apparel design can be very useful, yet some students do not pay enough attention to this aspect of learning. Therefore, teachers can use the flipped classroom approach to guide students to recognize the importance of apparel CAD software so that they can actively participate in classroom activities. At the same time, teachers should focus on cultivating students' creative ability and professional quality, rather than simply explaining the details and specific functions of apparel CAD, which in the traditional teaching process, teachers only combine the basic functions of apparel CAD software to show students the overall drawing process and design operation process, which is very lacking for the software. Even if students master the operation of CAD software in the classroom, it is difficult for them to apply the knowledge they have learned in the workplace after graduation. In addition, the teacher should not only focus on the operation methods and skills, but also explain the ideas of using the software, and use the flipped classroom to set up the corresponding teaching videos, so that students can

watch them according to their own shortcomings, to ensure that students can better use the functions of CAD software, and to clarify the core functions and specific features of the software. The core functions and specific features of the software are clearly defined. In addition, in the actual teaching process of apparel CAD, students should be shown the accuracy and standardization of computer-aided design, which can save a lot of practice in drawing apparel design and can visually and graphically show the position, shape and quantity of the fabric to ensure that students can have a more comprehensive knowledge of the work they are involved in. In the absence of drafting tools, students should use CAD to complete the design task, complete the layout and layout of materials and other operations, so that students can fundamentally understand the importance of CAD software, and fully stimulate the enthusiasm and initiative of students to learn the CAD software.

The application of computer-aided design in college apparel design teaching, on the one hand, teachers can carry out demonstration teaching work of apparel design software with the help of multimedia technology to present relevant contents vividly and intuitively, on the other hand, students can design with the help of Photoshop, apparel CAD and other software to present their design concepts in a diversified and standardized way through computer. The powerful editing and calculation functions of computer software can help students achieve visual effects that are difficult to express by hand drawing, and also allow students to quickly modify and store their design drawings, playing the role of design assistance. The application of computer-aided design in the teaching of college apparel design helps to improve the efficiency of teaching, and in the process of students' learning, they can better master the way of computer software application, which can also have an important impact on their future career development. After the students' independent design is completed, they can also realize the sharing of works through computer, display the students' excellent design works, realize classroom communication and interaction, and enhance the authenticity and visual value of clothing effect. It can also be downloaded through the network platform after class, or anonymous excellent works selection among students with the help of the network, etc. The exchange of garment design works is realized in the network to maintain students' interest in design and to keep learning and progressing in the exchange.

3.2 Discussion of the Results of Computer-Aided Design

CAD is the effective auxiliary software designed with the help of computer technology and graphic equipment, which is widely used in many industries. Based on the process of garment design and production, several links such as garment pattern making, pattern scaling and fitting can be designed with the aid of CAD software to enhance the close integration of each link and to achieve the role of automatic production, which is an effective way to improve design efficiency and work efficiency, as shown in Figure 4. In the teaching of garment design in colleges and universities, students can be instructed to use CAD software flexibly. It can not only improve the efficiency of apparel design teaching, but also help students lay a good foundation for their future career work and development. In the process of apparel pattern making, the application of apparel CAD software can improve the design efficiency, especially for the pattern with more changes in pleats, the efficiency of pattern making with the help of apparel CAD software is significantly higher than the manual operation method. In the process of garment plate repair, only the basic code needs to be modified on the already pushed code pattern, then the relevant pattern will also be automatically changed, and the work efficiency is significantly improved, as shown in Figure 5.

Apparel CAD course is generally the core course of apparel majors, which is based on the completion of apparel structure design and apparel technology skills courses, and the comprehensive use of modern computer software for apparel pattern design, pushing the board and scheduling expertise and skills, laying a professional foundation for subsequent course learning and apparel enterprise positions, as shown in Figure 6. At present, the garment CAD software commonly used in colleges and universities are Fuyi, ET, ZhiZunBaoFang CAD and RishengTianChen, etc., which are developed in China, and the software developed in foreign countries are Rick and PGM, etc. The kinds of garment CAD software are not uniform and the

systems are usually incompatible with each other. On the one hand, this situation is related to the local garment enterprises served by colleges and universities, and on the other hand, colleges and universities are facing the confusion of software selection.

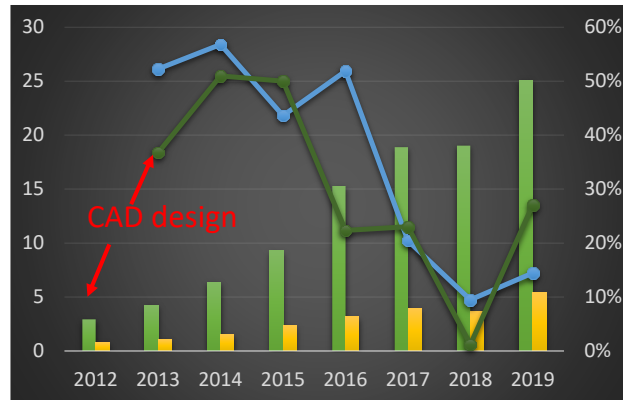


Figure 4: The introduction of CAD technology to improve design efficiency.

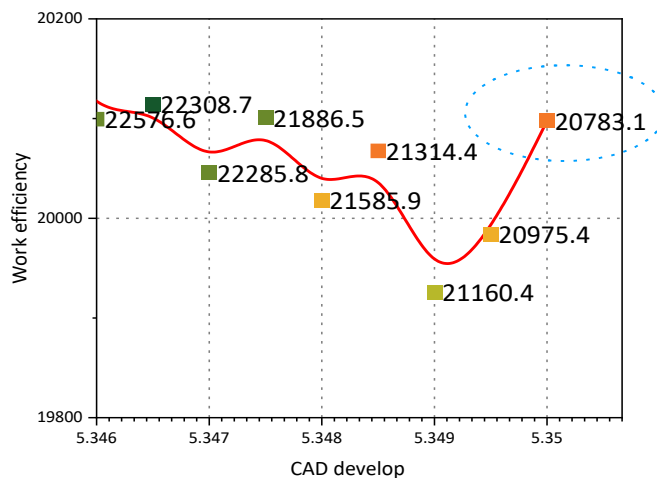


Figure 5: Changes in work efficiency.

Strengthen the connection with the previous and after courses to enhance the practicality of the apparel CAD course, and also to increase students' interest in learning. Combine student practice files with the apparel 3D virtual fitting software to achieve garment effects with virtual mannequins. By allowing students to perform virtual fitting process, they can more deeply experience the garment effect of garment CAD pattern making. The virtual fitting realizes the information digitization of the whole garment design process through the steps of mannequin adjustment, fabric simulation, virtual stitching, pattern correction and dynamic display, as shown in Figure 7. Realistic simulation of the real effect of clothing, on the one hand, it is easy to find the pattern problems, on the other hand, it is also easier to stimulate the students' active innovation. Apparel CAD course is a basic course for apparel majors and has a very important position in the curriculum system of apparel higher education.

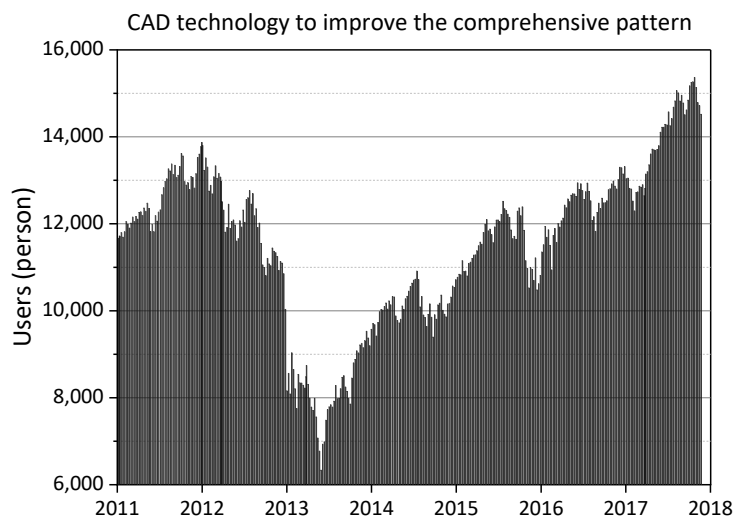


Figure 6: CAD technology to improve the comprehensive pattern design ability.

Through the apparel CAD course teaching, mainly to train students to use software tools for plate drawing, production and processing in the apparel industry comprehensive ability. The apparel CAD course is an important link between apparel modeling and apparel technology, and is an important guarantee of apparel quality in the apparel production process. At present, the traditional classroom teaching of apparel CAD usually consists of teacher demonstration and student practice. This traditional teaching mode is limited by classroom time. On the one hand, teachers can only give individual tutorials and cannot take care of every student; on the other hand, each student has limited time to concentrate, so students' ability to think and innovate is restricted within the limited time, and their learning efficiency is affected.

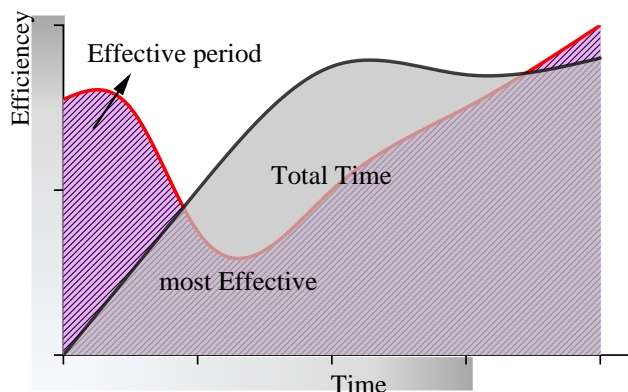


Figure 7: Effectiveness of web-based learning platform in improving learning efficiency.

In the context of the deep integration of information technology and education teaching, "micro-courses" have the advantages of being short, fast and efficient, which meet the characteristics of modern people's mobile learning and fragmented learning, and can become the main material for extra-curricular learning and review. We make micro-video for specific problems such as easy mistakes and difficult points. Although the key points and difficulties of the course content are explained in detail in the classroom, occasionally students do not pay attention, or have

misunderstandings, do not have a good grasp of some drawing tools and drawing methods, and often make mistakes in the practice process, making micro-videos on the teaching website, not only saves the teacher's classroom tutoring time, but also allows students to watch repeatedly to check and fill in the gaps. Virtual simulation test, using VR technology such as computers to realize simulation test, so that students can experience the teaching content of apparel CAD course more realistically. Introduce fashionable styles in the apparel market to the classroom and introduce enterprise projects. Through the selection of popular styles in the market, the structural changes of garment modeling are reflected in specific styles, and the basic composition theory methods are applied to actual cases. Although it is not as comprehensive as traditional teaching system, it can reflect the changes in style in specific styles. Students can't learn all the styles in school, so we pay attention to the development of students' clothing modeling methods, working ideas and working habits, so that students can have the innovative consciousness and ability needed by enterprises and better serve garment enterprises.

4 CONCLUSION

At present, some college classrooms still use traditional teaching methods and traditional teacher-teaching methods, which to some extent limit the long-term development of students' creative thinking. Due to the impact of the new crown epidemic, online classes have been fully implemented in the country. In recent years, the Internet has also gradually become popular in China, and the forms of integrating education with information technology have become more and more diversified. Apparel CAD course, as a practical and fast-changing apparel professional course, should be combined with modern information technology and innovative teaching mode to promote the overall development of cultivating students' ability. Information technology has become an important way to cultivate innovative talents in colleges and universities. The application of information technology in apparel education is no longer a simple traditional classroom plus computer-assisted teaching, but should be student-centered, centered on cultivating comprehensive and innovative abilities, and better adapted to the needs of enterprises. We should deconstruct the elements of apparel CAD course, integrate teaching contents, combine information technology, change teaching methods, and use network technology to create a teaching mode of apparel CAD course that can support diverse resources such as information access, resource sharing, multiple interactions, and school-enterprise collaboration, in order to cultivate professional talents who can better serve the apparel industry.

Lan Hu, <https://orcid.org/0000-0002-4282-3115>

REFERENCES

- [1] Cheng, W.; Cheng, Z.-L.: Applications of CAD in the Modern Garment Industry, Applied Mechanics and Materials, 2012, 1505-1508. <https://doi.org/10.4028/WWW.SCIENTIFIC.NET/AMM.152-154.1505>.
- [2] Hu, L.: Design and Implementation of a Component-Based Intelligent Clothing Style Cad System, Computer Aided Design and Applications, 18, 2020, 22-32. <https://doi.org/10.14733/CADAPS.2021.S1.22-32>.
- [3] Guo, H.; Ying, B.; Zhang, X.; Qi, J.: Acquisition of Plate-Making Process Knowledge for Smart Clothing Cad Systems, Journal of Fiber Bioengineering and Informatics, 12(3), 2019, 137-145. <https://doi.org/10.3993/JFBIM00295>.
- [4] Teng, Y.; Wang, R.-M.; Luo, X.-N.; Li, J.; Jiao, J.; Mao, A.-H.; Guo, Y.-P.; Li, Y.; Liu, Y. -F.; Luo, X. N.; Li, J. S.: M-Smart-an Improved Multi-Style Engineering Design Cad System for Clothing Thermal Functions, Journal of Fiber Bioengineering and Informatics, 4(1), 2011, 1296-1303. <https://doi.org/10.3993/TBIS2011229>.

- [5] Nagasawa, I.: Feature of Design and Intelligent Cad (Knowledge Engineering and Production Technology), Journal of the Japan Society For Precision Engineering, 54(8), 1988, 1429-1434. <https://doi.org/10.2493/JJSPE.54.1429>.
- [6] Da-Hong, L.; Hong-Yan, L.; Wei, L.; Guo, J.-J.; En-Zhong, L.: Application of Flipped Classroom Based on the Rain Classroom in the Teaching of Computer-Aided Landscape Design, Computer Applications in Engineering Education, 28(2), 2020, 357-366. <https://doi.org/10.1002/CAE.22198>.
- [7] Ige, O.-A.; Hlalele, D.-J.: Effects of Computer-Aided and Blended Teaching Strategies on Students' Achievement in Civic Education Concepts in Mountain Learning Ecologies, Education and Information Technologies, 22(6), 2017, 2693-2709. <https://doi.org/10.1007/S10639-017-9598-X>.
- [8] Yao, S.: Application of Computer-Aided Translation in English Teaching, International Journal of Emerging Technologies in Learning (IJET), 12(8), 2017, 105-117. <https://doi.org/10.3991/IJET.V12I08.7145>.
- [9] Akhtar, S.; Warburton, S.; Xu, W.: The Use of an Online Learning and Teaching System for Monitoring Computer Aided Design Student Participation and Predicting Student Success, International Journal of Technology and Design Education, 27(2), 2017, 251-270. <https://doi.org/10.1007/S10798-015-9346-8>.
- [10] Lee, J.; Park, H.-K.: A Study on Cases for Application of Flipped Learning in K-12 Education, journal of digital convergence, 14(8), 2016, 19-36. <https://doi.org/10.14400/JDC.2016.14.8.19>
- [11] Akçayır, M.; Akçayır, G.: Advantages and Challenges Associated with Augmented Reality for Education: A Systematic Review of the Literature, Educational Research Review, 20(20), 2017, 1-11. <https://doi.org/10.1016/J.EDUREV.2016.11.002>.