





Design and Implementation of Computer-Aided Art Teaching System based on Virtual Reality

Laiyun Feng^{1*}  and Wanlu Zhang² 

¹School of Art, Jiaozuo University, Jiaozuo 454000, China,
fenglaiyun@jzu.edu.cn

²School of Art, Jiaozuo University, Jiaozuo 454000, China,
wanluzhang@163.com

Corresponding author: Laiyun Feng, fenglaiyun@jzu.edu.cn

Abstract. As a high and new technology, computer aided technology based on virtual reality has been widely used in science and technology, medical treatment, national defense and military, art and many other fields. With the continuous promotion of education reform in recent years, art education curriculum in primary and secondary schools is gradually introducing advanced science and technology. Through the use of virtual reality technology and school education, it well avoids the disadvantages of traditional art teaching simple retelling, mechanical replication, it is a multi-structure teaching mode, the mode of art teaching theory and computer digital multimedia technology combined, forming a new method based on computer aided art teaching. The new model applies the advantage of computer technology to art education, promotes the orderly development of art education, and improves the professional learning level of art educators and learners. At first, this paper starting from the application value of computer aided technology, analyzes on the advantages of the auxiliary teaching, and then studied the auxiliary platform system design, and analyses the system's database construction and web search services, system framework and the teaching process is given, and the final system was applied to art teaching practice, has obtained certain achievements.

Key words: Virtual reality; Computer aided; Art teaching system

DOI: <https://doi.org/10.14733/cadaps.2023.S1.56-65>

1 INTRODUCTION

At present, China's fine arts curriculum according to the geographical distribution is slightly different, the characteristics of the teaching reality together for example textbooks, teaching materials and professional educators project instance, although the existence of a small amount of

use computer platform to carry out the art teaching, but these phenomena mainly tend to display and a small amount of courseware electronic tutorials and focus on the drawing and storage of applied teaching materials, for the construction of learning environment based on computer network and the development and implementation of learning mode and other forms have not given attention. Bi [1] thinks that it can say around educators as the center and teaching art in unidirectional teaching mode is still the mainstream, to fully exert computer teaching platform of network model for personal cultivation of learners, the formation of independent professional learning, research, interactive, haven't really realized, to computer digital network learning platform to the study of the teaching mode is still in its infancy.

Wu et al. [2] think that generally speaking, the teaching environment of the computer digital network learning platform is more suitable for research learning. Bi et al. [3] considers that he computer digital network learning platform has the characteristics of autonomy, interaction, inquiry and application. At present, in the practical application of research learning based on computer digital network learning platform, the use of computer is only in the search and retrieval of teaching materials. The new characteristics of computer digital network technology, such as rapid transmission, instant interaction, resource sharing and global synchronization, have not been fully developed. The computer digital network learning platform will provide support for research learning, and provide sufficient theoretical and practical environment for research based on computer aided art teaching.

Computer-assisted instruction (CAI) refers to a variety of teaching activities in colleges and universities assisted by computers. Feng [4] thinks it is a teaching training method and technology that students discuss teaching content, curriculum arrangement and other issues by means of dialogue. Computer aided instruction provides students with a good personal learning environment. Through the comprehensive use of artificial intelligence, multimedia and other network technology, to avoid the traditional teaching mode of single, one-sided shortcomings, shorten students' learning time, improve the quality of teaching, teaching objectives will be optimized.

As a computer aided technology, virtual reality technology (VR, see Figure 1) originated in the 1960s. Its goal is to create a virtual world that can be "immersed, interactive and imagined" through various technical means, so that people can not only feel the objective world lifelike, but also get the experience that cannot be experienced personally. Virtual reality technology integrates multimedia technology, sensing technology, Internet technology and so on. Adem [5] considers it has been widely used in science and technology, medical care, education, national defense and military, art and other industries, and has become an emerging industry with technological development and business model constantly innovating. This technology has three main characteristics: immersion, interaction and imagination. Immersion refers to making the experiencer feel the object image restored in the virtual environment with a strong sense of reality through the form of three-dimensional images. Interactivity refers to interactive manipulation with objects in the virtual environment in a specific virtual environment. The computer can process gestures, actions and other relevant data of the experiencer in real time and make responses. Imagination means that virtual reality technology can not only truly restore the objective environment, but also arbitrarily build things that do not exist in the virtual space, so that people can observe and experience richer scenes and images, and feel the charm of different situations. Introducing virtual reality technology into art education curriculum to show the teaching content in a vivid, lifelike and flexible form can greatly enrich the teaching form, improve the attraction of the course content, and enable students to be more active and focused on learning [6-7].

This study takes the fine arts curriculum integrated with virtual reality technology as the carrier, combines education and teaching with technology, develops teaching resources of virtual reality technology, and applies teaching to provide a new vision for the study of fine arts education and virtual reality technology. Using the immersive, interactive experience and interesting features of virtual reality technology to design and complete relevant curriculum resources, cultivate students' innovative consciousness and creative ability, boost the realization of the value of art education, improve the ability to find and solve problems, and further develop art education [8-9].

By applying new technology to art classroom teaching activities, traditional teaching methods can be improved to improve teaching efficiency and learning effect. Virtual reality and other technologies, as new means of auxiliary teaching, can enrich teaching forms, better stimulate students' enthusiasm and expand their imagination space. It can promote learners' mental thinking and practical ability, strengthen their active learning ability, and break through the pain points that cannot be solved by traditional teaching methods [10].



Figure 1: Virtual reality technology.

2 DESIGN IDEA OF ART TEACHING SYSTEM

The teaching mode of traditional art is "mentoring system". According to the teaching mode of "mentoring system", the teaching form can be summarized as follows: educators pass and teach art professional knowledge -- give learners art professional general education; Pedagogue art painting design demonstration -- to give learners art creation law training; Pedagogue art professional practice guidance -- to give learners art painting skills training; The "dual structure" teaching mode consists of four parts: appreciation and appreciation of art works by educators -- cultivation of learners' artistic aesthetic accomplishment.

At present, the advantages of computer digital technology and network technology are the embodiment of the characteristic function of computer aided art teaching mode. The model of computer-aided art teaching covers three theories of constructivism learning, humanistic learning and situational teaching. It is built and formed on the learning platform of computer digital network technology, and its main carrier is "digital network learning platform". The model is a research-based learning solution that includes realistic education activities of art educators and takes into account digital virtual experts, virtual administrators, virtual teachers and digital network databases. Its functions have the following characteristics:

1. Computer-aided art teaching mode has the function of cultivating learners individually. The new model embodies the learner-centered viewpoint advocated by constructivism learning and situational teaching theory, and the educator only acts as an assistant and guide. The new model of personalized training is a great complement to the traditional art general education.

2. "Digital Network learning platform", the main carrier of computer-aided art teaching mode, reflects the characteristics of modern digital teaching, which is a learning environment of "interaction" and "interactive penetration" based on the combination of constructivism learning and humanistic advocacy of digital teaching functions. New mode key depends on computer information resources, sharing interactive network environment, promotes the learning phase of the efficient learning of modern art, giving learners online interactive communication,

communication research, teamwork involved in the new environment, new condition, at the same time convenient online educators to guide and evaluate learners' research in time.

3. The computer-aided art teaching model has a rich database of digital materials and course notes, which can provide the reference of art creation materials and course learning for learners. The stimulation of intrinsic learning power advocated by humanistic learning theory plays an important decisive role in promoting art learning activities. The new model uses the concept of research-based learning to rationally integrate the intrinsic learning power theory of humanistic learning into the construction of the new model. The new model, with its openness, extensibility and richness, provides learners with a rich digital resource environment, which is beneficial to enhance learners' creative desire in art learning, and plays an important role in determining the intrinsic motivation of teaching in promoting art learning activities.

4. A computer aided art teaching mode is the perfect embodiment of computer digital learning concept, the new model is to integrate information technology and the art course, at the same time, a new mode to build virtual experts, teachers, managers of virtual learning environment of the participants, such as strong make up for the traditional art education model of repeated demonstration about teaching, classroom teaching shortcomings. Virtual experts provide supplementary functions for young teachers' teaching experience; The virtual teacher provides the repeated demonstration function of course teaching; The virtual manager provides the shaping function of the virtual classroom learning environment under the non-real environment.

Different from traditional art "dual structure" teaching mode, computer-aided art teaching mode is "multiple structure" teaching mode, because it includes participants in digital network (art educators and learners beyond time and space) in addition to the two participants of art educators and learners in real space. Teaching mode broke traditional fine arts teaching and learning of "dual structure", formed the educators, learners, digital network learning platform, virtual participants (virtual managers, experts, virtual classroom) "multiple structures" relationship, such as the "multiple structured" teaching mode embodies the equality of all participants in the mode of interaction. The extensive application of VR in education can be summarized into the following topics: research on VR's own technology optimization and technology integration; VR technology optimization and technology integration research, VR education and teaching design research, VR education and teaching development research, VR in education and teaching application research, as shown in Figure 2 and it also can be seen in Figure 3.

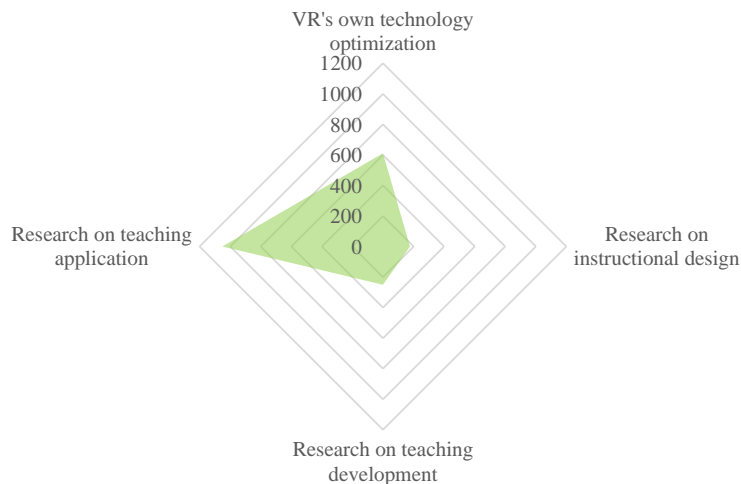


Figure 2: VR and educational research status radar map.

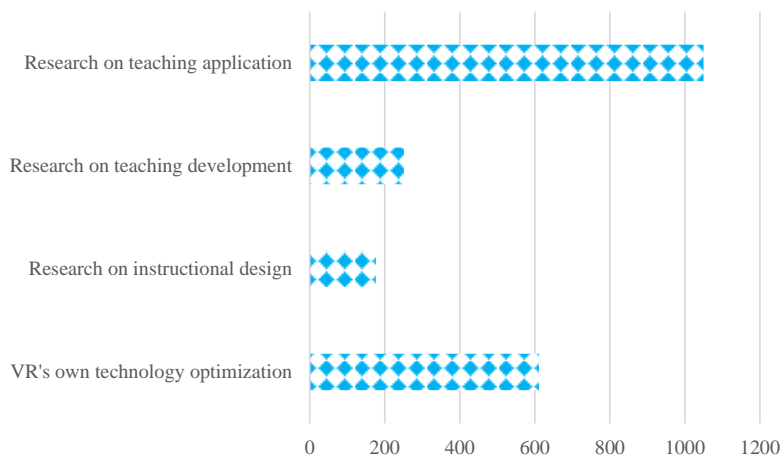


Figure 3: Collom map of VR and educational research status.

In the past teaching, teachers usually use language to describe or use slides and other forms of multimedia teaching; But now, immersive virtual reality technology can be used for experiential teaching, so that students can get richer and diversified experience in the art class, promote the formation of students' cognitive structure, and can greatly stimulate students' creative thinking. On the basis of cultivating students' creative thinking, teachers should also devote themselves to the continuous development of students' creative thinking and guide students to use more abundant artistic means for artistic creation. The use of certain material materials and means, around a certain purpose and use of design and production, transmission, exchange of information, beautify life and environment, to train students' design consciousness and practical ability; Let students understand the modern design concept and traditional craft related to life; Feel the characteristics of various materials, reasonable use of a variety of materials and tools for production activities, improve hands-on ability; Understand the beauty of art form and its unity with design function, improve students' ability of aesthetic evaluation of life objects and their surroundings, stimulate the desire to beautify life.

Through the virtual reality technology will be diversified art show, in the heart of the interpretation process concept in the form of a plain convey to all students, help students analyze works of art in the object image and the author's creation intention, cause the students' association and imagination, to make it naturally formed on the unity of content and form of art, a better understanding of the connotation of the works. At the same time, let the students establish a correct appreciation attitude towards multicultural art, through intuitive perceptual understanding, full of artistic language expression, let the students get aesthetic experience. In addition, teachers should give full play to students' subjective initiative, respect individual differences, give them sufficient space for thinking, actively guide students to express their personal aesthetic experience, strive to stimulate their subject consciousness, overcome the past teacher-led classroom teaching mode, and constantly explore new teaching mode. Through art appreciation education to cultivate students' sentiment, let students truly experience art, accept art, feel the beauty and purity brought by art, so as to cultivate their art appreciation and aesthetic ability.

In the past art courses, due to the shortage of teaching conditions, teachers could only describe and interpret art works in textbooks or slides, and only teach the modes and routines of appreciation. The classroom atmosphere was relatively dull, and students passively accepted the experience of teachers, lacking of active exploration of knowledge. Even with museums, art galleries and other resources, it is difficult for students to observe cultural relics in close proximity

due to the limitations of time and space. They can only obtain limited information through the explanation of the narrator, which is very unfavorable for the cultivation of students' art appreciation level. Using virtual reality technology to link of art appreciation teaching can greatly enrich the teaching content, improve teaching quality, lets the student in the classroom can understand the characteristics of art from all over the world, not only can close meticulous observation, and can grasp the rhythm of the ornamental, multi-angle and comprehensive view of art, and even can enter the production experience. Compared with teachers' flat explanation of books and pictures and students' unilateral acceptance of teachers' experience, this novel form of virtual experience can greatly attract students' interest and motivate them to actively explore knowledge.

3 DESIGN OF ART TEACHING SYSTEM BASED ON VIRTUAL REALITY COMPUTER AIDED

The system management module plays the role of platform service, through the administrator registration management, will be in the system input educators and learners qualification information and other relevant information, into the system management database; Educators and learners can enter educator management interface and learner learning world respectively through login. The platform login module is composed of five parts: educator registration module, educator management module, learner registration module, learner learning module and participant module.

Educator system management module, digital network learning platform art curriculum construction important part. In this module, educators manage the platform courses and supervise and manage the process of learners' research-based learning. The educator system management module consists of the art subject information module, the art subject announcement module, the art course teaching module, the art subject achievement resource module, the art subject learning management module, the art course exchange feedback module, the learner comprehensive management module and so on. The value of data is shown in Figure 4.

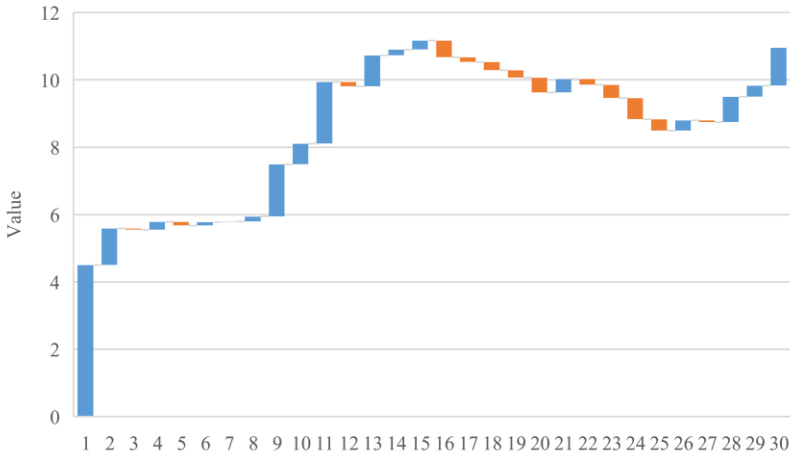


Figure 4: Value variation.

Among them, the main functions of the art subject information module include providing educators with the art subject creation plan, the management tasks of the art subject teaching arrangement, and timely updating. The main functions of the art topic announcement module include the relevant content of the education through the art topic research study, including the creation of the art topic project information, the evaluation of the topic selection information, etc., through this module to release tasks for learners. The main functions of the teaching module of fine arts

course handouts include providing fine arts professional course handouts based on digital network learning platform for educators, including course documents and tutorials, course video handouts, course project demonstrations and other relevant materials in line with the characteristics of network courses. The main function of the art subject achievement resource module is to provide the educators with the learning resources of the art subject research study and the relevant materials such as the achievements uploaded in the past. The main function of the art subject learning management module is that the educator guides and manages the creation and research of the art subject project through this module, tracks and manages the progress of the learner's research study scientifically and systematically, finds the problems in time and gives guidance and correction in time, and carries out the evaluation of the learner's research study. Fine arts curriculum module is mainly to complete communication feedback function is the educator of learners through this module on fine arts subject project difficult question to answer, educators and learners online asynchronous communication, educators project topic discussion with learners create a discussion, and have generated the FAQ, collect special features of the problem. The predicted value vs. item is shown in Figure 5.

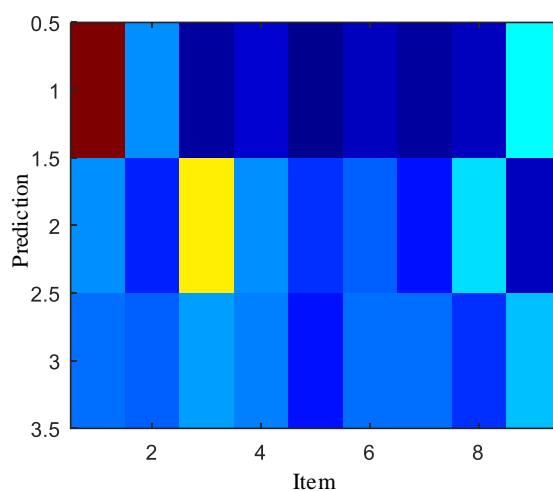


Figure 5: Predicted value vs. Item.

The learner system application module is the main module part of the application of digital network learning platform, and it is the research learning platform of learners based on the main learning activities of computer-aided art teaching. The course guide module consists of course introduction, educator introduction, course catalog and course introduction. The relevant content of online courses is introduced by the course introduction. The relevant information of the educator is introduced by the educator profile; Courses are outlined in the course catalogue; The nature and applicable objects of the course are introduced by the introduction. This module can effectively avoid the blindness of learners.

The learning activity sub-module can complete the communication and interaction between learners and learners and between learners and educators, and is a platform for learning to carry out research learning. Learning exchange provides the functions of registered learners to upload, download and comment on works. Learning discussion provides an online asynchronous communication space in the form of a message board where learners can make comments, reply to comments, and view comments. Learning Experience Provides registered learners to record their learning experience and problems in a journal. The study space provides support for web-based research learning, completing grouping functions, project announcements, uploading and

downloading functions, etc. At the same time, it provides a space for learners to carry out research learning. Learners can submit the topic selection report, activity log, conclusion report and so on about research learning here, and check the kinds of information released by educators. Educator Q&A offers keyword-based and section-based queries, as well as a collection of questions and learner questions. It also includes sections on homework and online tests. The data for different category is shown in Figure 6.

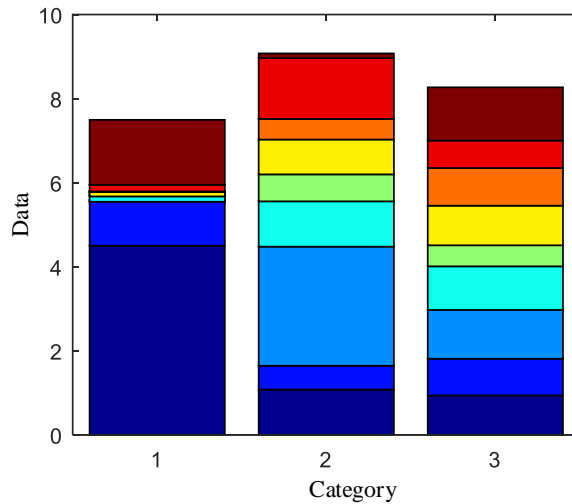


Figure 6: Data for different category.

The application of virtual reality technology in art appreciation class has some differences in traditional teaching methods. The teaching methods of this course are summarized as follows: teaching method, through the introduction of the history of art and the description of the expression of the objects of art class, let students have a solid understanding of history and improve the ability of art appreciation. Demonstration method, the control group of teachers will show the imitation of art objects, demonstration experiments, so that students through close observation and contact, learning knowledge. Situational teaching method is suitable for the experimental group teachers to let students enter the virtual situation by wearing virtual reality head display, and integrate into it to carry out learning and achieve teaching objectives. The discussion method is suitable for the sharing of works in the course. Students can discuss and share in groups at appropriate links, taking into account the physical and mental development and verbal expression of each student. Experiential learning is mainly in the creative part of teaching and the visiting process of the experimental group museum. Students can come to the scene in person, have empathy, achieve empathy, and complete the active construction of knowledge.

The development process of virtual reality teaching resources includes: (1) analysis preparation, including learning need analysis, learning situation analysis, etc.; (2) Scene script design, interaction design, evaluation design, etc.; (3) Operation structure design, thought design. (4) Courseware development, including graphics and image processing tools, 3d model building tools and virtual reality resource development tools; (5) Product test, improve content design, scene production and interactive experience of virtual reality resources, and finally release and use. The commonly used platforms of virtual reality courseware development are UE4, VR-Platform and Unity3D.

For virtual reality teaching resources, ordinary classrooms are required, and the school is required to be equipped with virtual reality dedicated classrooms. Therefore, courses are carried

out in this classroom, while control classes are carried out in ordinary classrooms. The VR classroom is equipped with a teacher machine, 30 VR integrated head display (PICO), HTC VIVE series head display of VR head display, each head display is connected to the teacher end, teachers can switch on and off for each student end, content push and simple device management. VR all-in-one equipment is cost-effective, lightweight and convenient, suitable for campus laboratories. Equipped with motion sensing handle, it can be connected through wireless network, supporting wireless file transfer, supporting wireless screen playing video and other functions. The helmet adopts lightweight polymer body and thin wall injection molding process. It belongs to aviation grade light metal, which is convenient for students to wear and use. The fabric front panel is made of fabric. The mask adopts high permeability foam, which is easy to clean. At present, the second-generation helmet has been produced, with various functions upgraded iteratively. The fitting function is shown in Figure 7.

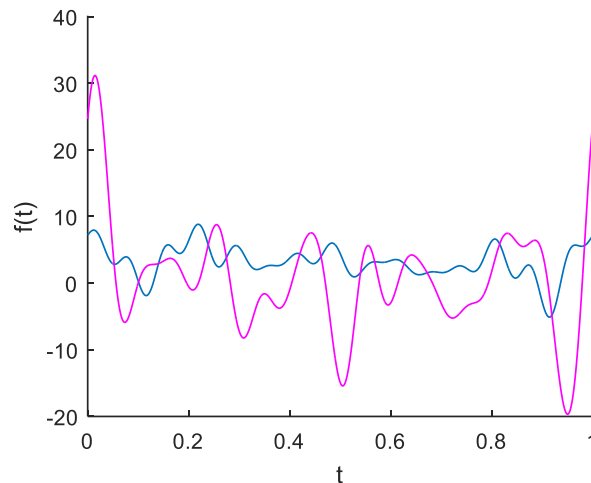


Figure 7: The fitting function.

4 CONCLUSION

Virtual reality technology is one of the most promising advanced technologies after computer network and multimedia teaching. It changes the previous teaching form, makes the teaching of art courses no longer restricted by time and space, greatly expands the source of learning resources and boosts the improvement of teaching quality. With the progress of society and science and technology, virtual reality technology continues to improve and boost the development of art education, I believe that it will play a more important role in the field of art education in the future.

All in all, virtual reality technology as a frontier science and technology, is the product of human imagination and creativity development, it represents the advanced scientific and cultural knowledge, and develop the spirit of adventure and infinite creativity, and it is introduced into education field, it is the most advanced ideas and technology brought into schools, to innovate the idea exerts a subtle infiltration into every teachers and students in the heart, This will not only bring about changes in teachers' teaching methods, such as changes in class places and equipment, but also changes in teaching content, so that students will have more opportunities to explore knowledge on their own initiative. The leader of the class is not the teacher who outputs unilaterally, but all the students, who control the progress and rhythm of the class. This makes students explore the way and method of receiving knowledge has undergone a great change, can promote the art teaching way innovation.

Laiyun Feng, <https://orcid.org/0000-0002-2545-9518>
 Wanlu Zhang, <https://orcid.org/0000-0001-8753-5339>

REFERENCES

- [1] Bi, H.-J.: Feasibility Analysis of Teaching Reform of Computer-Aided for Environmental Art Design Course, *Computer-Aided Design and Applications*, 1(2), 2020, 36-46. <https://doi.org/10.14733/cadaps.2021.s2.36-46>
- [2] Wu, M.-S.; Nathanael, E.; Timotheus, A.; Nathan, W.; Johann, L.: Computer-Assisted Language Comparison: State of the Art, *Journal of Open Humanities Data*, 6(1), 2020, 1-14. <https://doi.org/10.5334/johd.12>
- [3] Bi, X.-L.; Li, S.-T.; Bin, X.; Yu, L.; Wang, G.-Y.; Xu, M.: Computer aided Alzheimer's disease diagnosis by an unsupervised deep learning technology, *Neurocomputing*, 392(1), 2020, 296-304. <https://doi.org/10.1016/j.neucom.2018.11.111>
- [4] Feng, N.: Communicative Image Expression in Teaching of Computer-aided Design for Environmental Art Major, *Computer-Aided Design and Applications*, 2(3), 2020, 25-35. <https://doi.org/10.14733/cadaps.2021.s2.25-35>
- [5] Adem, M.: Computer-aided music education and musical creativity, *Journal of Human Sciences*, 17(3), 2020, 822-830. <https://doi.org/10.14687/jhs.v17i3.5908>
- [6] Halil, İ.: Cyber Security Skills of Pre-Service Teachers as a Factor in Computer-Assisted Education, *International Journal of Research in Education and Science*, 6(3), 2020, 2749-2759. <https://doi.org/10.46328/ijres.v1i1.1006>
- [7] Sun, Y.; Gao, L.: College Students' Psychological Cognitive Aided Education Based on Computer-Aided Design, *Computer-Aided Design and Applications*, 17(S1), 2019, 34-43. <https://doi.org/10.14733/cadaps.2020.s1.34-43>
- [8] Rasak, A.; Kola, Y.: Engineering Education: Computer-Aided Engineering with MATLAB; Discrete Wavelet Transform as a Case Study, *International Journal of Computer Applications*, 182(46), 2019, 6-17. <https://doi.org/10.5120/ijca2019918598>
- [9] Torbatinezhad, H.; Amani, H.: Computer-Assisted Instruction (CAI), Virtual Patients (VP), and Human Patient Simulation (HPS) in Medical Education Based on Gagne's Educational Design Pattern, *Jorjani Biomedicine Journal*, 6(2), 2018, 1-20. <https://doi.org/10.29252/jorjanibiomedj.6.2.1>
- [10] Li, Y.; Guo, M.-M.: Professional Development of Art Teachers under the Background of Curriculum Reform based on Computer Clustering Systems, *International Journal of Intelligent Information and Management Science*, 9(1), 2020, 1-8. <http://www.hknccp.org/Public/upload/goods/2020/03-11/5e68556086d59>