

# The Enlightenment of "AR / VR" Technical University Course Education in Taiwan, China

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## ABSTRACT

The development of computers and information technology, especially the emergence of the Internet, big data, artificial intelligence, virtual reality, and mental enhancement, has created a new field of educational technology and entered a new chapter in the development of educational information. Augmented reality technology will be the most promising technology in the field of education after multimedia and computer networks. The most common teaching application of AR/VR technology in mainland China is to integrate digital learning resources and carry out relevant theoretical and experimental courses in multiple universities; China's Taiwan AR/VR technology mainly focuses on image processing related fields and education, and combines multiple teaching methods. This article summarizes and compares the application of augmented reality technology in university curriculum education on both sides of the Taiwan Straits from mainland China and Taiwan, and draws some enlightenment.

## CCS CONCEPTS

• Applied computing; • Education; • Interactive learning environments; • Human-centered computing; • Visualization; • Visualization application domains; • General and reference; • Cross-computing tools and techniques; • Evaluation;

## KEYWORDS

AR technology, VR technology, cross-straits, university education, curriculum design and practice, course features

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## 1 INTRODUCTION

In recent years, VR and AR have gradually entered the public's vision and are widely used in medical, military, historical restoration and digital cultural heritage protection, industrial maintenance, network video communications, television broadcasting, entertainment games, tourism exhibitions and other fields, and are well received.

Virtual Reality (VR), also known as spiritual realm technology, includes computers, electronic information, and simulation technologies. It originated in the 1960s and refers to the use of computer systems and sensor technology to generate three-dimensional environments and create a brand new Human-computer interaction mode [1]. Augmented Reality (AR) technology [2] refers to the use of computer technology to fuse virtual information with the real world. Real environments and virtual objects are superimposed on the same screen or space in real time and coexist [3].

There are two definitions of augmented reality. One is proposed by Milgram P and Kishino F [4]: placing real environment and virtual environment at both ends. Among them, the one near the real environment is called augmented reality, and the one near the virtual environment is called augmented virtual reality. In the middle is called mixed reality; the other is defined by Azuma [5]: it is a technology that combines real and virtual, real-time interaction, and three-dimensional registration, and uses additional pictures and text information to enhance the real world.

With the combined penetration of emerging technologies such as virtual reality, artificial intelligence, the Internet, big data, and 5G into all levels of society, the current educational ecosystem will usher in a huge historical change. And each technology as an education technology, its application will have an impact on the learning environment, teaching methods, experimental methods, teaching activity design, learning evaluation and so on, which will cause the knowledge production view, knowledge production methods, and educators, learners And participants' cognitive styles and behavioral patterns have changed [6].

## 2 RESEARCH ON AR/VR EDUCATION APPLICATION IN CROSS-STRAITS

In recent years, AR/VR technology has been widely used in many fields such as industrial maintenance, film and television entertainment, medical surgery, education and training, and has gradually become the main direction for the development of next-generation human-computer interaction technology [7]. Many of the striking

features of AR/VR can be applied to the teaching field, and when it combines multiple types of technology, it can realize greater potential.

## 2.1 Research Development in Mainland China

There have been many examples of AR / VR technology being used in classroom teaching around the world. In addition to research on the application of AR / VR technology in education, foreign countries also pay attention to its practice and feedback in the field of education. , Special education, vocational college education, college education, etc. have applications [8].

In terms of teaching courses, Professor Wang Yongtian of Beijing Institute of Technology uses AR technology to establish a "digital Yuanmingyuan display enhancement system type" between the "big water method" and "water observation method" spots of the Yuanmingyuan site [9]. Cai Su, Song Qian, and Tang Yao's augmented reality concept demonstration book. The experiments of simple pendulum, Newton's first law, and Newton's second law in middle school physics are selected and combined with virtual reality demonstrations. Learners can simply use simple equipment to achieve Feel the experimental scene described in the flat book, and enhance the interest of learners [10]. The "AR" Visual Digital Training Course for Chinese Teachers of Foreign Languages conducted by Central China Normal University. At the same time, it undertakes the annual task of "first-class disciplines" in Chinese language and literature construction and "double first-rate" teaching practice; resources for psychological experimental teaching based on virtual reality technology Construction, etc.

In terms of competition practice, in May 2019, the first college in Zhejiang Province hosted a VR / AR competition, which was divided into "development group" and "video group". The topics of the entries included film and television, tourism, environmental protection, and architecture. In October 2019, the first college VR courseware design and production competition in Jiangxi Province was held in Nanchang. This competition aims to promote the use of VR technology to produce courseware, to give full play to the integration and development of emerging industries and education. Each participating team will present the VR courseware on site and explain the highlights of the courseware. It will bring convenience to teaching through the wonderful interpretation of VR technology.

On the market side, the 2019 World VR Industry Conference opened on October 19. At this conference, the Nangu Honggutan New District Management Committee and ZTE jointly signed a 5G cloud XR strategic cooperation agreement. Both parties will jointly explore 5G + cloud XR-based technology innovation applications and technology research. During the 6th World Internet Conference, JD.com, a subsidiary of JD.com, launched a "vending machine" with a "brush payment" function, which can provide services to large-scale shopping and catering companies and open up online and offline information flow and commodity flow. This conference also saw the wider application of AR technology. Such as experiencing space walks, AR fitting mirrors, AR table tennis based on 5G technology, etc.

Starting from November 2019, China Unicom has deployed 400 XR demonstration centers in the country's experience centers, with more than 10 million people radiating. In order to accelerate the



Figure 1: VR house viewing

landing of 5G + XR products, China Unicom and Nreal jointly bring a new way of connecting hybrid glasses and mobile phones to the majority of Chinese consumers. In the same month, ZTE and China Mobile launched a 5G + MEC-based cloud XR collaborative business incubation to jointly explore the practical application of 5G + XR industrial design. In the same month, JD.com also launched the "Ultra Future City", an AR immersive experience venue for home appliances.

## 2.2 Status of Research and Development in Taiwan, China

China Taiwan research focuses on the use of virtual reality technology and augmented reality technology for image processing related fields and education. In the campus, Figure 1 is a "VR technology guided tour of the house, a panoramic picture can be developed" developed by Zhu Hongtu, an associate professor of the Department of Information Engineering at Taiwan Tsinghua University. In this school, there are also CV lab and Computer Graphics and Vision Lab CGV Lab; Inter-University Lecture-"Creation Concept and Course of Jimmy Picture Book VR Experience", etc.

In terms of market, such as the "VR Star Warship" game in Taiwan Nantou Cultural Village; the "VR Virtual Kingdom" game at Taipei Children's Amusement Park; and a weekend VR art lecture at the VR Sports Theater-"The Past and Present of Movies: Train coming to VR technology! ".

In terms of companies, such as Taiwan's Hamasen Technology Co., Ltd, it has an innovative VR and AR technology research and development team that can realize somatosensory interaction with AR / VR intelligent medical applications; severe clinical somatosensory virtual reality games; somatosensory devices and VR Time Travel visits ancient and modern Qijin; historical military trails are transformed into VR geography textbooks, giving students a glimpse of historical trails and the mysteries of nature.

The VR-Cloud developed by Taiwan Fulumba Software Technology Co., Ltd. has 3D message board function, landscape evaluation function, camera function, multi-user conference function, etc; 3D •VR engineering services; 3D stereo system 3D-B-Vision, hybrid display / Augmented reality (MR / AR) hardware systems; VR services for traffic analysis; VR urban planning systems, etc.

Taiwan Lianxin Asia Medical Education Co., Ltd. manages the training of medical personnel, provides virtual clinical diagnosis and treatment system, virtual patient Amway, medical education



**Figure 2: VR Interstellar Magic Bus**

and other services to improve the clinical diagnosis and treatment capabilities of medical personnel through practical training, and ultimately improve medical quality and patient safety.

Taiwan Trend Technology Co., Ltd. combined astronomy education with VR devices to create the first VR interstellar magic bus in Taiwan, as shown in Figure 2, and help children improve their learning motivation with fun learning methods, and establish important milestones for digital education.

Taking the wisdom education as the starting point, China Taiwan Tianying Digital Media Co., Ltd. will focus on smart healthcare in 2019, show its technological strength, and launch the "Sensory 3D Display System", a virtual integrated virtual reality system, and freely flip 3D objects 360 degrees. The free-angle operation and head-free equipment are the striking features of this system. At the same time, develop innovative education such as AR learning paradise, VR English Academy, XR education platform, etc., and use the new XR technology to flip education.

### 3 AR / VR UNIVERSITY COURSE EDUCATION PRACTICE IN CROSS-STRAITS

We conducted a comparative study of AR / VR-related university courses selected by various universities on both sides of the Taiwan Straits, and obtained the following studies.

#### 3.1 Mainland China University Course Education

We have investigated the curriculum design and practice of AR/VR technology in many colleges and universities in mainland China, and most of them have actively carried out related teaching and research work and achieved fruitful results. This article only uses Tsinghua University, Zhejiang University, Central China Normal University, Jilin University, Shanghai Jiaotong University, Zhongnan University of Economics and Law as examples. In terms of comparison, as shown in Table 1

#### 3.2 Taiwan University Curriculum Education

We have investigated and studied the course design and practice of AR/VR technology in multiple colleges and universities in Taiwan, China. This article uses Taiwan Tsing Hua University, Taiwan Chiao Tung University, Taiwan University, and Taiwan University of Science and Technology as examples. Colleges offer fewer such courses and choose to adopt two courses from Taiwan Jiaotong University. Compare the seven aspects of the course name, course

description, teaching materials, starting department, teaching object, teaching progress, and performance assessment, as shown in Table 2

## 4 A COMPARATIVE STUDY OF AR/VR TECHNOLOGY IN UNIVERSITY CURRICULUM EDUCATION IN CROSS-STRAITS

Aiming at the above-mentioned application and development of AR / VR technology in the curriculum education of mainland China and Taiwan University of China, we make a comparative study from seven aspects: course name, teaching materials, teaching methods, teaching progress, performance assessment, and course characteristics.

### 4.1 Comparison of Course Names

Mainland China mostly adopts titles such as "Virtual Reality Technology and Multimedia Human-Computer Interaction", "Training Course for AR Chinese Visual Digital Teachers", "Virtual Reality", "VR / AR Design and Development Practice", etc. Using "VR Photography Surrounding Practice", "Interactive Design and Virtual Reality", "Research on Virtual Reality and Augmented Reality Communication", "Principle of VR / AR Reality Technology and Application of Civil Engineering", "AR / VR programming "and other names.

There is not much difference in the expression of the course names between the two, except for the habitual expression of individual words.

### 4.2 Comparison of Teaching Materials

Most of the Chinese mainland is Chinese textbooks, which are taught by Science Press textbooks or Tsinghua Press textbooks, combined with reference books such as digital image processing and related software operations, covering conceptual introduction, 3D spatial modeling, 3D visual modeling, panorama Image and panoramic video, computer vision, target detection and behavior analysis, face detection, practical application, etc; Taiwan, China mostly provides teachers with their own non-fixed textbooks, or adopts English textbooks such as those published by Cambridge University in Britain and America. Most of them master related skills through a combination of courseware and self-study in experiments.

There is a difference between the Chinese and English versions of the textbooks, and there is a slight difference in the proportion of textbook teaching aids and the dependence of students on textbooks.

### 4.3 Comparison of Teaching Methods

In mainland China, most of them are combined with face-to-face teaching and experimentation, covering daily homework research reports, and written examinations, mainly teaching, supplemented by homework experiments; Taiwan, China, includes English-language lessons, such as visits, lectures, workshops, do not take exams, focusing on homework and final experiments and

**Table 1: Comparison of AR / VR Technology in Curriculum Education in Mainland China**

School	Tsinghua University	Zhejiang University	Central China Normal University	Jilin University	Shanghai Jiaotong University	Zhongnan University of Economics and Law
Course title	《Virtual reality technology and multimedia human-computer interaction》	《 Virtual Reality 》	《 "AR" Visual Digital Training Course for Chinese as a Foreign Language Teachers 》	《 Virtual reality technology 》	《 VR talent training course 》	《 Virtual reality technology 》
Teaching material	Basics and Practical Algorithms of Virtual Reality, Shi Jiaoying, Science Press	Prepare your own textbook	《 "AR" Visual Digital Training Course for Chinese as a Foreign Language Teachers 》	Guangran Liu, Virtual Reality Technology, Tsinghua University Press.	Prepare your own textbook	"VR Technology", edited by Shen Wei, Tsinghua University Press. etc.
Teaching methods	The course trains students in theories and techniques in image and graphics processing, 3D modeling, human-computer interaction, and computer vision.	This course mainly introduces the basic concepts of VR and its system composition, applications, and introduces the current status, development and some key technologies.	The course covers the application of virtual reality technology in teaching Chinese as a foreign language; the use of AR cases for vocabulary of professional words; learning how to write and teach stereo digital AR textbooks.	Based on the "3I" characteristics of virtual reality, this course systematically describes the basic theoretical and practical skills of virtual reality.	The course is composed of a senior VR teaching team of the Jiaotong University Electric Academy and senior experts in the VR industry, jointly training excellent technical talents in virtual reality.	This course includes the hardware and software commonly used in VR; the application of software such as modeling language VRML, modeling tools 3ds max, and Cult 3D; panorama technology and concepts.
Faculty	Department of Electronics	School of Computer Science and Technology	School of International Cultural Exchange, Faculty of Arts, Language Institute, School of Computer	Computer science and Technology	Open	College of Engineering
Teaching object	30 graduate students	Master General Professional Elective	On-going master's degree and related master's degree in related majors	Undergraduate Professional Education Electives	Undergraduate	Undergraduate
Teaching progress	Hours: 32 Chapters: 12 Credits: 2	Teaching hours: 32 Course credits: 2	Five training courses 12 sessions 34 experimental sessions Total 46	multimedia teaching After class lab exercises 32 hours of theoretical teaching	Theoretical teaching combined with practical training	Total Hours: 32, eight chapters, final survey
Performance assessment	Two major assignments: latest paper research and research reports; Final open book exam.	Open book assessment, Chinese	At the end of the training, passing the test, a special training certificate is issued.	1. Inspection 2. Class attendance and homework 3. The score is based on a 5-point scale.	Students organize their own teams to independently design and produce graduation works	The way of small essay or reading report in the classroom refers to the students' usual class performance.

**Table 2: Comparison of AR / VR technology in curriculum education in taiwan university of china**

School	Taiwan Tsing Hua University	Taiwan Chiao Tung University	Taiwan Chiao Tung University	Taiwan University	Taiwan University of Science and Technology
Course title	《VR photography surroundings implementation》	《Interaction Design and Virtual Reality》	《Research on Virtual Reality and Augmented Reality Communication》	《Principles of VR / AR Reality Technology and Application of Civil Engineering》	《AR / VR programming》
Teaching material	Teacher-supplied teaching materials	《The VR Book: Human Centered Design for Virtual Reality CHI and UIST conference proceedings》	《Light Course Making Your AR Augmented Reality and VR Virtual Reality, Liu Weikai, NTUST, 2018》	《Hartley, R. and Zisserman, A., Multiple View Geometry in Computer Vision, Cambridge University Press, 2004.》etc	Teacher-supplied teaching materials
Teaching methods	This course is co-sponsored by lecturers from the VR industry, introducing students interested in creating VR and 360 environments, as well as operating photography equipment and practical guidance.	This course will cover the process and skills of building innovative interactive systems and touch usability tests, and students will form project teams.	The course will be based on VR virtual reality film creation practices, supplemented by AR image creation practices. Make interactive movies and APPs, execute VR and AR applications, and implement a research plan.	This course will bring the basic virtual reality (VR) / augmented reality (AR) / mixed reality (MR) background knowledge to the students, and then present the application of real estate technology in civil engineering through discussion and final topics.	This course teaches students to borrow the Unity C # language and use Vuforia and Unity as AR development kits to generate augmented reality applications for various platforms.
Teaching progress	The course will be completed in three days in the form of a workshop. Guided by two teachers, the director was invited to share VR creative experience. See Table 3 for details.	It is taught in English, including 19 hours of lectures, 16 hours of demonstration, 13 hours of assignments, including a total of 17 weeks.	This course requires computer time. Including visits, special lectures, etc. Includes a total of 19 weeks of interim and final reports.	There is no exam in this course. The focus of grading is on homework and final report. Contains 6 experiments and special report at the end of the period, totaling 17 weeks.	Includes mid-term exams, Google Play launches, and final exams for a total of 18 weeks.
Teaching object	All	Master of Science and Technology (Elective)	Master of Communication (Elective)	School of Engineering Survey and Spatial Information Group	Inter-school course
Performance assessment	Class performance 20% Group work 30% Group term work 40% Semester experience and self-assessment 10%	Semester project 60% (Interim proposal: 20%, final lecture: 30%, final report: 20%) Assignment 30% Project participation 10%	Normal attendance and performance 35% Interim report 30% End of period implementation 35%	Group members score participation 10% Class interaction and reporting 20% Program assignment 30% Grouping Final report 40%	Self-assessment within the classroom
Other	The classroom experience is shown in Figure 3			Course requirements: Prerequisite for any programming language.	Open for university-wide electives, limited to 45 people





Figure 3: NTHU Course experience

reports; some course teachers will invite two or three teachers to jointly guide.

#### 4.4 Comparison of Teaching Objects

Most of the Chinese mainland is basically taught by various departments, most of which are related departments of engineering, electronics, information, computer, etc. The remaining departments are relatively small, and the number of classrooms is generally 30 or more; most of Taiwan is an elective course. Cross-faculty course selection has few basic requirements. Some courses restrict the number of course selections such as 15 due to equipment and other factors. Some courses are open for elective courses throughout the school, such as a limit of 45 people, and can be signed. At the same time, the number of classrooms is limited to 5% -10% float.

#### 4.5 Comparison of Teaching Progress

Most of the mainland China is about 30-40 class-hours and the credit system. Classes are mainly concentrated on teaching hours, and the experimental hours are mostly after class. It is not necessary to specifically restrict the location and length. Chapters are used for teaching. There are many teams in Taiwan in China, which are basically 17-19 week course is taught in weeks, and some courses are completed in the form of workshops, such as focusing on three consecutive days.

#### 4.6 Performance Assessment Comparison

Mainland China covers daily assignments such as topic selection surveys, reports, daily attendance, and final exams, and most of them are open-book exams. The proportion of ordinary and final exams varies slightly from college to university. For example, 60% and 40% at the end of the week and 80% at the end 20%, etc. at the end of the period; Taiwan, China covers mid-term exams, final exams, group reports, experiments, etc. The scoring rules are clearer and the team's ability is more important. In the end of some courses, the experimental group displays the reference group mutual scores.

#### 4.7 Comparison of Course Features

There are both team and individual forms in mainland China. Teachers mainly teach and experiment. Some of the experiments are after-school hours, covering software such as PHTOSHOP, FLASH, 3D max, Unity3D, virtual reality modeling language VRML, and graphics-based three-dimensional space modeling. OpenGL, image-based 3D scene modeling IBMR, etc; the classroom atmosphere in Taiwan, China is more relaxed and active. Basically, they take the form of classroom teams, focus on training students' self-ability

Table 3: Teaching progress hours

Days	class schedule	Duration (hr)
The first day	Global VR development trends	2
	Introduction to Surrounding Photography Technology	1
	VR360 equipment introduction and content discussion	3
	Group Implementation I (360 video shooting)	2
	Group Implementation II (360 movie clips)	3
The second day	Group assignment sharing and discussion	3
	HTC-Vive Experience (Appreciation of Excellent Works)	2
	Group short film release and comment	3
The third day	Director creation sharing and communication 1	1.5
	Director creation sharing and communication 2	1.5
	Comprehensive discussion and comment	2

improvement and team awareness, and put the cooperation ability into the assessment ratio. Students have more room to play subjectively, learn simple html5 grammar, make interactive movies and apps, and use Vuforia with Unity as an AR development kit.

Comprehensive comparison, each has its own advantages, especially in mobilizing students' subjective initiative.

## 5 ENLIGHTENMENT OF AR/VR EDUCATION IN UNIVERSITIES IN CROSS-STRAITS

In recent years, augmented reality has received widespread attention from researchers. Research shows that young learners who are willing to accept new things believe that AR technology is easy to operate and can help to concentrate, so they are very willing to use it [11]; Compared with VR technology, AR is a better educational fun Entertainment education technology [12]. The advantages of AR / VR's interactive technology can help learners interact with teaching content practically and naturally, and guide them to focus on the learning content. As UNESCO pointed out in The Future of Mobile Learning Implication for Policy Makers and Planners 2013, in the next 15 years, mobile augmented reality technology can lead and support learners by adapting to different environments, promoting usefulness and lasting Personal learning [13-14]. AR / VR technology adds a layer of virtual information to the real world, so it brings new opportunities to education [15].

Augmented reality AR technology will become a technology that people have high hopes in the field of education after multimedia and computer networks [16]. Driven by computer vision and artificial intelligence technology, augmented reality technology has shown strong development momentum. The combination of augmented reality (AR), big data technology (DT), artificial intelligence,

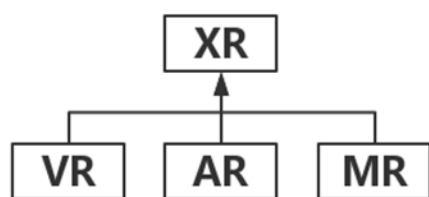


Figure 4: XR / VR / AR / MR diagram

and the Internet of Things (AIOT) and 5G technology will break the limitations of traditional education and may change the future of the education industry [17].

With the development of 5G, AI, Internet VR, edge VR / AR and other technologies, AR will become a new entrance to the Internet and a new social environment, thereby enriching and improving the connotation and effectiveness of the lifelong learning system. The popularity of 5G will lift the data transmission bottlenecks that restrict the development of AR, and some important platforms and key technologies in AR education will make breakthrough progress. The 3I characteristics of VR have evolved into 4I characteristics, that is, immersion, interaction, imagination and intelligence; combined with artificial intelligence may become the ultimate educational technology.

Computers and the Internet provide a platform for education information, and AR can provide a new platform and means for the design and display of education and teaching scenarios and the implementation of teaching. AR technology is a new and powerful educational technology, and it is an important constituent technology of smart education. Education is also a vital application field for AR.

Extended Reality (XR) is a term that refers to a real-virtual combination of human-computer interaction environment generated by computer technology and wearable devices. Augmented reality includes augmented reality (AR), virtual reality (VR), mixed reality (MR) and other forms and multiple levels, from a virtual world input through limited sensors to a fully immersive virtual world.

As a new interactive technology that has developed rapidly in recent years, XR can realize the integrated development of AR, VR and MR, as shown in Figure 4. It has not only become a key to start a new generation of interactive revolution. It focuses on returning to the essence of education by reshaping the learning method, and has had a profound impact on the cultivation of innovative talents and the popularization of education. And it also brings new challenges and opportunities to many fields such as education and teaching [18].

## 6 CONCLUSION

The analysis and discussion of a lot of empirical studies show that AR/VR technology has great potential and application prospects in learning to support and teach students, and has gradually grown into a new and powerful educational technology. Education and new technologies are integrated to further cultivate high-end talents. Both sides of the Taiwan Straits AR/VR technology have their advantages and disadvantages in university curriculum education,

but we can see that the AR/VR learning environment brings us more than just a technology platform and tools. AR/VR + AI may become the ultimate educational technology, and it may be a kind of the birth of new teaching models and methods. The emergence of endless emerging technologies is not only a feast for the exchange of innovative ideas. Their sparks of wisdom will guide the direction of talent training in the intelligent era, and better serve the society, education, and the future.

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