

# SWOT Analysis of AR/VR+ Vocational Teaching Materials and the Publishing Strategies

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**Abstract:** Today's information technology has entered the fast lane, and the application of AR/VR technology into vocational education has opened the window towards the teaching modernization. In this paper, the teaching materials for AR/VR+ vocational education are systematically analyzed with respect to their inherited features, opportunities, and challenges. Proposals are given in attempt to realize the integration of publishing house + vocational college + AR/VA content production agency. A unified standard are also suggested by building AR/VR professional teaching materials alliances or associations. Particularly, the introduction of overseas teaching materials may play a part in training the professional publishing talents. The publication of this kind will definitely act to fuel the integrated development of new technologies and vocational education.

**Keywords:** AR/VR; modern vocational education; content construction; textbook publishing

## 1. Basics on AR/VR Technology

### 1.1. AR (Augmented Reality) Technology

Broadly speaking, it is a technology that involves the use of computer graphics technology and visual AR technology as power to generate various dynamic and virtual images by superimposing real scenes, which are then accurately placed in the real world. The real and virtual information are superimposed and exist in the same plane or space at the same time, making it possible for people to enjoy a kind of visual effect being more three-dimensional. Moreover, a series of digital information with or without sound can be used as virtual targets, such as video, audio, 3D model animation, picture or text, etc. Users may interact in real time through the mobile client so as to fully experience the atmosphere created by combining the virtual imagination with the real world. This is a higher level of immersive feeling. It features the most in three-dimensional display, virtual and real combination, and human-computer interaction.

### 1.2. VR (Virtual Reality) Technology

With the help of computer technology, it presents a

kind of multi-dimensional virtual space simulated by various sense organs, such as sight, touch and hearing, so that the user can interact with it through special input/output devices. Essentially, it is a technical means to provide users with a variety of sensory experiences, featuring three aspects: immersion, conception, and interactivity.

## 2. Basic Situation

Beneficial from the continuous advancement, "Internet + vocational education" has seen a lot more of improvements. As far as teaching is concerned, vocational education has gradually emerged a diversified development trend. Also, the development and publication of related teaching materials need to find a new way, the same to the paper teaching materials based on traditional teaching models, which are in urgent need for digital transformation. In this scenario, in recent years' rapid development provides a golden opportunity for the publication of textbooks for AR/VR+ vocational education.

### 2.1. Current Status

As early as the 2013 Jiangsu Book Fair, the China University of Mining and Technology Press exhibited a type of *Book* entitled as *Excavation Machinery and Hydraulic Drive*, which was regarded as the first domestic book using AR mobile reading technology in the paper-number interactive mode. Readers were only required to point the camera at a page with black and white excavator images printed on the book, and a 3D big red excavator would appear on the display screen, with the equipped gears in rotating continuously. As of early 2021, Fudan University Press is creating mechanical AR textbooks such as *Tolerance Fit and Measurement Technology*, and Peking University Press has published *Building Engineering Construction Technology (Third Edition) (AR Edition)* and other vocational education textbooks. In responding to the 13th Five-Year Plan for the development of automotive vocational skills, People's Posts and Telecommunications Publishing House has issued the AR version of more than a dozen of the textbooks and teaching aids, such as *Car Culture (AR Augmented Reality Edition)*, *Automotive Overhaul on Electrical System*, and *Maintenance on the*

*Mechanical System of Car Chassis* etc. The National University of Defense Technology Press published *Engineering Graphics AR (Augmented Reality)* (a collection of textbooks and exercises) as a textbook for the 13th Five-Year Plan for higher vocational education. Higher Education Press published *Engineering Drawing and CAD (AR version)*. The Publishing House of Electronics Industry has compiled the textbook *Mechanical Drawing and Surveying and Mapping of Typical Parts (2nd edition of AR edition)*, a textbook of high vocational education quality courses. Southwest Jiaotong University Press has also presented a higher vocational textbook, *Hydraulic and Pneumatic Transmission Technology (AR version)*. *Mechanical Drawing (Multiple Hours) (AR 10th Edition)* published by China Machinery Industry Press is now designed as a typical teaching material for secondary vocational education.

VR technology is helpful to supplement the development of traditional teaching materials, for which publishers may also develop digital publications based on their respective featured resources. Therefore, major publishing houses are also launching active promotion activities. Competition is fierce around VR+ vocational education textbooks. Qingdao Publishing Group and Qingdao City Media Co., Ltd. introduced a series of innovative education products such as "VR Future Classroom" in 2016. November 2017, they also jointly put online a sort of VR reading platform with HTC, which was available for readers to get access to high-quality VR reading content by way of libraries, bookstores and other channels. June 2017, Jilin Science and Technology Press held the "Scent of Books Jilin-VR Reading Experience" activity to give a brief idea of VR technology. July 2017, the People's Medical Publishing House exhibited the "3D System Anatomy" (VR teaching version) at the 7th Digital Publishing Expo held in the China Press and Publication Research Institute. The human body structure was displayed in an all-round and three-dimensional manner, which made up for the regret that the lack of human body samples failed to provide students with sufficient learning opportunities. On the same day, Petroleum Industry Press demonstrated the simulation system designed for petroleum vocational training, which combined advanced technologies such as VR, 3D animation, and database to truly simulate a working environment including the oil production well site, measuring room as well as pumping unit and key equipment, etc.

## 2.2. The Varieties Limited were Coupled with Average Market Sales

According to the latest statistics from Rongzhiku (Think Tank of Converged Media): As of March 2018, Dangdang, Amazon, and JD.com with their countable 275 types of AR books, 15 were published in 2015, 87 in 2016, and 66 in 2017; Children's popular science books took up the highest proportion, showing considerable sales, as many as 168 categories, accounting for 61%; 5 popular categories, for 2%; 56 animation and cartoon

categories, for 20%; 46 education categories, for 17 %, where the proportion of vocational teaching materials were even lower.

Regarding sales and distribution, the sales volume of CITIC Publishing House's "Science Runs-out Series" exceeded one million copies in 2015, creating the myth of 68 million yuan in fixed price. Things were different in the market for AR books, including many vocational education textbooks, which did not perform well. Part of reasons may be those traditional vocational teaching materials going through offline wholesale channels. OpenBook, an authority IT agency based in Beijing, published the cumulative retail data that were not that ideal as less than 1,000 copies. Here is an example. According to OpenBook, the secondary vocational education textbook *Mechanical Drawing (Multiple Class Hours) (AR 10th Edition)* by the Machinery Industry Press had a cumulative sales of less than 50 volumes. The higher vocational textbook *Hydraulic and Pneumatic Transmission Technology* from Southwest Jiaotong University Press (AR version) set back on a cumulative sales volume even less than 10, and so on.

Stricken by the bleak market distribution data, the ever-changing information technology still gives us hope to witness the ongoing modernization of this country's vocational education. It can be expected that in the near future, AR/VR+ vocational teaching materials will bring to publishers a broader development space with more market opportunities.

## 3. SWOT Analysis

### 3.1. Advantages

#### 3.1.1. Visual presentation deepens knowledge understanding

In the learning process of theoretical courses in vocational education, especially in majors such as medical care, machinery, chemical engineering, architecture, electronics, and catering, AR/VA+ vocational teaching materials may be available there to make obscure and difficult knowledge points concrete and sensible. Students may be given more concrete learning scenarios to deepen their understanding of knowledge points and intuitive grasp of operation procedures.

#### 3.1.2. Expand the volume of content in various forms

Traditional vocational teaching materials have a single format and a fixed layout, and the amount of information that may be carried is limited. Students can only rely on the pictures in the textbook to imagine in the theoretical courses. AR/VA+ vocational education textbooks may get the knowledge points in the paper textbooks associated with the corresponding digital resources. This makes it much easier for students to check in and learn online. Moreover, the APP on the textbook may be identified through mobile devices to get access to rich contents and various resources. Consequently, the "boundary" of textbooks is expanded to the increased amount of knowledge content that may be contained in a

single paper textbook.

### 3.1.3. *Enrich the experience and enhance the learning effect*

The development of similar teaching materials is a de facto extension of the traditional visual experience. This kind of three-dimensional, multi-level experience may sweep away the boringness of facing those traditional teaching materials and stimulate more students' enthusiasm for learning. Students are allowed to obtain diversified sensory stimuli from vision, hearing and even touch, thereby enhancing students' participation in the classroom, and objectively helping to eliminate the phenomenon of skipping classes.

### 3.1.4 *anti-piracy effect*

AR/VA+ technology vocational teaching materials cannot be simply duplicated owing to its impressive anti-piracy effect.

## 3.2. Disadvantages

### 3.2.1. *Large initial investment*

In response to the implementation of AR/VR+ vocational education, the state has formulated a large number of encouragement and promotion policies, which have gradually improved the level of hardware facilities in a large number of vocational education colleges. This means that not only a AR/VR training room is planned, but also the corresponding hardware equipment is equipped. Nevertheless, this development opportunity itself is subject to policy influences and constraints. In fact, publishing units engaged in the development of AR/VR+ vocational education textbooks are still in need of large investment, multi-party coordination, and long development cycles. Therefore, it is not as easy as it looks to achieve a balance of payments during the initial stage of the application of new technologies. . This is bound to become a major flaw in new-style teaching materials.

### 3.2.2. *The existing textbooks have limited varieties and serious content duplication*

Currently, many publishing units and AR/VR content production units are making a big fuss about the vocational education textbook project. Nonetheless, practical majors in vocational education are many. This has become more complicated due to the characteristics of each school, the difficulty of secondary and higher vocational colleges. The AR/VR teaching materials for practical professional courses in a vocational college are hard to meet in a short period of time. In the early stage of development, the existing publishing units' textbooks and professional courses are relatively close to each other and the varieties are limited. There is a considerable gap with the selection of about 100 demonstrative virtual simulation training bases mentioned in the "Action Plan to Improve the Quality of Vocational Education (2020-2023)". At the same time, these courses are not in line with the goal of some 5,000 online boutique courses on vocational education, and the

duplication of developed content is serious. Additionally, actual teaching contents are continuously updated, and it will inevitably take a long time to update the teaching content and the corresponding AR/VR teaching content. This can be a major shortcoming of this new type of teaching material.

### 3.2.3. *Fully competitive and fragmented market.*

Numerous publishers and production units have swarmed in without uniform market standards and technical specifications, resulting in multifarious apps to be produced. Even the same publisher has different apps to cater book categories, which has hindered the development of teaching activities and the practical experience of students.

### 3.2.4. *Publishing is restricted by traditional channels*

For vocational education textbooks, AR/VR textbooks have to face up with rising production costs and pushed up their prices, being incompatible with the original wholesale channels. Some insight people said that increasing the price of AR books by 10% would exceed the bottleneck that the original channels may accept. If the old channels are not put aside unused, there are no new wholesale channels that are available to count on. Obviously, the old wholesale sales channel has become a big hidden catch to the publication and promotion of AR/VR vocational teaching materials.

### 3.2.5. *AR/VR+ vocational teaching materials have some negative aspects*

This type of textbook is highlighted by displaying knowledge three-dimensionally and intuitively in front of readers, bringing about a brand-new enhancement effect for knowledge service. As a presentation of a new technology, it can neither replace the traditional textbook's induction of knowledge points, nor can it subvert the structure of traditional knowledge and replace real practice operations.

### 3.2.6. *The potential impact on the health of students*

VR technology originally came from the field of games. Ever since it has been applied to vocational technology teaching and textbook development, the rich and wonderful virtual reality teaching model have posed a certain impact on the mental and physical and mental health of young people who are relatively weak in self-control. Substantially, it is so attractive to students that many of them are liable to over-indulging in it and even escaping from reality. This worst case may get obsessed with VR games, causing fatigue and motion sickness, etc. The potential problems or shortcomings of these new technologies will gradually be exposed with the popularization of the technology and the long-term application of AR/VR vocational teaching materials.

## 3.3. Opportunities

### 3.3.1. *Policy support*

Since the introduction of the National Vocational Education Reform Implementation Plan in 2019,

vocational education has been placed in a more prominent position. In September 2020, nine Chinese ministries and commissions including the Ministry of Education issued the Action Plan for Quality Improvement and Training of Vocational Education (2020-2023), aiming to promote the in-depth integration of information technology and education and teaching. In this manner, vocational colleges are encouraged to take advantage of modern information technology to promote talent training models. Here, it is pointed out that some 100 demonstration virtual simulation training bases will be selected, covering 5,000 online quality courses of vocational education. The Vocational and Technical Department of the Ministry of Education issued the "Notice on Carrying out the Construction of a Demonstrative Virtual Simulation Training Base for Vocational Education" [2020] No.26). The provincial education administration is required to select and recommend 5 colleges and universities within each province to participate in the construction of a training base of demonstration virtual simulation for vocational education. The "Guiding Opinions on Promoting the Co-construction and Sharing of Public Training Bases" issued by the National Development and Reform Commission (Fagai Employment [2020] No. 1951) clearly stated that "Encourage and promote the application of VR/AR/AI and other technologies in the public training base to carry out new industry technology format training", etc. The release of a series of policy documents has undoubtedly injected a booster for the development of AR/VR technology in vocational education.

### 3.3.2. *The popularity of the Internet and the continuous development of mobile reading*

According to the 2020 National Economic and Social Development Statistical Bulletin published by the National Bureau of Statistics, the penetration rate of mobile phones in this country was 113.9 units per 100 people; the annual access traffic of mobile Internet users was 165.6 billion GB, an increase of 35.7% over the previous year; At the end of the year, there were 989 million people surfing the Internet, of which 986 million were surfing the Internet on mobile phones. The Internet penetration rate was 70.4%, and in rural areas, 55.9%. Besides, the 2018 AR/VR industry research report shows that the domestic shipments of AR and VR headsets reached 32,000 and 1.168 million, respectively. The desktop and independent head-mounted display equipment market maintained rapid development. The non-screen head-mounted display form gradually becomes weak in its dominant market presence.

### 3.3.3. *The advent of the 5G era triggers a leap in mobile life*

According to China Unicom's statistics for 2020, China had the highest number of 5G base stations in the world (over 700,000, accounting for app. 70% of the world) and the number of users (app. 150 million people), and the network speed reached 270 trillion. This heralds

a qualitative leap in people's mobile life, where the next generation of social networks, immersive content experiences and related services, as well as the "Internet of Everything" will all become possible. Faster network, higher bandwidth, and continuously accelerating the pace of research and development of VR hardware technology have paved the way for the wide application of AR/VR technology.

### 3.3.4. *The domestic VR/AR education industry is speeding up gradually.*

According to the statistics of the VR Research Institute of Education Network in 2019, China's VR companies in the education field include NetDragon Huayu (launched a VR101 classroom), Perfant(WanMeiHuanJing), Beijing Sail Before, Beijing VR School, HeiVR (Heijing) Technology (launched a VR /AR Super Classroom), Zishi Digital, Subor (Xiaobawang) (planning to invest 400 million yuan to enter VR education), Huanyu Technology, etc.. The education companies that introduced VR technology include Pan-mei Education, ChuangAiLi Technology, Choc English Interactive (QiaoKeHuDong), and companies such as New Oriental, smartstudy.com, and Weirui Education. Giants in the layout of VR education, and listed companies include Baidu, Lanxum (Lisichen), Wisisoft, Tianyu Information, etc. Media companies include City Media (Based on the advantages of copyright resources for teaching materials and auxiliary materials of Qingdao Publishing House Co., Ltd., the development of multi-disciplinary VR courseware products is being promoted). Phoenix Media (Xiamen Chuangyi Software launched "100VR.com Education Network". This is the country's largest cloud platform for 3D interactive online education based on virtual reality, with all independent IPRs of virtual reality technology), Wanxin Media (creating an all-media platform for VR digital education content, reconstructing the industrial ecosystem), Yishi Interactive (creating VR books, saving the traditional book market), etc. Additionally, VR laboratories have been established in some universities, such as Tsinghua University, Beijing University of Aeronautics and Astronautics, Beijing Normal University, Southwest Jiaotong University, Shandong University, Sichuan Normal University, etc. The construction of numerous production companies, research institutions, and content publishing platforms has laid a solid foundation for the publication of AR/VR vocational teaching materials.

### 3.3.5. *The development of AR/VR technical personnel training institutions*

According to the survey, Law-totem Education: launched an integrated VR talent training system of "authorization + certification + teaching support"; Turanca Training: launched VR/AR industrialization training + training education curriculum system; VRStar: launched VR talent vertical training; Crystal Institute: set up a professional VR/AR education industry website for VR interactive display; VR Education Network: the first

stop in China's VR education industry, a leader in VR education research; AR Academy: the comprehensive learning website in AR industry, etc. The establishment of many AR/VR technical talent training institutions has prepared talent conditions for the development and production of AR/VR vocational teaching materials.

### 3.3.6. Huge potential in domestic market

According to data from the VR Research Institute in 2018, Greenlight VR, a VR industry market research company, conducted a survey of 1,200 consumers' personal interests in different types of VR applications. Where, education was ranked fifth place, and 63.9% of consumers were interested in it. Wang Congqing, general manager of HTC Vive China, believed that VR education is the most promising industry for VR. Moreover, VR education is viewed as one of the few ultra-platinum industries in VR. Compared with other VR industries, domestic VR education has the following four absolute advantages: the largest education market in the world, plus one of the countries that value education most. Chinese parents are willing to spend money on the education of their children, and VR education can bridge the gap resulting from the polarization of education.

## 3.4. Challenges

### 3.4.1. Talent demand

This is a main problem present in the following two aspects: 1) Compound talents in project management. As a new form of publication, AR/VR+ vocational teaching materials aim to achieve the deep integration of technology and content. Under this situation, the implementation of vocational education textbook projects requires compound talents being able to control, manage and implement technology and content. Note that some good traditional content planning and editing ideas may not be achieved by AR/VR technicians, or the implementation cost may come up to an unacceptable level. A project developer who is proficient in both technology and content planning can ensure the smooth communication and coordination of AR/VR vocational teaching materials in the development and publishing process, and avoid excessive time and cost. 2) Talents of three-dimensional model production. There is no doubt that the approach of AR technology to superimpose digital resources on vocational teaching materials is to help publishers revitalize some of the existing digital resources, such as audio, video, and pictures. Nevertheless, the three-dimensional model is a must to get the best of the professional knowledge points of vocational education in three-dimensional and intuitive manner. To deal with this, publishing houses need to rely on the power of professional three-dimensional modelers. The construction of three-dimensional models such as human organs and mechanical parts requires professional knowledge to ensure that every blood vessel in the organ model and every screw in the mechanical model should be set up in its proper position. Otherwise, it could mislead the students, affect the teaching effect, and even cause losses in practical operations.

### 3.4.2. Cost

In the development of AR vocational teaching materials, Three-dimensional model construction is used to display the knowledge points and simulated operation steps of automobiles, machinery, human bodies and organs, machine tools, food materials and other physical objects, which may consume considerable human, financial and time costs. Additionally, an AR book needs to have a supporting application to identify the textbook pages and present the 3D models. Also, it needs to develop the Android version and the iOS version, as well as the corresponding Apps and various functions. This series of supporting development has led to the high direct cost of developing such teaching materials, being even equivalent to the development cost of several traditional teaching materials, as high as hundreds of thousands of yuan. The application of VR technology will be positively related to the corresponding VR equipment. Entry-level equipment has low pixels and obvious full-screen pulls, which greatly reduces the performance. The high-end equipment remains at higher prices, and it is updated quickly. Additionally, currently there are fewer AR/VR interactive platforms in China, and most publishing units tend to operate in a loan mode, which greatly restricts the integration and development of AR/VR+ vocational teaching materials.

### 3.4.3. Technical level standard

Since the "Publication AR Technology Application Specification" (CY/T 178-2019) has been issued, the specific implementation rules differ greatly due to the different understandings of the executors; and the "Publication VR Technology Application Requirements" is still being drafted, there is no unified normative document. Therefore, due to the uneven level, the AR/VR contents of vocational education textbooks produced by various technology companies are also quite different. It is not likely to use a unified standard to ensure the standardization of technology and product quality, and shoddy products would be inevitably put on the market.

Furthermore, AR/VR technology itself also needs more improvements. For example, the current AR publications are still at a rough stage in the management of the relationship between 3D models, pictures, and texts. This situation is worsened by mixed results in AR coding rules, recognition and display, etc. The AR editor is not closely connected with the ISLI national standard. It is still in a state of absence in terms of ISLI code application, code segment allocation, code paving specifications, code management, and determination of the relationship between models and text. As for VR technology, not only the network is restricted by the transmission speed, but also the level of head-mounted display technology still needs to get better, and so on.

At present, the application of AR/VR technology to the development and publication of vocational education teaching materials is still in the exploring stage.

### 3.4.4. Policy barriers

On the one hand, the publication of vocational education textbooks is subject to the national vocational education policy, the level of schooling, and the level of teachers; on the other hand, the publication and adoption of these textbooks are also restricted by the management systems of various regions and schools.

#### 4. Countermeasures by Publishing Units

AR/VR+ vocational education are viewed as an inevitable way to develop modern education and teaching. The accompanying publication of teaching materials will also become the best choice for teaching materials construction in the new era of information technology. In order to overcome the aforementioned shortcomings and the challenges of new technology development, publishing units may break through the following aspects:

##### 4.1. Promote the Integration of Publishing Houses + Vocational Colleges + Enterprises + AR/VA Content Production Companies

Publishing houses should give full play to their own content resource reserves and the advantages of the distribution of the textbook market in the field of textbook publishing. On the basis of the traditional textbook construction, i.e. the “publishing + vocational college + enterprise” strategic cooperation, strategic cooperation with AR/VR content production companies such as Jiangsu Mengren Company should be expanded by way of building up an AR/VR content cloud platform, and jointly developing relevant professional teaching materials for different vocational colleges. This attempt is to overcome the shortcomings of unilateral advancement and create an online + offline integrated vocational education and teaching material construction, and on-the-job operation platform.

##### 4.2. Establish an AR/VR Professional Teaching Material Alliance or Association to Unify Standards

It is necessary for all publishing houses, vocational education management institutions, major vocational education colleges, and production companies engaged in the development of AR/VR vocational education textbooks to form industry alliances or associations. In this way, they may take the chance to participate in the drafting of “Publication VR Technology Application Requirements”. Additionally, the format and corresponding technical standards of the produced AR/VR content files should be standardized, so as to ensure the quality of market products.

##### 4.3. Introduce the Copyright of Overseas AR/VA Teaching Materials for Traditional Publishers

For those who are technically difficult to directly participate in the development of AR/VR books, the introduction of copyright is a safe choice. This may also save the direct costs and time costs incurred by self-invested production and improve publishing efficiency.

##### 4.4. Realize the Transformation of Traditional Textbooks to Digital Materials

In the 5G era, publishing houses dedicated to the publication of AR/VR+ vocational education textbooks should actively use new technologies to create VR/MR digital textbooks. This may help eliminate defects of traditional paper textbooks and traditional textbooks (AR enhanced version). More than this, it may also reduce the effect of relying on the cost of paper-based teaching materials, which is more conducive to breaking through the channel constraints of the distribution link.

##### 4.5. Cultivate Publishing Talents Specialized in AR/VR

The publishing units should set up a department engaged in the development of AR/VR vocational teaching materials, and recruit and train professionals to participate in the project. This makes it easy to coordinate and unify with the production company to formulate and implement a feasibility plan for this type of teaching materials.

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