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Construction and Analysis of the Digital Textbook for "Engineering Geology"

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Abstract: Digital textbooks are a key focus for enriching the textbook system with Chinese characteristics and a driving force for advancing the digital transformation of higher education. Based on a brief introduction to the concept and characteristics of the digital textbook for "Engineering Geology," this paper emphasizes the significance of constructing Tongji University's "Engineering Geology" digital textbook and establishes its framework. It aims to comprehensively promote the in-depth integration of modern information technology with traditional textbooks and realize the all-round development of students.

Keywords: Digital textbook; Engineering geology; Paper textbook; Information technology

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1. Introduction

Textbooks are an essential guarantee for talent training. Targeting the development direction of textbooks and improving their construction quality are the top priorities of textbook development [1–3]. The Report to the 20th National Congress of the Communist Party of China clearly pointed out the need to strengthen textbook construction and management and promote educational digitalization, which undoubtedly points out the direction for textbook development—realizing the digital development of textbooks. Therefore, we should fully promote the construction and application of digital textbooks, which is of great practical significance for enriching the textbook system with Chinese characteristics, improving the quality of talent training, and building a talent-strong country [4,5].

As an important professional basic course for engineering majors such as Geological Engineering, Civil Engineering, Transportation Engineering, Surveying and Mapping Engineering, and Port, Waterway and Coastal Engineering, "Engineering Geology" is a necessary course for cultivating future geological engineers, geotechnical engineers and other talents [6]. The course of "Engineering Geology" is actually an organic combination of engineering and geology, featuring strong practicality and great abstraction. Specifically,

engineering focuses on practice, emphasizing drawing valuable technical experience from actual projects; while geology is more theoretical, containing many abstract concepts and complex geological phenomena that often require full use of imagination to understand. In recent years, with the continuous development of information technology, digital textbooks have been widely used in the field of education [7,8]. With the help of technologies such as AI, AR (Augmented Reality), the Internet, and intelligent APPs, the construction of the digital textbook for "Engineering Geology" can be promoted, effectively solving the above-mentioned problems existing in the course.

As one of the first institutions of higher education in China to offer majors such as Geological Engineering, Tongji University has been adhering to innovating and developing the "Engineering Geology" course for many years. With the widespread application of digital textbooks, Tongji University keeps up with the times, emphasizes the significance of constructing the digital textbook for "Engineering Geology," and establishes its framework, aiming to provide certain guidance for sibling universities in constructing their own digital textbooks for "Engineering Geology."

2. Concept and characteristics of the digital textbook for "Engineering Geology"

The digital textbook for "Engineering Geology" is the digital transformation of traditional paper textbooks. Specifically, relying on excellent paper textbooks and high-level courses, it fully utilizes modern information technology to integrate various digital resources, learning tools and other elements according to actual teaching activities. Based on knowledge graphs and with the help of modern AI technology, it realizes that textbooks can be listened to, viewed, practiced, crossed, and optimally updated, forming a digital teaching content product that meets national standard requirements. Different from paper textbooks, electronic textbooks, and online courses (including learning resources such as MOOC teaching videos, PPT, and exercises), the characteristics of the digital textbook for "Engineering Geology" mainly include the following aspects:

2.1. Strong interactivity

Traditional paper textbooks for "Engineering Geology" are compiled based on the knowledge system of first-level disciplines such as Civil Engineering or Geological Resources and Geological Engineering. Understanding the content mostly relies on the explanation of teachers, and the teaching effect often depends on the teachers' teaching level. The form of knowledge acquisition and course content transmission is relatively single. AR technology, tablet computers and other devices have strong human-computer interaction functions, which can enrich the form of course content transmission. Digital textbooks based on AR technology and tablet computers can provide a variety of interaction methods. For example, when explaining rocks in nature, students can further understand the classification, structure, texture, and identification methods of igneous rocks, sedimentary rocks, and metamorphic rocks by clicking on videos and animations, and can check their learning effects online by clicking interactive icons. The application of digital technology makes words no longer lie coldly in textbooks, but are active in interactive communication with people [9].

2.2. Rich content

Traditional paper textbooks are limited by the number of pages, and the presented content is often limited to icons or text. However, the content carrier of digital textbooks is storage space [10], whose storage capacity is unlimited. Therefore, it can store a variety of teaching resources, including actual engineering cases, teaching

videos, graphic animations, teaching reference materials, thinking questions and exercise sets, and question banks. The construction of digital textbooks can break through the graphic design of traditional textbooks and enliven the content. For example, designing 3D animations, enriching graphic color matching, and changing table styles to establish a relaxed visual space. For example, when explaining the impact of geological structures on engineering, specific topographic maps of horizontal structures, monoclinic structures, fold structures, fault structures, etc., in actual projects can be combined to clarify the characteristics of different structures and dynamically deduce the impact of the development of different structures on actual projects.

2.3. Real-time update

For the course of "Engineering Geology", some paper textbooks are updated every 10 years, with a slow update speed. Many new technologies or construction methods are not supplemented in the textbooks in a timely manner, which is not conducive to students' learning. However, digital textbooks can be based on knowledge graphs and updated in real time according to current domestic and foreign research progress. Especially relying on the Internet platform, it can realize unified release and synchronous update across the network, with fast update speed and low cost. For example, when explaining the prevention and control of landslide disasters, the governance principles proposed in traditional paper textbooks are prevention first and remediation supplemented, and the governance measures are mostly drainage, support, cutting and weight reduction, and improving the properties of sliding surfaces. But in existing projects, around the prevention and control of geological disasters such as landslides, an integrated air (Global Navigation Satellite System)-space (UAV)-ground (surface monitoring) method has been adopted to realize the identification and real-time early warning of landslide disasters [11].

3. Significance of constructing Tongji University's digital textbook for "Engineering Geology"

"Engineering Geology" is a professional basic course for majors such as Geological Engineering, Civil Engineering, Intelligent Construction, and Port, Waterway and Coastal Engineering at Tongji University, with a wide range of applicable majors and flexible applicable objects; this course covers knowledge such as Soil Mechanics, Mineral and Rock Mechanics, Rock Mass Mechanics, Hydrogeology, and Engineering Geological Investigation, covering a wide range of knowledge. When adhering to and innovating the development of the "Engineering Geology" course, Tongji University should strive to promote the construction of its digital textbook in view of the characteristics and problems of this course. Its significance mainly includes the following points [12].

3.1. Conducive to accelerating the modernization of education

With the rapid development and strong penetration of modern information technology, the teaching methods and textbook forms in higher education are constantly changing. As an important support for talent training, digital textbooks are also constantly progressing and developing. Digital textbooks are not just a combination of boring text and digital technology, but a deep integration of course content, professional cutting-edge progress, and digital technology, striving to build an open, adaptive, and sustainable education system, so that modern higher education can continuously adapt to the new pace of modern technological development and become an important support for building an education-strong country. Tongji University offers many majors that include "Engineering Geology" as a course. Constructing a good digital textbook for "Engineering Geology"

is conducive to comprehensively cultivating innovative and compound talents in engineering, enriching the engineering textbook system of Chinese universities, and promoting the informatization development of higher education.

3.2. Conducive to giving play to the new function of collaborative education

The competition between countries and enterprises in the 21st century ultimately boils down to the competition for talent. As an important carrier of education, digital textbooks play an important role [13]. For example, digital textbooks combine basic engineering geology content with engineering practice applications, and can further provide students with an interactive learning platform and practical application system. With the help of modern information technology, a large number of real-time updated actual engineering case libraries are established to enrich students' knowledge, making the "engineering flavor" of the "Engineering Geology" course stronger. In short, the construction of digital textbooks is not only conducive to enriching teaching content, but also can greatly improve students' professional identity, help students obtain and absorb new knowledge in real time, continuously improve the organic connection between professional practice and course content, and enhance students' practical engineering application abilities.

3.3. Conducive to consolidating students' professional foundation

When adhering to and innovating the development of the "Engineering Geology" course, Tongji University should pay attention to the characteristics and problems of this course, fully construct its digital textbook, and strive to present complex geological concepts or geological phenomena using emerging visual technologies (AR, VR) to deepen students' understanding, making the "geological flavor" of the "Engineering Geology" course stronger. For example, when explaining landslides, it is difficult to let students go to the field to understand the entire stages of landslide initiation, sliding, and gradual stability, and their respective characteristics. With the mature application of Virtual Reality (VR) technology, on-site visits can be completely introduced into indoor teaching. For existing landslide image data, an engineering case library can be established based on on-site collected data and 3D virtual technology, allowing students to wear VR headsets to experience the entire process of landslides in real time, deepen their understanding, and continuously consolidate professional knowledge.

4. Framework of Tongji University's digital textbook for "Engineering Geology"

The overall framework of Tongji University's digital textbook for "Engineering Geology" takes talent training objectives as the main line to promote the all-around development of students. The main line specifically includes two modules: the curriculum system and the evaluation system. Among them, the curriculum system mainly takes content directly related to "Engineering Geology" as compulsory content and other knowledge related to engineering geology as optional content, with the design focusing on teachers who teach the digital textbook; the evaluation system focuses on evaluating students' mastery of course knowledge. The framework of Tongji University's digital textbook system for "Engineering Geology" is shown in **Figure 1**.

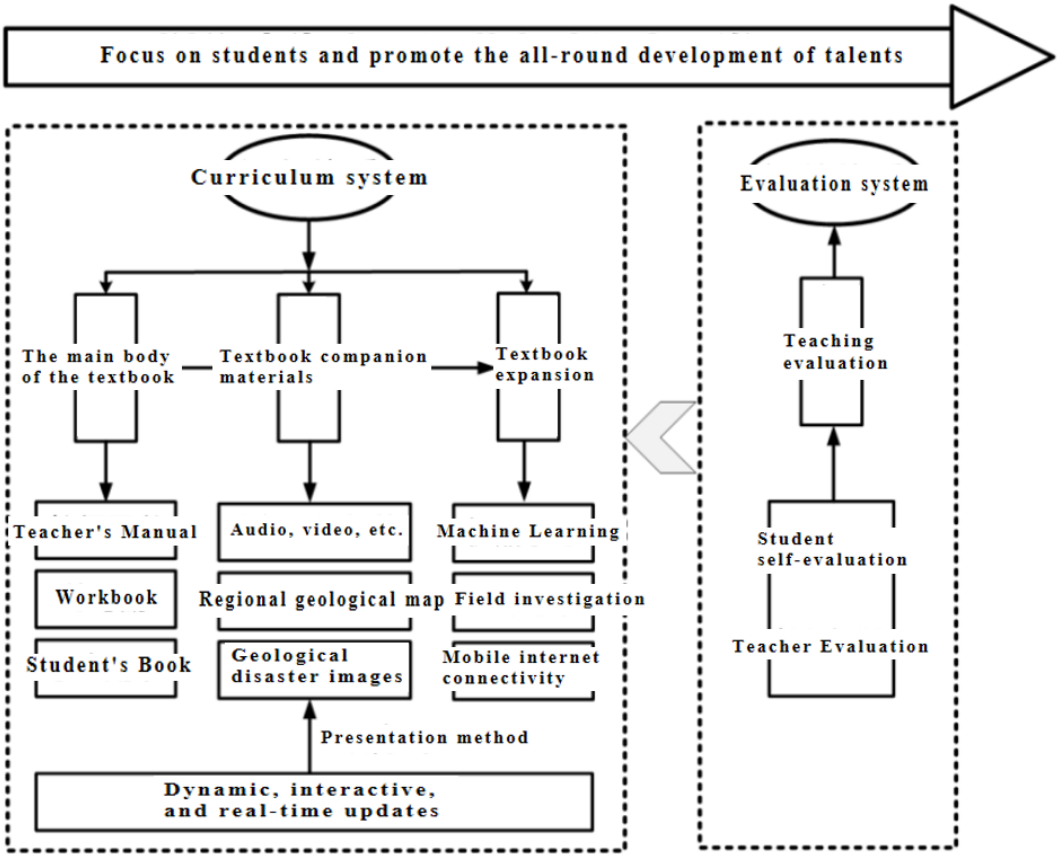

Figure 1. Construction System Diagram of the Digital Textbook for "Engineering Geology."

4.1. Highlighting the core essence of digital textbook construction

Taking students as the foundation and promoting the all-round development of talents as the core main line of digital textbooks embodies the core essence of the development of the digital textbook system with Chinese characteristics. To highlight the core construction idea of student-centeredness, the digital textbook for "Engineering Geology" should form a horizontally cross-cutting and vertically divided system: horizontal cross-cutting means that the construction of digital textbooks requires the joint cooperation of multiple disciplines. By selecting disciplinary knowledge conducive to students' development and using diversified information arrangement technologies [14], students' practical skills and disciplinary literacy can be comprehensively improved; vertical division means that digital textbooks include elements such as the textbook main body, textbook supporting materials, and textbook expansion. Different elements have specific components, and textbook knowledge content should be presented in a multi-level, multi-element, and modular manner to promote talent training.

4.2. Highlighting the main body of the curriculum system construction

On the basis of constructing the core main line of the digital textbook system for "Engineering Geology", the construction of digital textbooks should also highlight the importance of teachers and continuously improve their ability to integrate resources in content, such as the textbook main body, textbook supporting materials, and textbook expansion. Fully mobilize teachers to continuously collect a variety of geological structure pictures, improve course teaching videos, carefully make courseware combined with cutting-edge research progress of

the course, establish different levels of pass-through questions using interactive platforms, and adopt AR three-dimensional simulation models for obscure geological models to deepen students' understanding, with the help of Virtual Reality (VR) [15], Augmented Reality (AR), 3D technology, the Internet, and big data. Thus, students' active learning can be continuously stimulated, the teaching quality of the "Engineering Geology" course can be improved, and a multi-mode teaching model can be realized.

4.3. Considering the application of the curriculum evaluation system

Whether the construction system of the digital textbook for "Engineering Geology" meets the actual needs of students needs to be further verified. On the one hand, as the fundamental basis for teachers' teaching, whether digital textbooks truly promote the all-round development of students needs to be dynamically adjusted in combination with curriculum evaluation; on the other hand, special attention should be paid to cultivating students' sense of participation. Allowing students to participate in the evaluation of the curriculum system is conducive to putting forward content that urgently needs to be improved in digital textbooks from the perspective of students, thereby continuously improving and strengthening the construction of digital textbooks to truly and effectively serve the long-term development of students.

5. Conclusion

In short, in view of the characteristics and existing problems of the "Engineering Geology" course, we should fully utilize modern information technology to promote the construction of its digital textbook, continuously enrich the digital textbook system with Chinese characteristics, realize the deep integration of digital technology with higher education teaching, continuously improve and update research progress, strengthen the interactivity, audibility, visibility, perceptibility, etc. between students and course knowledge, and continuously promote the all-round development of students. In the process of constructing the digital textbook for "Engineering Geology", Tongji University should take talent training objectives as the main line, fully reflect the student-centered construction concept, give full play to the significance of digital textbook construction, comprehensively improve students' practical application abilities, and make due contributions to accelerating the modernization of education and cultivating compound talents.

Disclosure statement

The authors declare no conflict of interest.

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