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Research and Practices of University-Enterprise Collaborative on Big Geographical Data Education

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Abstract: University-enterprise collaborative education can promote technologies for university education, and ensure that students' skills meet market demands. The author's team, in response to the evolving trends in technology, introduced some technologies (geographic big data, artificial intelligence, real scene modelling) into university education and built a new mode of collaborative investment of manpower and material resources. This paper describes some research practices related to how to build a series of training cases on geographic big data and real scene modelling through cross-course collaboration and introduces a corresponding training platform. The paper then analyses the platform how to promote GIS experiments education's upgrades. One upgrade involves transitioning the experimental environment from PCs to the network cloud, while the other upgrade involves moving from small dataset to big data. These improvements enhance both teaching quality and faculty development, and also aligning talent training with market needs. These practices could be referred by other university-enterprise collaborative educations. This research won the Geographic Big Data Competition (2024) Award for Geographic Data Education and Science Popularization.

Keywords: geographic big data; real scene modelling; education and market demand; experimental platform

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1 Introduction

With the generation and development of big data, artificial intelligence (AI), virtual reality and other technologies, geographic information systems (GISs) have gradually been integrated into industry applications in the form of geographic big data, smart cities, etc., and have presented new challenges to geographic information science research and education[1–3]. In recent years, driven by new technologies such as big data or AI, Chinese universities have gradually begun to adjust and optimize the curriculum system, teaching content and teaching methods[4–9], but there has been less discussion on the construction of digital and shared platforms for relevant experimental teaching cases[10]. One of the reasons for the relative lag of experimental teaching of new technologies and new applications is that they have higher requirements for experimental hardware and software environments,

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which are difficult to meet by the previous stand-alone desktop version of the GIS teaching environment[11]. The second reason is that these new technologies are usually researched and developed by enterprises in recent years, and relatively few fields of practical application exist, which leads to a lack of classic and mature experimental teaching cases in colleges and universities, restricting the promotion and popularization of teaching new technologies and applications. Especially in the context of the current era of Western GIS software sales restrictions on China, it is particularly important to collaborate with domestic GIS manufacturers to carry out the digital construction and sharing of teaching experimental cases around geographic big data, AI, digital twins and other advanced technologies[12].

The collaborative education model proposed by China's national policy in 2020 provides an opportunity for "advanced technology of enterprises to enter colleges and universities, and talent cultivation in colleges and universities to meet the needs of the society". In recent years, collaborative education projects in the field of GIS have focused mostly on enterprises providing university with places and facilities for internship practice and graduation design or providing schools with practical teachers who are in short supply for talent cultivation[13,14]; there are relatively few cooperations between schools and enterprises where both sides invest substantial resources and manpower to build experimental platforms[15].

To advance the experimental teaching of geographic big data and other advanced technologies, Beijing Normal University (hereinafter referred to as BNU) and Beijing SuperMap Software Co., Ltd. (hereinafter referred to as SuperMap) collaborated to build an experimental teaching platform for geographic big data and 3D modeling of real scenes. This collaboration leverages both parties' material and human resources to promote the popularization of SuperMap software in experimental teaching.

(1) In the construction of hardware and software environments, the school provides teaching space, computer and network hardware environments for collaborative education, and the enterprise provides software and technical support, such as Super Map GIS iDesktop10.1 and Super Map GIS iServer10.1, and has built experimental hardware and software environments of "1 host + 3 cluster nodes + 70 clients with GPU graphics cards", which have been completed.

(2) In the construction of experimental cases, the school is responsible for the overall design of the experimental cases, the enterprise is responsible for the technical implementation of the cases on the platform, and the two sides jointly promote the construction of experimental data, syllabuses, courseware and teaching materials.

(3) In terms of teaching practice, the school is responsible for helping students complete the grafting of new methods and technologies under the existing knowledge system and emphasizing the key points and difficulties that should be mastered in the experiments, whereas the enterprise is responsible for the technical support and guidance in the experiments.

To date, the platform has built a series of experimental cases of geographic big data, such as ship flow data and geo-fence analysis, taxi track data and urban OD analysis, etc. It has built a series of experimental cases of real scene modelling and analysis, such as real scene generation of drone aerial images and Building Information Modeling (BIM), etc., and has carried out practice in accordance with the curriculum, forming a new mode of school-enterprise codevelopment and collaborative education.

2 Exploration of the GIS Experimental Teaching Platform

2.1 Experimental Teaching Case Vase Construction Through Cross-course Association

The teaching cases of geographic big data and 3D modeling of real scenes usually involve several courses, such as Geographic Information System, Principles and Practice of Spatial

Databases, Spatio-temporal Big Data Analysis, and even related professional courses such as Urban Geography, which are highly comprehensive. The digital construction of teaching cases jointly carried out by many courses can help improve the quality of teaching cases, increase the sequential articulation relationship between courses, let students experience the real-world relevance of prerequisite courses, and improve the enthusiasm of students' learning; Furthermore, by using teaching experiment cases as the framework, can effectively promote the development of teaching teams for course clusters and enhance overall instructional quality.

In addition, the centralized and shareable teaching case library can help senior teachers carry out the digital construction of classic experimental cases, avoid the loss of excellent cases due to departure or retirement, and promote the transfer of teaching work; at the same time, the centralized and shareable, unified management and continuous improvement of the teaching case library not only improves the overall quality of teaching but also ensures the sustainability of the quality of the teaching experiments.

2.2 Upgrading the Experimental Environment from the Microcomputer to the Network Cloud

The traditional microcomputer experimental environment has limitations in terms of computing power and 3D visualization, which severely restricts the teaching of geographic big data analysis and high-quality visualization of real scenes. The "1 host + 3 cluster nodes + 70 clients with GPU graphics cards" have realized an upgrade from a microcomputer to a network cloud, and the school servers and graphics cards provide the storage, computation and rendering capabilities required for the experiment, laying a hardware foundation for geographic big data, AI, and real-scene modelling and analysis. The improved experimental environment helps students grasp cutting-edge methods and technologies in the field of GIS and broadens their horizons.

In addition, the experimental environment of the network cloud also makes it possible for the platform's offsite teaching and offsite experiments. In the context of BNU's strategy of "one body, two wings", the shared experimental platform has provided services for the experimental teaching of undergraduate experiments of BNU at Zhuhai, which opens a new mode of cloud teaching and cloud experiments on the platform.

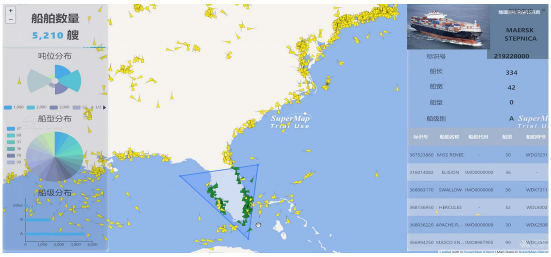
2.3 Upgrading GIS Teaching from Small Data to Big Data

Traditional GIS courses usually rely on small amounts of data to carry out teaching focused on functions. However, with the continuous development of Earth observation technology, geographic big data with spatial and temporal characteristics have opened a new direction and new applications of social perception[16]. In recent years, various types of geographic big data, such as mobile phone signalling, social media, streaming data based on the Internet of Things, the internet, and volunteer GIS, have gradually opened a new direction of social perception and have been widely used in various fields, such as urban planning, disaster emergency response, traffic management, and business intelligence.

The platform has developed several case studies, including: ship flow data management and geo-fence analysis, shared bicycle POI data and urban functional area perception, Taxi track trajectory data and urban districts' OD analysis, detection of taxi dwelling areas (Figure 1). These cases help students understand the differences between geo-big data and small data, the analytical paradigms and methodologies of geo-big data, and the management and analysis of big data using SuperMap software. This cultivates innovative talent aligned with market demand.

2.4 Real Scene Modelling for the Frontiers of Science and Technology

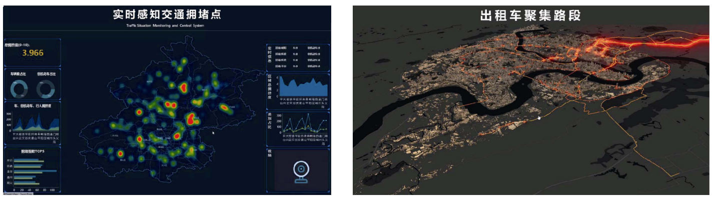
With the development of new-generation information technologies such as the Internet of



(a) Interface view of ship flow data management and geofencing analysis

(b) Interface view of shared bicycle POI data and urban functional area perception

(c) Interface view of taxi track trajectory data and urban districts' OD analysis



(d) Interface view of detection of taxi dwelling areas

Figure 1 Screenshots from experiments cases about geographic big data

Things, big data, cloud computing, and artificial intelligence, the implementation of digital twins has gradually become possible[17]. Currently, many industries and organizations are paying great attention to digital twins and have started to explore new modes of intelligent applications based on digital twins, which is an effective means to realize the interactive integration of the information world and the real physical world[17]. Therefore, technologies and applications such as "smart cities", "digital twins" and "metaverse" have great potential in the future.

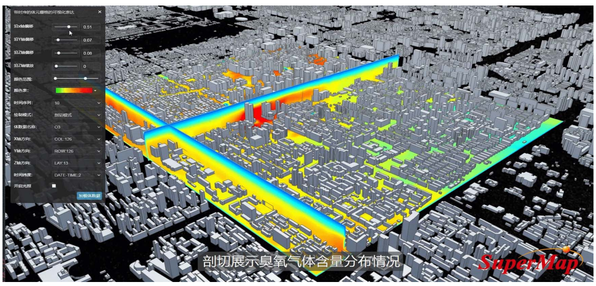
To address the future science and technology, universities and enterprises have jointly constructed experimental cases, such as real scene modeling of drone aerial images, BIM and sunshine analysis, and 3D visualizations of city skylines and ozone Tetrahedralized Irregular Mesh (TIM), as depicted in Figure 2. These cases aimed to inspire students to understand and think about the application and possible impacts of digital twins in the future fields of urban planning, traffic planning, environmental safety and health; to think about future changes in geographic research paradigms and methods; and to inspire innovation thought.

3 Application of the Platform

To date, the platform has served the experimental teaching of 7 professional undergraduate courses in geography, such as Geographic Information System, Principles and Practice of Spatial Databases, Analysis of Spatio-temporal Big Data, and Comprehensive Internship in GIS, on the school's Beijing and Zhuhai campuses of BNU; at the same time, it also serves the experimental teaching of the liberal studies course Spatio-temporal Big Data and Social

(a) Interface view of real scene modeling of drone aerial images

(b) Interface view of BIM and sunshine analysis



(c) Interface view of 3D visualizations of city skylines and ozone Tetrahedralized Irregular Mesh (TIM)

Figure 2 Screenshots from experiments cases about real scene modelling based on geographic big data

Perception and has cumulatively cultivated several hundreds of undergraduates majoring in geography, economics and other disciplines.

At present, the geographic big data management and analysis methods taught by the platform can help students quickly extract OD matrices of 2,000 traffic intervals from GB-level Beijing taxi track data; it lays the methodological and technological foundation for the practice of perceiving city functions based on taxi tracks in the subsequent urban geography course, realizes the linkage with the urban geography course and promotes the upgrading of its teaching practices.

4 Conclusion

In the context of deepening the integration of university-enterprise and promoting high-quality collaborative education, BNU and SuperMap explored a new mode of university-enterprise actual input of human and material resources for collaborative education based on the sharing platform for geographic big data and real scenes modeling, which can serve as a reference for university-enterprise collaborative education practices for other disciplines or universities.

Currently, the platform serves BNU's courses. Future plans include expanding its application to other universities, enhancing collaborative education, and fostering innovative talent in geographic information science nationwide.

Author Contributions

Cheng, C. X. presided over the construction of the geographic big data experiment platform. Shen, S., Du, K. P. and Zhao, W. Z. were responsible for carrying out teaching practices on the experiment platform in conjunction with the curriculum. Chi, L. X., Wang, L. and Xie, K. T. served as practical instructors from SuperMap.

Conflicts of Interest

The authors declare no conflicts of interest.

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