A Synergetic Talent Training Mode for Cultural Heritage Digitalization

—A Case of GIS

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Abstract—Currently, the speeding economic development of China triggers a new era mission for applied talents to satisfy the need of converting the economic growth and promoting the industrial structure improvement. Consequently, it is of great significances to establish a novel GIS applied talent training mode of GIS under the support from transforming strategy for the local colleges/universities of China. Hence, this research firstly reports the important experiences from GIS specialty of Hengyang Normal University who are striving to explore the applied talent cultivating ways. Then, this work discourses the main features of GIS applied talents through detailing how the GIS specialties of local universities/colleges meet the national need on cultural heritage digitalization. Noted that, the case of this paper tries to establish a synergetic framework within its host to cultivate the creative talents. First and foremost, the resources and supports from the excellence disciplines, platforms, as well as related specialties play significant role in setting up the framework. Through this paper, the synergetic framework for cultivating applied GIS talents must be popular to the local universities/colleges to improve the similar specialties under combining the discipline establishment and national strategic needs.

Keywords—local university transformation; applied talents training; GIS specialty; cultural heritage digitalization; synergetic and creative training mode

I. INTRODUCTION

In China, currently, it is very clear that the rapid development of economy and improvement of industrial structures have triggered a strong national need of cultivating the applied talents [1]. Hence, most of the universities or colleges are trying to train the applied talents to meet the new economic and social needs when China has been falling into the new era of development [2,3]. So, a great amount of the local universities/colleges are exploring the most appropriate ways to cultivate applied talents under the support from the national strategies on improving the distributions of disciplines and specialties [4-8].

In fact, the high education system of China has been strengthening, deepening, and widening the volume of applied talents training with an education innovation perspective [9]. At the same time, it is considered as the best choice for the high education system of China to explore the mechanisms/strategies for cultivating the applied talents.

Actually, the applied talent training can cover the needs of all kinds of human resources to promote the development of economy and society. This has already been verified by the developed countries like as UK, America, and Germany [8,10,11].

In China, there are rich augments on the definitions or standards of the applied talents [12]. However, the urgent needs of the applied talents are accepted by the different level governments, local universities/colleges, and industries. This is very useful to help the local universities/colleges precisely locate their functions on talents training.

Geographic Information System and Technology (GIS&T), rising in the 1960s, has been viewed as one of the most critical parts of the global information infrastructure industries [13]. As well known that GIS&T is also seen as an emerging strategic industry based on the earth science, computer science, information science, survey, and remote sense & technology, etc. In fact, GIS&T is mainly employed to service the areas of the geographic spatial information producing, processing, applying, and development of the related technologies. Hence, GIS&T, driven by innovation, is usually treated as a cross-cutting discipline through integrating the modern information sciences and technologies [14,15].

The emerging of GIS Specialty is accompanied with the rise and expansion of GIS industry. In China, from a historic perspective, the GIS Specialty originated in the end of 1980s. And now, it has already covered college, undergraduate, master programs, and doctor programs [16]. According to the related statistics, there are about more than 150 universities who has established the GIS undergraduate programs [16]. Noted that, most of these 150 universities are local universities.

GIS industries & sectors, featured as new technology-driven and creative application, determine that GIS specialty of universities should focus on the practical problems in the field of industry in terms of school orientation, talent training, teaching systems, and guarantee mechanisms. This is very of significance to train the applied talents with great creative application skills. Consequently, it is very clear that exploring a possible way to establish a novel cultivation mode of applied
talents is very meaningful for the GIS specialties of local universities/colleges.

This work details the ways to train the applied talents of GIS specialty under the support from excellent discipline groups and orientation of digitalization of traditional cultural heritages through the case of Hengyang Normal University.

II. FEATURES OF APPLIED TALENTS TRAINING OF GIS SPECIALTY

The driving forces of GIS&T are from information sciences where consecutively provide the new conceptions, novel methods, and innovative technologies. Therefore, not only the typical attributes of informatic specialties but also the properties of applied specialties can easily be observed in the GIS specialty at the same time [17]. So, emphasis on the continuous professional skills training is an international way that can help those who will launch the career in GIS industries [13].

A. A brief for the Art-of-the-state of Talents Training of GIS Specialty

It has been more than 30 years since the first GIS specialty of university was founded in China. However, the education of GIS specialties of universities/colleges has made great progress in recent decades under the support of numerous experts and scholars. Accordingly, GIS specialties have already turned the functions from cultivating compound talents [17] to training applied talents to meet the need of human resource market [18,19].

In China, the main features of talents training of GIS specialties of universities/colleges can be observed as following: (1) China has been seen as the main part for developing GIS education through the world although it is launched relatively late [14]. (2) Different GIS specialties hosted by different universities/colleges are supported by their own disciplines like geography, survey, city, hydrology, communication, computer sciences, etc., and then form different orientations after a long time of full development. (3) Although there is lack of a standard definition on both the core characteristics and professional skills of the applied talents of GIS specialty, China has gradually formed a good applied talents training pattern which can mainly fit the market needs of GIS industries. (4) Many modes for the applied talents training are proposed by a lot of universities in terms of the characteristics of GIS specialty education. Especially, some new talents training modes have achieved good results, such as industry-university-research collaboration, research driving, engineering teaching, order-based training, university-enterprise cooperation, etc. (5) It is worthy to pay long attention to establish the standardize and useful mechanisms for GIS talents' cultivation.

Totally, GIS education of universities/colleges in China characters as rapid development. However, it also is accompanied by the challenges, opportunities, and problems. Particularly, apparent spatial patterns of regional differences are observed [20]. The reasons are attributed as faculty crews, support-discipline groups, foundation specialty chains, orientations, and talents training objectives, etc. Importantly, the specialty orientations, curriculums, and learning hours are viewed as the direct factors to generate the former patterns [21]. In fact, this makes a significance difference in the scale and quality of GIS specialties at different levels/types of universities/colleges.

B. Orientation to the Special Applied Fields

GIS is seen as the new geographical language [22] since it acts as the basic toolkits for dealing with the spatial information, such as observing, surveying, mapping, hydrology, marine, climate, etc. So, this determines that GIS talents training has to originate in special applied fields.

For example, constructing the 3D models is seen as one of the most effective protection ways for traditional building heritages. Therefore, 3D-mode is also considered as one of the most important applications of the digitalization industries of cultural heritages. However, constructing 3D models for traditional buildings usually includes a lot of prerequisite skills like professionally manipulating the GIS software, 3D data capture and processing, 3D building modelling, etc. In addition, some domain knowledge and laws about cultural heritages preservation can also play important roles in this field.

As we all know that the new generation information technologies are deeply impacting on every area of the human society. This leads to the social division of labor is becoming more and more refined. On the other hand, so many labor-intensive industries will be gradually replaced in the future. Obviously, GIS specialties in universities/colleges should try to establish the professional talents training systems in terms of applied fields, professional knowledge, and applied abilities.

According to some scholars’ investigation [21], in China, GIS industries especially welcome the graduates of the universities who are good at application development, data processing, technology support, sales, data analysis, and scientific research, etc. Hence, the students of GIS specialties of universities/colleges must master much knowledge of applied areas and professional skills whether they will work in GIS industries after graduation or not.

C. Multi-level Practicing-skill Training System

The explosion of scientific knowledge and technologies is usually considered as the main feature of the information age. So, it can be foreseen that the artificial intelligence must be the basic tools for people to cope with the spatial big data in the future. And it is also clear that the enormous market needs of technological frameworks on the spatial intelligence data processing, intelligence parallel processing procedures for spatial analysis and distributions, and the intelligence management of infrastructures, etc. must impact on the geographical information sciences.

Apparently, the stride changes and rapid developments of technologies and industries must deliver the mentioned impact to the GIS specialties of universities/colleges. Firstly, the talents training mode, talents education plan, as well as curriculum construction will be changed so much. Then, the great changes will also be brought to the body of knowledge of GIS specialty and related structures. All of the above can be
attributed as the adaptable changes of GIS specialty for the talent education plan, curriculum knowledge systems, and practicing-skill training system in order to keep the pace with the rapid development of industries.

In fact, the locations of GIS industries serving the national economic and social developments have been confirmed since 2014 through a couple of key plans, such as the National GIS Industries Development Planning from 2014-2020, etc. This also makes it possible for universities/colleges to explore the practicing-skill training systems which can meet the needs from different levels and applied fields of GIS industries. For example, a local university established the platform-level-standard practicing-skill training system for GIS specialty [23].

The graduates from GIS specialty should try to resolve some important applied problems of industries by using their professional knowledge or skills. This is treated as the criteria to check the performances of the practicing-skill training.

In general, a deep understanding on the role of practicing-skill training during the whole processes of talents cultivation has been made by the GIS education communities. This includes a multi-level practicing training system [24] which can cover the curriculums, field training, research-study-research, applied projects, and competitions, etc. It is an important way to teach GIS students to obtain the solid knowledge and creative thinking skills.

**D. Cultivate the Research Talents Who Can Resolve the Given Application Problems**

It is well known that spatial information is the critical strategic resource of modern society. And we can see that more and more novel technologies are employed by the GIS industries since that the dimensions, width, and depth of the mining and application of spatial information are consecutively deepening.

That is to say, students of GIS specialties should master the principles, and be as skilled with the creative applications. In addition, they should be capable of starting the compound engineering applications and running. This is because of the following.

1. Generally, GIS industries often include a very broad range. At the same time, deeply finding the valuable spatial information and geo-knowledge through the geo-spatial big data of different resources, types, temporal-spatial dimensions is full of challenges. Hence, this determines that the talents from GIS specialty should master not only the abilities of running engineering but also creative skills to fit their future professional positions. In fact, the abilities of research and creation is usually seen as the base and guarantee for the job vacancies of the GIS graduates [25].

2. The range of GIS industries almost covers every field of the national economies and societies from an application perspective. Furthermore, GIS sciences typically character as cross-cutting the disciplines of geography, survey, cartography, remote sensing, as well as computer sciences, etc. from a disciplinary perspective. Finally, the newest progresses of information technologies are necessary to be included in every step of spatial data processing from capture, analysis, dealing, and application.

Hence, the needs from GIS industries and related application areas request that GIS specialties should cultivate students to resolve the special application problems through their creative research skills.

**III. SYNERGETIC TRAINING MODE FOR CULTURAL HERITAGE DIGITALIZATION THROUGH CROSSING SPECIALTIES (STMCHD)**

Currently, in China, the strategic chances of conversion and developments are brought to most of the local universities/colleges by the high education tactic “serving the local social-economic developments and cultivating the applied talents”.

The case of this work trying to cultivate the applied talents oriented the national key needs through cross-cutting disciplines under the support from its host. Firstly, the case fully coordinates multiple discipline platforms and faculty resources of different specialties through the excellent discipline groups and specialty chains. Secondly, the case establishes a novel talents training mode for the cultural heritage digitalization. Lastly, the case puts its mode into effect.

**A. Setting up an Experiment Class for Cultural Heritage Digitalization through Combing Disciplines Platforms**

Recently, the host has greatly promoted the discipline groups of human geography which mainly focuses on the cultural heritage digitalization for traditional settlements. Taking GIS as the cornerstone of discipline development, the host carries out the discipline construction plans in the digital fields of traditional settlement landscapes and their cultural heritages. Further, the host has set up a series of discipline platforms including the National and Local Joint Engineering Laboratory, the Cooperative Innovation Center of Hunan Province, the Key Laboratory of Hunan Province, the Engineering Laboratory of Hunan Province, Innovation Training Center for University Students of Hunan Province, etc. Importantly, these platforms are integrated into the advantageous platform clusters which can take the responsibility for scientific research and talent training. Undoubtedly, this provides the excellent support for the case to explore how train the applied talents.

Talent training has been the core context and basic objectives to discipline construction. That is, the case has been treated as the heart of the experiment to cultivate the talents by the host.

The case has set up an experiment class for the cultural heritage digitalization in terms of the Cooperative Innovation Center of Hunan Province. This experiment class starts to implement a talent training plan named as “2+2 Quality Promotion”. During the 4-year university study, the students enrolled in the experiment class have to finish all the basic curriculums of their specialties in the first half part. Then, these students are introduced to carry out some given research works or tasks in terms of their interests, skills or personal features by the Cooperative Innovation Center of Hunan Province through the discipline platforms or the external cooperation institutions.
For example, the Cooperative Innovation Center of Hunan Province usually open the applications of a couple of projects for the students every year. And the students can freely apply for their favorite topics without any conditions. The students can launch their research projects under the help of their supervisors if their applications are ratified.

C. Emphasizing on Application Skills through Students’ Autonomic Learning

Here, the case gradually builds an application skill training system for the digital fields of cultural heritages in terms of the Creative Innovation Training Center of cultural heritages and GIS of university students of Hunan Province. In fact, students can rapidly master the basic professional skills through intense training.

In addition, the case tries to introduce the senior students with proficient skills to form the instruction teams under the support from their supervisors to teach the lower grade students. At the same time, the supervisors are in charge of outlining the contents and approaches, however, the training sessions are mainly implemented by the senior students.

Noted that, the senior students automatically form the Student Group Work Room (SGWR) to intensify the managements of the training processes and qualities. For example, SGWR can run the daily affairs by itself including teaching time table, training instruction plans, training results collect and archives, etc.

Importantly, this new training management mechanism which features as students’ self-management through SGWR does not only improve the management abilities of the students and promote the efficiency but also relieve the teachers of their burden. Obviously, this novel training management mode can achieve win-win for the students and teachers.

D. Highlighting the Key Knowledge and Skills of the Heart Professional Curriculums

In order to intensify the teaching of key knowledge and skills, the case classifies the professional curriculums into four types, including survey, remote sensing, GIS software and application, as well as GIS development, respectively. The teaching of all the heart curriculums is undertaken by the teachers with proficient skills and rich knowledge. And the teaching design of contents and experiment projects are determined by the faculty through comprehensive augments.

Through the above, the case guarantees the students can master the basic theoretical knowledge and skills well. This has established a good foundation for the coming creative ability cultivation.

In addition, the case implements the task-based teaching mode to ensure the training qualities. This teaching mode integrates the resources of the discipline platforms and projects of teachers into an experiment teaching task system. So, this intensifies the application attributes of experiment teaching and leads the students who can deeply know about the research areas of the teachers. As a result, the students can take part in the scientific researches of the teachers because they have enough knowledge about the research frontiers of GIS. For example, some students of the case have published their research works at the journal like Tropical Geography, Geography and Geoinformation Sciences, etc. after they successfully finished their research tasks.

E. Professional Contests to Improve the Students’ Ability of Creative Application

In order to fully mobilize their enthusiasm of innovation and starting up business, the case encourage the students to participate the regular contests such as technic innovation, “Challenge Cup” extracurricular academic works competition, and all levels of the discipline contests. For example, the case encourages the students to participate the national GIS industrial conventions or contests, and provides necessary financial supports in terms of the management rules of the discipline platforms.

Encouraging the students goes out for conventions or contests plays good roles in the talent cultivation. On the one side, this opens up the students’ horizons and extend the range of good influence of the case. On the other side, this also helps the students locate their own deficiencies, deeply stimulate their learning interests, and release their learning enthusiasms. For example, the are five student groups including over 20 students have gone out of the campus to take part in different industrial or academic conventions since 2015, and there are also seven student teams who have registered for the industrial contests like ESRI, including more than 20 students obtaining awards.

IV. DISCUSSIONS

The case has been exploring how to build a synergetic talent cultivation mode of GIS specialty oriented the national key needs of the digital fields of cultural heritages since 2016. Of course, there are so many limitations supposed not be bypassed, including no adding any more faculty members, keeping the recruiting methods within the host’s regulations, training the students in terms of their specialities which they have registered before entering.

Although there are so many difficulties, the case still has established the talent cultivation framework through merging
the scientific needs of the teacher’s research projects and GIS talent training in terms of the discipline platforms. After continuous improving the experiences and lasting innovations, the effects of the new talent cultivation mode of the case can be observed.

Here, a few questions needed to be deeply discussed are proposed.

Firstly, GIS specialties of the local universities/colleges should integrate the advantageous discipline clusters and specialty chains. This readily forms the education features for GIS specialties, and further train the applied talents with proficient creative skills. Actually, the advantageous discipline clusters of one university/college usually have the long history and own ample education resources. Hence, they can provide powerful support for GIS specialty.

Secondly, GIS specialties of the local universities/colleges should combine key national and social needs with the orientation of talent cultivation to serve the great needs of important talents of the development of the economy and society. As we all know that GIS industries are driven by the innovation and application, so GIS are used to resolve a wide range of application problems. We can predict that the applications of special rector and industries will generate a great volume of need of talents because that GIS industries are continuously attracting the newest results of information technologies. For example, the extending digital industries of cultural heritages are attracting the technologies and talents of GIS industries.

Thirdly, GIS specialties of the local universities/colleges should think carefully about not only the needs of the GIS industries and application markets but also the special needs of the frontier fields when exploring the core questions of the specialty education, such as talent training plan, curriculums, practicing skill training methods, etc. Only in this way can we forge the school-running characteristics, and form a certain development advantage.

V. CONCLUSION

This work explores a synergetic talent cultivation mode oriented the digitalization fields of cultural heritages for GIS specialties of local universities/colleges through drawing the experiences/findings from the education practices of Hengyang Normal University in recent years.

(1) The case has formed the certain school-running characteristics and development advantages through exploring the way to train the applied talents for the digitalization fields of cultural heritages.

Cultural heritage digitalization is one of the new emerging industries of the world. Cultural heritage digitalization is an inexorable trend since it merges the modern information technologies and cultural heritage preservations and reasonable use. Importantly, cultural heritage digitalization has become the particular critical need of current economic and social development in China.

The developed countries in Europe and United States have formed the first-mover advantages in the technologies, industries, and talent cultivations of the digitalization fields of cultural heritages since the beginning of this century. For example, the Europe Union has been carrying out its talent training plan within its members for the digitalization fields of cultural heritages through the Cultural Heritage and the Planning of European Landscapes (HERILAND).

From an international view, it is well known that the talents of cultural heritage digitalization are requested proficient in rich knowledge of GIS and creative application skills. For example, the members of HERILAND such as Vrije University Amsterdam, Newcastle University, etc. clearly point out that the applicants with GIS education background will be ranked first when recruiting the new Ph.D candidates.

However, at present, the specialty of Digitalization for cultural heritages is still vacant in China. Hence, it is of great practical and social significances to explore the possible ways and useful modes for cultural heritage digitalization and GIS specialties in terms of the enormous industrial needs and education experiences of the local universities/colleges.

(2) Exploring the new mode of GIS professional talent training in terms of the dominant disciplines is an effective way to transfer the education orientations. It can not only train the professional talents for the national industries of cultural heritage digitalization, but also meet the key national needs. Importantly, it is very helpful to collect the useful experiences of GIS specialty development.

REFERENCES


