

PROBLEM, INNOVATION AND DEVELOPMENT OF GIS HIGHER EDUCATION IN OUR COUNTRY

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ABSTRACT:

Geographic Information System (GIS) is a Spatial Information Science which is interdisciplinary subject. It has aroused extensive concern in the whole world and developed rapidly. In our country, GIS technology enlightened in 1970s and 1980s, developed in 1980s, promoted in 1990s, and is popularized and extensively applied in every trade in the 21st century. Now, a relatively complete GIS education system with specifically Chinese characters has been established in China. But, along with economic development and all-round social progress and interdisciplinary subjects progress, it is a important problem to our development strategy for science and technology that how to promote innovations of GIS education and maintain a sustained, rapid and sound development so as to make GIS technology serve socialist better. In this paper, the current problems consist in GIS education in our country are analyzed firstly. Then author elaborate GIS education from various angles, for example, subject innovation, theory innovation, technology innovation, educational system innovation, educational mode innovation, educational methods innovation and training of scientific and technical personnel with innovative ideas, etc. Finally prospect of GIS education is put forward in our country.

1. INTRODUCTION

Innovation, especially science, technology and culture is a eternal theme in relation to national survival. In a knowledge-based economy. If a nation have no capability of innovation, then she will lose good opportunity of survival and development, and be eliminated and marginalised by times. The level of IT education have been a most distinct symbol of overall national strength of a country. As the kernel of digital earth, GIS\GPS\RS are integration of spatial information technology, representative of IT, concentrated expression of digital culture. The level of our GIS higher education have gap to America and Europe, but entered advanced rank as a whole. Problem, innovation and development of GIS higher education have a bearing on our development strategy for science and technology. All GIS profession, especially GIS educational workers must pay enough attention to it.

2. CURRENT PROBLEM OF GIS HIGHER EDUCATION IN OUR COUNTRY

GIS is a integrated and cross spatial information science, and have maintain manifold links with the oldest geography science. It is heard widely and developing very rapidly. An unique and relatively complete system of GIS education have already created in our country the GIS technique have gone through the enlightenment in the 1970s-1980s, the development in the 1980s, and the promotion in the 1990s and comprehensive application in the 21st Century.

In my another paper^[1], I reviewed the development of GIS higher education in China and list the related significant events. In 2003, more than 100 colleges and universities have set up a GIS-related subjects in China, and the number have risen to over 500 in Chinese Mainland, in 200 universities of them have

established GIS laboratory. The speed of economic development is amazing! I am pleased with it, but feel worried at the same time.

It is encouraging for me that the number fully demonstrated the level of our GIS higher education and scientific knowledge popularization has risen to a new height. The concept of geographic information have gone deep into people's minds. The overall information science quality of entire people of the nation have been rised greatly. More and more talented people of GIS major are required.

It is worrying that how the quality of GIS education is? How their living condition is? How to monitor and control the quality of teaching? So fast development pace is whether really help promote the developments of the subject or not?

By other's faults, wise men correct their own. Given the GIS education at home and abroad, the essence of the difference reflected in the teaching system and the mode of teaching. Some developed countries even have not GIS professional, and have some problems in teaching, but their technology level is very high, such as Japan and Germany, that is a question that needs careful consideration. In fact, each country has its own national conditions and the situation of a country, we should absorb the merits of others, and develop and promoting innovations in the situation of China. Now, I analysis the existing problems of GIS education in our country.

First, the intergration of GIS main courses and professional courses. GIS is a new frontier subject integrated of computer science, geography, mapping of remote sensing science, environmental science, urban science, space science and management science. At present, China's GIS professional course generally include four categories: geographic categories, mapping and remote sensing category, computer science and

technology and GIS professional, they formed the the so-called core curriculum courses of the undergraduate GIS professional education.

Here, there is a core curriculum selection and integration issue, which standards is both to make the student grasp the basic systematized knowledge of GIS, but also understand the forefront of the field. On the other hand, most GIS professional in our colleges and universities rely on the related professionals, such as agriculture, forestry, geology, which characteristics is obviously. So that there are still a major integration issues between the curriculum course and the related professional courses (characteristic courses), the purpose is to allow students to have specific GIS application to every trade. In this respect, the foreign done better, we should learn from their experience.

Second, the integrate issue of the theory education and the technical education. GIS is a highly technical subjects. This should be the reasons for GIS education have the goal-oriented applications and skills on the operation at home and abroad. However, theory and technology are not contradictory, we can not neglect the GIS basic theory. If we have no solid theoretical foundation, we can't acquire deep-level applications. A GIS qualified personnel should have both perfect technology and theory.

Third, level and positioning of GIS quality personnel. GIS is a subject have very widely applications. We do not expect all the students become a senior GIS personnel. Scientific approach should be to enable students independently choose the relevant theoretical and technical courses according to their own situation and interests. For some students have good mathematics base and interest in GIS basic theory, we can let them to study more advanced knowledge and encourage them to take a postgraduate; For some students have good programming ability, we can let them deeply study some related software technique, and engaged them devise and develop GIS systems. In a word, it is in accord with China's actual situation that GIS education is divided into four layer: the public layer (obligatory course), the application layer (vocational education, colleges), the professional layer (undergraduate) and the elite layer (master's, Ph.D.).

Fourth, the teaching methods and modalities of GIS. In essence, the fundamental difference in the teaching mode of education between China and foreign lies in whether or not to encourage students to personality development, self-study. In China's exam-oriented education mode, students have a study habits of "spoon-feeding", lacking in the ability of self-study, and on the contrary abroad, they even have not a formal teaching materials and lectures, teachers only provide some slides and some reference books to students to do their own; but it is improbably in China because the teachers must to completed amount of work each year, etc. But we can borrow their trick for some student. In addition, there is an existing gap in network education between China and foreign, we have many work to do.

In short, the above-mentioned problems may be the general representative problem of China's higher education. The problems of education system and mode covering a wide range, need the educationalists to make a effort together.

3. INNOVATIONON OF GIS HIGHER EDUCATION

3.1 GIS subject innovation

From the 1960s, GIS has traversed more than half a century of history, some basic theory and technology problems have been solved. With the development of computer hardware and software, GPS, RS, Geographic information science are facing with new opportunities and challenges. the traditional GIS in which the spatial information processing is the mainstay is gradually being taken space of the Information Engineering in which the spatial and non-spatial data mining and processing on base of massive spatial data is the mainstay. Geographic information science is entering the new times of GIS Information Engineering which have some characteristics ,such as the big technology ,big platform, big share, big application.

Modern geographic information project follow the open advanced international technical standards, set up a platform based on the integration of advanced technology and many systems, build the decision-oriented big application. So, integrating traditional and new theory and technology, improving the modern scientific disciplines of geographic information sciences, creating the disciplinary system, curriculum design and standardization of campaign materials with Chinese characteristics are new tasks.

3.2 GIS theoretical innovation

Theoretical innovation is the most nature of the subject innovation. Now the GIS technology is based on the traditional map model, namely, the use coordinates to describe and express the spatial information. This static model is face to spatial data, instead of spatial information, that is the spatial information must be derived from spatial data by an algorithm . In the background of the grid technology, this spatial information sharing face inconsistencies base of spatial data, such as the temporal inconsistencies, semantic description inconsistencies and data storageformat inconsistencies, which is the source of bring about "islands of information". At present, the problems are solved by open spatial data standards. In order to fundamentally solve this problem, need to study the new theory of data model, for example, body theory based on the philosophy cognitive is a hot point.

The traditional two-dimensional spatial data model performance spatial information by simple symbol approach. But it is very limited. While 3-dimensional data model realistically restore to the original state of spatial information, but the 3-dimensional spatial data models and data structure is much more complex than the two-dimensional, so it is hot and difficult one on the forefront of GIS disciplines. At the same time, the traditional two-dimensional model is a static model, can not reflect the dynamic change of objective world. At the sensitive area, the application is very inconvenient, the temporal spatial data model is the hot and difficult point. Distributed GIS for spatial data sharing on the standards and norms, such as OpenGIS, XML, GML research is also active. How to perform data mining from the plentiful spatial data, search and discover the spatial knowledge and discipline, and how to use the knowledge to carry out these automation, intelligent decision-making are to be resolved urgently. There are many task in forefront fields of GIS. As teachers and instructors in GIS field, them should bring the students into the forefront of subjects to study, to develop.

3.3 GIS technology innovation

Technology innovation occupy a very important position in the GIS fields. It can be said that the GIS discipline development are closely related with the modern information technology development. Computer hardware and software technology development directly led to the birth of GIS. GIS grow out of computer technology being applied to spatial data management. The development of computer network technology led to distributed network GIS. Based on LAN technology, people developed the GIS on the client / server (C / S) structure, and created a precedent distributed GIS; With the rapid development of Internet, people quickly develop a multi-layer Browser/server (B/S) structure (WebGIS) on the base of the C/S structure, which overcome the "fat client" defects on the C/S structure. But WebGIS technology is still immature need to be further developed, for example:GIS middleware, spatial data compression research is hot too;distributed database and data warehouse technology (the integration and file management of graphic data, attribute data, image data, DEM data, thematic data and statistical data), knowledge mining based on spatial data warehouse, distributed spatial data sharing technology, spatial Web services technology of space information, the data visualization technology on browser are the forefront of technology fields.

With the development of communications and grid technology, mobile GIS and grid GIS technology have entered people's vision; mobile GIS combine communications technology to GIS to achieve Mobile Location Services.; Grid GIS based on grid technology, break all closure marginal and make GIS fully integrate into the Internet environment, is a completely distributed architecture; mobile GIS and grid GIS and other new concepts of new technologies, make GIS can automatically, intelligently answer when, where, what object, what changes, and provide the information (that is 4W) to everyone at any time, services to everything (that is 4A service --- Anyone, Anything, Anytime and Anywhere); mobile GIS functions and interface design, grid GIS architecture, spatial information Grid standards, spatial information services and the grid data security, are the key areas of GIS. We must be good at leading the students study and development GIS advanced technologies.

The trend of modern science is the science technicalization, technique scientific, and integration of science and technology. This feature was particularly obvious in the geographical information science, such as the spatial data model, spatial information-sharing, spatial data mining, virtual geographical environment, theory and technical, which requires a modern higher GIS personnel who should have strong theoretical and technological innovation capacity. We should grasp this characteristic in GIS teaching.

3.4 The innovation of GIS education system, the pattern and methods

In the developed countries of Europe and the United States, due to their relatively early start, both in the GIS theory, technology, scientific research, education, popularization, institutions, organizations are more mature, each form a complete and scientific system.

We should learn from the successful experience of foreign countries to establish and improve GIS education system at all levels based on different GIS personnel levels, such as higher professional education, science popularization, certification training, and so on. Integrating various educational resources (teaching equipment,

teaching software environment, teachers, etc.) , developing new modes of multimedia and network education, conducting classroom teaching and extra-curricular training extensively, participating in research projects and training, combining professional education and quality education, combining production and research study is effective teaching form. To promote independent learning, personality development, encourage students to self-designed, self-creation, and stimulate their interest in learning and innovative thinking, to provide students with superior and relaxed (not relax) learning conditions and environment is good measure too.

Of course, GIS education innovation also involves the country's education principles, policies. In 2002, in the meeting of "21st Century University GIS development strategy seminar" the Ministry of Education pointed out our country should vigorously develop homemade GIS software, and actively promote the development of the GIS industry.

The University should become the main force in the development of GIS industry. The state should promulgated relevant policies to vigorously develop college GIS education. State departments should be enacted the relevant laws and regulations as soon as early, including the basic database, standardization, data sharing, data-paid services, system security, and so on. The government should invest the basis data as a social welfare undertakings. Companies to should be responsible for the data management to avoid monopoly, should make full use of information resources. GIS special features decide it should play a important role in planning in central China and the development of western China, such as resources management, forecasting, decision-making and so on. The community has very little understanding of GIS, news media, educational system, government agencies should take the necessary measures to popularize knowledge of GIS, promote the development of GIS.

3.5 How to train GIS innovative talent

Except for the above strategies innovation of GIS education, how to train GIS innovative talent is very important.

First, we must train student the healthy quality of spatial information science. In the theory, they must have broad knowledge and solid foundation of knowledge, in the technical, the ability of operational and development must be strong. We have scientific and rational disciplines quality, then we can have innovation awareness, spirituality and ability.

Second, we must be good at bringing our students to the forefront of disciplines to make they timely follow-up the latest international academic progress. So, we can find the possible innovative points, and could gain a "world-class" results.

Third, we should encourage students to actively participate in domestic and international academic exchanges. Only by sharing with others, we can track academic development, realize their own strengths and shortcomings, establish their own research goals.

Fourth, should give students more training opportunities in scientific research and projects. Let them grow in practice. Genuine knowledge comes from practice. That is my experience of training graduate students for many years.

Fifth, must train the teams spirit. The development of modern science emphasis more on the collective wisdom, it is difficult to successes relying on individuals alone. This is not easy in theac

tual teaching and research, because it relates to the right, interests, and relation between lower and higher, teachers and students, students with students, etc, and involves personal skills. A good team spirit is indeed an essential foundation quality of scientific research personnel, we must pay attention to train students' capacity in this aspect.

In short, we must not only encourage students to innovate, but also train them innovative skills, to create the space to display their talent and opportunities.

4. DEVELOPMENT PROSPECTS FOR THE FUTURE OF GIS HIGHER EDUCATION

Explosive development of GIS education in China should arouse our attention, research and rational thinking. The national should provide appropriate macro-control, and be given the more right guidance, regulations and support. As GIS educators, we should seriously study their own development discipline, increase the scientific quality, and actively cooperate with the reform of state education system, discuss new ideas, new modes and new methods, be good at encouraging students' interest in learning and innovation, train qualified GIS innovative talents for our country, promoting our hi-tech development strategy. I think the future of the GIS higher education in China should be: efficient system, scientific policy, liberal environment, advanced model, appropriate level, the excellent quality.

I believe that through our efforts, the largest GIS higher education in our country will catch up with or surpass the advanced level of the world in the near future!

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