REMOTE SENSING EDUCATION IN CHINA AND THE UK: SYNERGY AND OPPORTUNITIES

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KEY WORDS: Remote Sensing Education, Resource Sharing, e-Learning, Bilingual Teaching, Curriculum Structure

ABSTRACT:

With the rapid development of remote sensing science and technology, remote sensing specialists are increasingly in demand. This paper compares current practices in remote sensing education in China and the UK, drawing recommendations about teaching best-practice and identifying opportunities for Chinese-UK collaboration. First, although the setup of remote sensing course programmes differs between China and the UK, it would be beneficial to incorporate merits from each in future educational programmes. As many experts have proposed, the programme name "Geographical Information System" used in China, may be sensibly replaced by "Geographical Information Science" as used in the UK and elsewhere. The Remote Sensing Science and Technology bachelor programme run in China represents an effective way of training specialists, and universities in the UK could consider offering a remote sensing undergraduate programme. Second, practical experience of image processing and remote sensing exercises should be included within any remote sensing teaching programme. It is advantageous to have more practice so students can develop strong skills in remote sensing information processing and its uses in different fields. Third, the ability to organize remote sensing use projects should be developed. It is challenging and difficult to organize and manage the remote sensing use project, and students should be trained in project management through case studies and comprehensive practical projects. Fourth, online education and e-Learning could be enhanced and resources shared between different institutions. Fifth, remote sensing modules taught in the UK could be introduced in China though bilingual teaching. Educational collaboration initiatives between China and the UK will be useful in this regard. Finally, regular exchange among universities should be promoted.

1. INTRODUCTION

With the rapid development of remote sensing science and technology, remote sensing specialists are increasingly in demand (Gewin 2004). As the main way of providing qualified and high-level remote sensing specialists, interest in remote sensing education has grown markedly in recent years. Since different countries have different education systems and policies, and curriculum structures, it may be beneficial to integrate the merits of countries' programmes to create a unified curriculum. Remote sensing education has developed rapidly in China and the UK in recent years, and much collaborative remote sensing research has been conducted by Chinese and UK scientists. This paper compares current practices in remote sensing education in China and the UK and identifies collaboration opportunities.

2. CURRICULUM STRUCTURE AND COMPARISON

In terms of education levels, three main approaches are widely adopted in remote sensing education: undergraduate education, postgraduate education, and other special training programs. Since remote sensing technology is developing quickly, shown by the occurrence of new sensors, new information sources, new applications and new information processing methods, special remote sensing career training programs are popular in many countries, including thematic tutorials, summer schools and short training courses. The curriculum structure of specific training programs varies widely according to topic and audience, so there are not addressed here. Instead, this paper focuses on undergraduate and postgraduate remote sensing education.

In China, the Ministry of Education, as the state education administration agency, dictates a standard guideline for specialities in universities. This involves stipulating different degree programs and disciplines, and all universities must design their programs according to this guideline. In the past, remote sensing education has been included in various programs such as surveying, mapping, geography, geographical information systems, geology and engineering. Remote sensing usually comprises one or two modules for these programs, in which both fundamental principles and practical applications are taught. This rather superficial treatment of the topic limits advanced understanding.

Recently, educational reform in China has meant that some universities can set up new programs not listed in the national guideline but urgent in terms of potential demand. From the undergraduate perspective, the most important change is the establishment of a new bachelor degree program named Remote Sensing Science and Technology. The program was first established by Wuhan University (a unified institution comprising the former Wuhan Technical University of Surveying and Mapping and three other universities), later followed by ten or so other universities.

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In comparison, no specific undergraduate programme exists for remote sensing in the UK, although some remote sensing content is included in related programmes such as geography, geographical information science, geomatics, geodesy and surveying.

In addition to overall bachelor degree programme, the contents of individual remote sensing-related modules were compared between a selection of universities. This revealed that while overall content is similar in remote sensing modules in Chinese and UK universities, practical work is emphasized more strongly in the UK.

As with undergraduate programs, China has specific guidelines for postgraduate master and doctoral programs. In the UK, however, universities have considerable freedom to design their own programs. Traditionally, photogrammetry and remote sensing represents the most focused program for postgraduate degrees in this field in China, while other programs, such as Cartology and Geographical Information Systems, Cartography and Geographical Information Engineering, Earth Exploration and Information Technology, include remote sensing as one of their components. However, as with the undergraduate program, the Chinese postgraduate program has also been reformed in recent years. Therefore, some universities have the option to launch new programs focusing on remote sensing theory methods and applications, such as resources and environmental remote sensing, remote sensing application technology, urban remote sensing, and so on.

In the UK, remote sensing is an important component of some postgraduate programs such as Geographical Information Science, Geomatic Engineering, Geography and others. Furthermore, some universities provide programs specifically for remote sensing, such as the joint remote sensing masters program run by University College London and Imperial College London (http://www.cege.ucl.ac.uk/ students/postgraduate/remote_sensing), and the University of Edinburgh's Quantitative Earth Observation program (http://www.geos.ed.ac.uk /postgraduate/MSc/qeo), Remote Sensing and Image Processing program (http://www.geos.ed.ac.uk/postgraduate/MSc/ remotesip/) and Geoscience and Remote Sensing program (http://www.geos.ed.ac.uk/masters/grs.html).

Based on the above comparison, it is shown that the curriculum is broadly similar in the two countries, and any differences are decreasing due to educational reform in China and structural change. The current situation in both countries demonstrates that remote sensing education is developing rapidly and remote sensing is becoming established as a discipline in its own right.

3. RECOMMENDATIONS AND OPPORTUNITIES

The comparison described above leads to recommendations for future remote sensing educational practice in China and the UK. First, the Remote Sensing Science and Technology bachelor programme run in China represents a very effective way of training specialists, and universities in the UK could consider offering a remote sensing undergraduate programme. Second, practical experience of image processing and remote sensing exercises should be emphasized. Third, the ability to organize remote sensing use projects should be developed. Fourth, online education and e-Learning could be enhanced and resources shared. Fifth, remote sensing modules taught in the UK could be introduced to China for bilingual teaching. Finally, regular exchange and permanent partnership among universities should be promoted.

3.1 Synergy of educational programs

Although the setup of related course programmes differs between China and the UK, it would be beneficial to incorporate the merits of each. About 10 universities establish the special bachelor degree for remote sensing science and technology. In contrast, degrees in Geographical Information System, existing in about 150 universities, are still the most widely adopted in China. As many experts have proposed recently, the programme name "Geographical Information System" used in China, may be sensibly replaced by, "Geographical Information Science", as used in the UK (DiBiase 2006)

On the other hand, although there are some very advanced postgraduate programs on remote sensing in the UK, corresponding undergraduate programs are still unavailable. Therefore, the formula provided by the Remote Sensing Science and Technology bachelor programme run in China could be considered by some universities in the UK to offer a remote sensing undergraduate programme. Correspondingly, the diversified postgraduate programs in the UK, such as Quantitative Earth Observation, Remote Sensing and Image Processing, and Geoscience and Remote Sensing also have potential for remote sensing education in China.

3.2 Practical experience

With respect to the contents of taught programs, it seems clear that practical experience of image processing should be emphasized. This experience is crucial for demonstrating the significance of remote sensing theory to students and for giving students the practical skills they are likely to need in the workplace. In broad terms, the ratio of theory to practice (lecture to practical exercise) is 2:1 in China, but a ratio of 1:1 is more common in the UK. From the use view, it is advantageous to have more practice so students can develop strong skills in remote sensing information processing and its application to different fields. Further, related issues, including the selection of software systems used for teaching and the availability of free data sets for practical exercises should be explored in the near future.

3.3 Training of project organization and management

Applying remote sensing to practical examples and real-world projects is more than a technical issue. Project organization and management are key to conducting successful remote sensing studies. Remote sensing applications can be complex projects involving large study areas, mixed land cover and multidisciplinary objectives. It can be challenging to organize and manage the remote sensing use projects, so related project management skills should be trained through case studies and practical projects.

3.4 Online education and e-Learning

Online education and e-Learning offers great scope for training remote sensing experts and can overcome local infrastructural issues to a large extent. That is, online resources can reduce the need for both technological (e.g., hardware, software) and instructional (e.g., teachers) infrastructure. Many educational

resources are already available throughout the world and the internet and e-resources offer a straightforward means to share these. For example, NASA provide a remote sensing tutorial at http://rst.gsfc.nasa.gov/, remote sensing fundamentals can be learned from the website of the Canadian Centre of Remote Sensing at http://www.ccrs.nrcan.gc.ca/resource/tutor/fundam/index_e.php and a brief introduction to remote sensing is available at http://www.gisdevelopment.net/tutorials/tuman008.htm. Many other online resources are available for online education both in the UK and in China.

In China, the Ministry of Education has been promoting the establishment of national courses and resources to be made available widely to Chinese universities. Peking University's Introductory Remote Sensing course represents the only one covering remote sensing.

One problem with online education is the tendency towards static resources. That is, often such resources simply involve reading material, and interaction and practical experience is limited. Computer and information technology now hold much potential for interactive e-Learning and efforts should be made to develop practical engagement with remote sensing resources.

Another important information source that could be adopted more widely is that provided by commercial remote sensing software providers and, in particular, their websites. Although the resources provided by software vendors may be of most relevance for specific techniques and problems, they do provide examples of real-world application of remote sensing. Some commercial companies provide free educational versions of their software.

3.5 Bilingual teaching in China using resources of the UK

Recently, a new mechanism of education, bilingual teaching, has been encouraged by the Chinese Ministry of Education. Here, lectures are given both in Chinese and English, with a particular aim of improving Chinese students' ability to use English in academic activities. Clearly, bilingual teaching opens up the possibility of UK remote sensing modules being introduced to China. Educational collaboration initiatives between China and the UK are encouraged to promote this. Implementation mechanisms may include: 1) the introduction of textbooks used in the UK to China; 2) teaching materials, such as lecture notes, slides and multimedia resources, in the UK can be adopted by universities in China; and 3) teacher training through short courses or academic visits, whereby Chinese educators observe the teaching process in the UK to inform their teaching activities in China.

3.6 Establishment of partnership

Cooperation among Chinese and UK universities represents the most important factor for synergy in remote sensing education. The establishment of educational partnerships is key to ensuring a meaningful and lasting impact. Partnerships could be established at teacher to teacher level, department to department level or university to university level depending on the scope of the relationship. At a start towards establishing links, regular academic exchange among universities should be promoted.

4. SUMMARY

As remote sensing gains familiarity and application in a world where demand for geographical information is growing rapidly, it is important to train skilled practitioners who are able to apply the technology effectively. This will rely on excellent educational structures. Much expertise has been developed in this field in areas throughout the world, and further advances can be made by sharing this expertise. Specifically, here, UK knowledge and resources can usefully be extended to China where demand for remote sensing education is growing at a significant rate.. Synergy and collaboration in remote sensing education is a long term process, so efforts to achieve this are likely to be gradual and continuous. This paper mainly describes opportunities that exist for collaboration between China and the UK, but the implications are worldwide..

ACKNOWLEDGEMENT

The authors thank the China Scholarship Council (CSC) for supporting Peijun Du's academic visit to the University of Nottingham, and "CHINA – UK SCIENCE NETWORKS" project supported by the China Scholarship Council (CSC) and the Royal Society of the UK.

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