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Popularization of remote sensing education and general course construction in undergraduate education

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Abstract. The construction of a course focused on remote sensing is important because it cultivates college students' geographic abilities and popularizes remote sensing technology. Using internet datasets, this article compares data from general undergraduate courses at almost 100 universities located in the United States and China with 3 years of experimental teaching data from the general undergraduate “Remote sensing Region” course at Beijing Normal University. The comparison focuses on curricular concepts, course content, website construction and the popularity of the remote sensing topic. Our research shows that the “remote sensing region” course can promote the geographic abilities of college students by popularizing remote sensing observation technology. The course can improve the overall quality of college students by breaking major barriers, and it can promote global and national consciousness by presenting material with global and regional relevancy. Remote sensing imaging has become known as the third most intuitive geographic language after text and maps. The general remote sensing course have the three following developmental qualities: interdisciplinarity, popularization and internationalization.

Keywords: General course; Undergraduates; Remote sensing image; University course; Comprehensive quality

1. Current situation of the remote sensing general course

Using information in public databases, we investigated and analyzed the remote sensing general education curricula at domestic and foreign institutions of higher education. We selected fifty domestic universities; the selections primarily considered top-ranking national universities, but they also considered geographical professional rankings. Nearly all of the selected institutions belong to "985 program", "211 program" colleges and universities. Using this list, we surveyed the remote sensing general education curricula on behalf of the domestic best condition [1]. We selected representative foreign universities in the United States because it hosts the most developed higher education program. We surveyed the 50 highest-ranking remote sensing general education courses in U.S. higher education institutions that could be grouped into three main categories as follows: highly ranked comprehensive institutions, highly ranked institutions with significant undergraduate general education programs, and institutions that were not necessarily highly ranked but were highly influenced by professional geography.

Surveys and statistical analyses have demonstrated that both domestic and foreign institutions of higher education have added remote sensing class curricula, suggesting that these institutions consider
that a remote sensing general education curriculum plays an important role in improving the geographic literacy of contemporary college students. The remote sensing courses at foreign universities tend to be tailored to underclass students; however, remote sensing general education courses at domestic universities are generally offered as public electives. By contrasting curriculum ideas, content, and the general degree, we determined that Chinese college courses focus on technical aspects, prioritizing the teaching of remote sensing image processing methods. In contrast, U.S. colleges and universities focus on the introduction of the nature of the course and the qualitative discipline course, which directly reflects the nature of the general curriculum.[2][3]

2. Curriculum concept of the remote sensing course

Popularity - promoting college students’ quality of geography. The primary goal of general remote sensing courses is to introduce remote sensing images as the most intuitive third geographical language (following text and maps). By combining information technology development and cognitive extension, the quality of students’ geographic abilities can be rapidly enhanced.

Getting through - promoting the comprehensive qualities of college students. First, the course content is designed with regions as a joint point, breaking the barriers of the majority of students. Second, professionals and teachers alike can apply remote sensing images as oriented tools that can be applied throughout the entire learning process; for example, Google Earth (Google, US.) is a commonly used remote sensing image program. Third, a consensus on regional sustainable development issues can be gained by utilizing interactive teaching that breaks the traditional professor teaching - student learning mode.

Overall view - promoting the global and national conscientiousness of college students. In the era of global change and globalization, materials, energy, information flow in the man-land relationship, and cross-national and geographical restrictions are applicable worldwide. Thus, it is important to consider the issue of regional, sustainable development from global and national perspectives. Remote sensing topics in the curriculum design firmly reinforce this concept, strengthening the application of remote sensing images of global issues. Teaching goals include the relationship between global change and increased disaster events, human activities and disaster feedback relationships, scientific ideas, the responsibilities of large countries; these topics force the students to consider regional issues from a global perspective, and this mode of thinking develops a student’s global and national consciousness.

Sharing- The teacher-student interaction and subsequent growth. Geography is an interdisciplinary topic that bridges the natural and social sciences. Its comprehensiveness and extensiveness produce cohesion, allowing students and teachers in the different disciplines to grow together. Remote sensing regional courses in the curriculum underscore the concept of sharing by utilizing regional remote sensing landscape optical models and through mechanisms such as questions, lectures, discussions, debates, talks, sketches and notes. These methods expand the interaction between students and between teachers and students to promote common development.

3. "Five-dimensional" observation method of remote sensing the landscape optical model

Several observation methods can be used to remote sense the landscape optical model when performing multi-dimensional geographic observations; these methods have similar perspectives and record more accurate and thorough data for functional, geographic objects. After much teaching practice, we propose a "five-dimensional" model of remote sensing landscape optical observation.

1. Multi-scale observation. The use of remote sensing images with spacial resolution characteristics, that range from the macroscopic to microscopic identification of different geographical regional scales and including the interpretation of regional structures and comprehensive characteristics.

2. Multi-angle observation. The use of the 3-d rotation observation tools in the Google Earth software program to make observations from different angles and azimuths to promote the comprehensive interpretation of regional geographic information.

3. Multi-temporal observation. The use of remote sensing images with spatial and temporal resolutions on different time scales, such as annual variation, monthly changes, daily variation, the identification
of regional geographic evolution information, and the interpretation of the geographical space pattern change rule. For example, the space-time alteration of the Yellow River Delta could be studied (Figure 1).

![Figure 1](image.png)

Figure 1. Yellow River Delta changes as observed with a time series of remote sensing images. (The images from 1975, 1986, 1995, and 2000 were obtained from the remote sensing witness - China remote sensing satellite ground station set-up and anniversary image atlas; the 2012 image was obtained from Google Earth)

4. Multi-spectral observations. The use of remote sensing images with spectral resolution characteristics to identify terrain features from the infrared and visible light spectra from different bands and to construct regional landscape optical models.

5. Multi-factor observation. The use of remote sensing image spectral comprehensive characteristics from geographic factors, such as geology, hydrology, vegetation, and land use to promote the hierarchical identification of elemental characteristics, the interpretation of regional geographical features and the cause of such formations.

4. The practice of curriculum
4.1 Course objectives and content system

Based on the concept and the background information presented above, the following goals exist for Beijing Normal University “remote sensing region” curricula tailored to liberal arts students and the subset of science and engineering students interested in or familiar with geography. The students would be able to apply remote sensing image cognitive area surface features and development uses, popularize remote sensing image information area identification technology, perform a preliminary remote sensing geological analysis, and understand national conditions. The course is designed for undergraduate students enrolling in a public general elective course and counts as a 1-credit elementary course.

The course system is divided into three major parts of the progressive step by step, they are Topics, Perception and cognition, Scientific and technical issues of concern(Table 1).

<table>
<thead>
<tr>
<th>Topic</th>
<th>Perception and cognition</th>
<th>Scientific and technical issues of concern</th>
</tr>
</thead>
</table>
| Lecture one: Remote sensing regions | • Remote sensing foundation  
   • regional basis  
   • remote sensing home | • The combination of regional geography and remote sensing technology  
   • Google Earth tools |
| Lecture two: coastal zone        | • estuary and delta  
   • three major economic growth poles  
   • coastal change | • sustainable development of coastal economic zones  
   • coastal land use change  
   • coastal change recognition technology |
| Lecture three: China Eastern – Northern | • plain and mountain landscapes | • foundation and development of the Northeast Regional Resource and Environment |
| | • North China Plain, agriculture and development of Beijing-Tianjin-Tangshan river and lake changes (Yellow River) | • North China urbanization and disaster risk |
| | • metropolitan area of Beijing and Tianjin integration | • land use identification technology |
| Lecture four: China Eastern – Southern | • mountain and hilly landscapes | • Yangtze River economic belt development |
| | • middle and lower reaches of the Yangtze River Plain and the Yangtze River Delta development | • foothills of soil and water conservation and ecological construction |
| | • forest river systems change | • urban flood disaster – environmental recognition technology |
| Lecture five: Central China | • plateau basin landforms | • Chinese ecological barrier construction |
| | • agriculture and animal husbandry and land degradation | • Inner Mongolia grassland animal husbandry and pasture |
| | • ecological construction | • Loess Plateau development and soil erosion |
| | | • Sichuan Basin development and Wenchuan earthquake |
| | | • development of the Yunnan-Guizhou Plateau and rocky desertification |
| | | • regional land degradation recognition technology |
| Lecture six: China’s western region | • plateau mountain basin geomorphology | • arid oasis ecosystem and development |
| | • water change and natural landscape | • alpine area of natural ecosystems and development |
| | • signs of human activity | • western environmental evolution |
| | | • western human footprint recognition technology |
| Lecture seven: Earth/ world from space | • global natural zone continental geographical events | • Differentiation of global land and sea and landscape zonality |
| | • travel landscape | • distribution of major natural disasters worldwide |
| | | • distribution of important tourist destinations worldwide |
| | | • Google Earth image resource application technology |

4.2 Curriculum management

The course website is the most effective platform for promoting interactions between the teacher and students. The “Remote sensing region” course website and course implementation are synchronous. The structure and function of the course website design reflect the course requirements, primarily including browsing, information query and issuing curriculum notices, and dynamic functions, such as uploading assignments, online discussions and resource sharing. These functions play important roles in facilitating communication and reflecting the “communication general” concept. Beyond this course, each student has a unique background; thus, the course emphasizes “general” concepts. The final course examination is in the form of a report. This project requires each student to perform a remote sensing tourism speech report from a standard starting point (his hometown) using standard tools (the
Google Earth software program). In practice, this curriculum design has produced final reports of unusually impressive results that better reflect the “sharing” concept.

4.3 Course construction planning
General course construction requires long, hard work and persistence. The "Remote sensing region" course teaching plans can be continually updated to maintain course flexibility, to facilitate content adjustments, and to provide content updates from semester to semester, thus avoiding simple repetition. For auxiliary teaching, it is important to continually improve the network teaching management system such that it can fully realize the core functions, continuously introduce new communication modes, and improve public access to expand the course’s influence; these improvements will all improve the user’s experience. When constructing teaching materials, we plan to publically provide supporting teaching materials or a reference book and to improve the construction of the electronic materials to better facilitate network teaching. Finally, to meet the teaching goal, we will increase the course enrollment and target students worldwide via an open video which will be publically available worldwide.

5. The trend of the popularization of remote sensing education and general course construction
The implementation of universal and general education remote sensing courses is important in the context of the information age and geography; however, it is also important when training high-quality, specialized personnel who can adapt to future changes in higher education. Based on the remote sensing region courses at Beijing Normal University, three major trends regarding the popularity of remote sensing education and general education courses become apparent. 1. United networking—remote sensing science and technology are rooted in geography but display distinct regional characteristics. By combining the different regional characteristics, universal and general education remote sensing courses can be highly improved. 2. Popular and universal—the popularization and application of remote sensing knowledge is critical for remote sensing education. Liberal, openly available course-building initiatives that utilize video, internet and other types of public delivery of quality educational resources will provide advanced scientific knowledge and service to the community[5]. 3. International—absorbing the latest achievements in domestic and foreign remote sensing science and technology research and incorporating geography into the development of novel knowledge, ideas, methods, and even the formation of an international remote sensing education alliance regardless of national boundaries will highly improve undergraduate education.

References