GEOS4S: ADVANCED CURRICULUM DEVELOPMENT FOR INTERNATIONAL GEOSPATIAL PROFESSIONALS

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ABSTRACT: The world has become increasingly dependent on spatial information for a wide range of purposes. Meanwhile, many studies have indicated a severe, world-wide lack of individuals who are qualified for jobs that require expertise in geospatial technologies. This paper describes the GeoServices-4-Sustainability (GeoS4S) project, an international collaboration designed to help fill this skills and knowledge gap. Our objective in the paper is to create awareness of this effort and its expected outcomes, which should be useful to many institutions involved with geoinformatics and geoscience education.

1. THE PROBLEM

In the past decade, geospatial analysis has become increasingly important world-wide. New technologies have revolutionized remote sensing, GIS, and cartography. Both the size and variety of available geo-data have increased exponentially as new sensors have been developed and deployed. Applications for geospatial data have also become far more diverse, as those data have become more accessible. Geospatial information is no longer primarily of interest to professionals in the planning and natural resource domains, but has become essential for business, security, even entertainment.

The wide-spread availability and use of geospatial information have created a strong demand for individuals with the necessary skills to manipulate and understand geo-data. Many studies have indicated a significant shortfall in the number of individuals who are qualified for geospatial jobs. This is particularly true with regards to skills in recently-developed technologies. In the U.S., the National Geospatial Intelligence Agency (2014) concluded that "future shortages in cartography, photogrammetry, and geodesy seem likely" and noted that "competition for GIS applications analysts is strong". Both Australia and New Zealand face a "critical shortage" of geospatially skilled graduates (PreventionWeb, 2010; New Zealand Geospatial Office, 2012). Rip et al. (2014) found that there is a gap between what geospatial education is needed and what is available, especially with regard to the newest technological developments and newly relevant problem domains.

Most research has focused on these more mature markets (United States, Europe, Australia and New Zealand). The situation in less well-developed countries is, if anything, more serious. Thailand, for instance, has three university-based programs that offer masters degrees in geoinformatics (at AIT, Chiang Mai University, and Burapha University). Together these programs produce fewer than twenty graduates per year.

Furthermore, formal geoinformatics curricula tend to focus on core topics such as basic remote sensing, spatial data bases, cartography, and so on. Rarely do these programs include courses that address more advanced topics, emerging technologies, or new applications.

2. GEOSPATIAL CURRICULA FOR THE TWENTY FIRST CENTURY

The GeoServices-4-Sustainability (GeoS4S) project (http://www.zgis.net/geos4s) is trying to address the geospatial skills gap and the need for education in advanced and emerging topics by developing new, free educational materials. GeoS4S is a three-year, one million Euro project initiated by the University of Salzburg in Austria and funded by the Erasmus+ Programme of the European Commission. The project brings together geospatial experts from four European, three Thai and three Chinese universities to develop a set of course modules focusing on new and innovative spatial technologies and applications. When completed, the GeoS4S teaching materials will be available online for free download. Furthermore, the modules will be designed from the outset to be appropriate for distance learning environments, so they can have the maximum impact and utility.

GeoS4S focuses on advanced topics which are not currently covered in typical master's level curricula in GIS or geoinformatics. Each partner institution will develop two course modules, for a total of twenty in all.

Secondary goals of GeoS4S include developing cross-regional relationships between individuals and organizations, and building an international community of researchers. This is being accomplished through a series of workshops for the experts and summer schools that will bring together graduate students from all ten partner universities.

This paper describes the organization of GeoS4S and provides details on the educational modules under development and the plans for testing those modules, with an emphasis on the potential benefits for countries and educational institutions not directly involved in the project.

3. PROJECT PARTNERS AND ORGANIZATION

The partners in the GeoS4S project come from the following institutions:

Europe

- Palacký University – Olomouc, Czech Republic
- University of Salzburg – Salzburg, Austria
- University of Sustainable Development – Eberswalde, Germany
- VU University – Amsterdam, The Netherlands

China

- Nanjing Normal University – Nanjing, China
- Wuhan University – Wuhan, China
- Xinjiang Institute of Ecology and Geography – Urumqi, China

Thailand

- Asian Institute of Technology – Pathumthani, Thailand
- Chiang Mai University – Chiang Mai, Thailand
- King Mongkut's University of Technology Thonburi – Bangkok, Thailand

Each institution is responsible for developing two educational modules, where a module is roughly equivalent to a one-semester course. The materials under development include lecture slides and notes, self-assessment tests, hands-on exercises, readings, and assignments to be used for student evaluation. The target audience for these teaching and learning materials are masters-level students in geoinformatics or GIScience.

Over the course of the three-year project, each institution is hosting one meeting, workshop or summer school training activity. The project initiation meeting was held in Austria in October 2015. The first workshop took place in Chiang Mai, Thailand, in February 2016, and was devoted to reviewing the syllabi for each module. A second workshop in the Czech Republic in June 2016 reviewed initial drafts of individual lessons. Review and evaluation of the project's first year accomplishments took place in late September 2016 in Urumqi, China.

Figure 1 summarizes the project organization and activities. In addition to creating teaching and learning materials, the project will engage in practical evaluation of the modules by running three training events called “summer schools”. At each of these events, the project will train additional faculty members and graduate students from the partner institutions in the use of the teaching materials. Several mini-courses will be presented during each two week activity. This will allow us to fine-tune the curriculum contents as well as providing new knowledge for the students and faculty members involved.

4. MODULE TOPICS

The modules to be developed include both technology-oriented and application-oriented topics. In almost all cases, these are topics unlikely to be included in a typical geoinformatics or GIScience masters curriculum. Thus, they are intended to broaden and deepen the students' knowledge.

Figure 1. Project organization and activities
(Source: http://www.zgis.net/geos4s)

The topics of each module are listed below. Note that the exact titles for each module may change slightly before the curriculum is released.

Technology- and theory-focused modules

- GeoApplication Development
- GeoVisualization
- Advanced Remote Sensing
- Real Time Geospatial Analysis
- Open GIS and SDI
- Intelligent Transportation Systems
- 3D City Modelling
- Smart Cities
- Terrain Analysis

Application- and process-focused modules

- Carbon Stock Analysis
- Incident and Crisis Management
- Food Security
- Coastal and Marine GIS
- Health GIS
- Commercial Plantation Suitability Assessment
- Arid Ecosystem Management
- Disaster Risk Management
- Climate Change and Adaptation Strategies
- Community and Participatory GIS
- GeoDesign

Although the modules will be tested in a live classroom setting during the summer school activities, they are designed to be fully self-documenting, so they can also be used for distance learning or self-learning.

Each module includes a syllabus with learning objectives and an evaluation procedure, as well as ancillary materials such as readings, self-tests, practice exercises, and assignments. The goal is to provide an instructor who might not be very familiar with the module subject to present the course with relatively little additional preparation.

5. OUTCOMES

The GeoS4S project will produce teaching and learning materials for twenty innovative modules, jointly developed by the partners. These materials will be available free for use by anyone who wishes to download them. Any educational organization, anywhere in the world, can use these free resources to present the courses locally. We anticipate that this pre-packaged curriculum will be of great utility to universities who are just beginning to establish their own infrastructure for geospatial education, especially in lesser developed countries. The courses do not require any investment in commercial software, and students do not need Internet connectivity to use the materials.

Individuals can also download the project materials, for self-learning. In fact, even commercial organizations may find the content useful for training their staff. There are no restrictions on using the content as long as the materials are not modified and the project attribution remains intact.

In addition to the curriculum materials, the project will develop a framework for granting an "International Geospatial Qualification Certificate" to students who successfully complete a subset of the modules. This credential will hopefully attract both individual students and educational institutions to take advantage of the GeoS4S materials, and will support our goal of increasing the number of individuals who have a deep knowledge of geospatial topics.

The summer school activities will result in training up to fifty faculty members and one hundred fifty graduate students about the module content.

Finally, the project will enhance communication and collaboration among researchers, educators and graduate students from the partner institutions. The first summer school will be in Thailand, the second in China, and the third in Germany. The project budget includes funds to cover expenses for graduate students from different regions to attend each one. Thus, students will have the opportunity to meet peers from other countries and cultures, to exchange ideas and to establish friendships. The expert teams from the partner institutions have already developed a strong sense of community and shared purpose, after working on the project for a year. By the time the project concludes, we will have new connections that we can exploit for future cooperation.

6. CONCLUSION

The GeoS4S project attempts to help fill the geospatial skills gap by developing new, innovative learning materials in advanced topics related to GIScience. Ten institutions from three regions are collaborating to create twenty new course modules, which will be available for free download. The project will also present these courses to a larger audience from the partner institutions in order to test the curriculum and refine the content.

In addition to its concrete outcomes, the project fosters international scientific and educational collaboration which will benefit everyone involved in the effort, both the individuals immediately involved in the course development and the faculty and students at their institutions.

7. REFERENCES

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