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Internet Resources and a Web-based Learning Environment for the Enhancement of Satellite Positioning Teaching and Learning

Kefei Zhang, Erjiang Fu, Shanshan Zhou, Thierry Demathieu and Falin Wu

School of Mathematical and Geospatial Sciences, RMIT University
GPO Box 2476V, Melbourne, Victoria, 3001 Australia
Tel: +61 3 99253272, Fax: +61 6 96632517, Erjiang.fu@rmit.edu.au

ABSTRACT

e-Education has played a significant role in contemporary teaching and learning in both tertiary education and professional training. The computer-based and web-based learning environments have many acknowledged advantages and are addressed as an essential alternative to the conventional lecture-based face to face education. Both satellite positioning and surveying are core components of the high-education (HE) and the technical and further education (TAFE) programs in geospatial science, RMIT University. With the rapid developments of global navigation satellite system (GNSS) technologies and the ever-increasing exposure of "unscrutinised" and often obsolete information in the internet, the demands for an effective IT-based education system arise to ease the difficulties in student learning process. Currently, there are over 17 GPS and surveying related courses at RMIT University across both HE and TAFE sectors. This contribution outlines a recent action research in T&L project at RMIT. A new mindset system using both IT and web-based technique is introduced. It is anticipated that this system will provide an easy access platform of acquiring categorised, reliable and "pin-point" information and learning resources in a well-designed and adaptable knowledge structure for different levels of students to help the learners to know, to think and to understand better.

KEYWORDS: GNSS, Surveying, Web-based, e-Education, mind map

1. INTRODUCTION

More and more universities and educational organisations realise that e-Education plays a significant role in contemporary teaching and learning in many ways (Brusilovsky, Eklund & Schwarz 1998; Greenhalgh 2001; Yunus *et al*. 2006). Many computer-based learning programs, web-based more recently, are developed as essential alternatives to traditional lecture-based education and training practice which is conducted in a face-to-face environment. By contrast to the conventional education methods, IT-based system has many advantages, such as broader accessibility, higher flexibility, easier manageability, more multimedia capability and advanced interactivity, and lower distribution cost. With the aid of the computer and the web, lecturers can perform much better delivery of knowledge (Yunus *et al*. 2006). Digital demonstration of learning materials can not only save the valuable lecture time but also illustrate complicated concepts and structures of knowledge in advanced representation methods, e.g. three dimensional (3-D) model, animation and multimedia. From the learner's point of view, such computer-based systems, normally learner-centred system, can enhance their understanding of the knowledge and learning flexibility. In the era of internet, the reliability and accessibility of internet service have been improved rapidly and abundant learning resources can be searched in web pages from any internet terminals worldwide. More and more people, especially young students (generations X and Y), are getting familiar with and rely on online information searching engine in their daily study. It is a very important for learners to obtain high quality, reliable and highly relevant online information effectively (Don 2003). On the other hand, however, the online learning experience of learners is not always satisfactory. The difficulties of that could result from lack of learners' self learning skills, and ill-information structure and poor organisation, poor quality and narrow target user groups of the online resources.

Global Navigation Satellite Systems (GNSS) have revolutionised positioning and navigation practice and have become an extremely important component of space-based world-wide geospatial information infrastructure. Due to the rapid technology evolution, GPS/GNSS has experienced very rapid and significant developments in the past a few years. The way the instrument is operated and techniques and data processing in geospatial have accordingly changed. This is well recognised by the RMIT University (Australia) through its recent heavy investment in new generation Trimble R8 GPS/GNSS receivers (4 sets, network RTK capable). This, in combination with the significant investment made in the past a few years in GPS and surveying (over $0.5 million), suggests that there is a critical need to capitalise this "heavy" investment for teaching and learning (T&L) and it offers a unique opportunity to further smooth the pathways between the two sectors. These developments have greatly enhanced our teaching and learning practice in campus, particularly in third-year and fourth-year studies. However, further improvements are needed to achieve better learning experience for both on-campus and field practice.

An Action Research in T&L (ARTL) project is recently fund by RMIT (June 2007). The main objectives of this project are to explore rich internet resources by developing a web-based and IT-based learning environment to enhance teaching and learning practice of satellite positioning, surveying and geodesy related courses currently delivered through both TAFE and HE sectors. The innovation of this development is to enhance students' learning with the help of online interactive 3-D and 4-D animations, and structured and adaptable hyperlinks of the subjects discussed in the class and in the textbooks on the web with real-world examples. The purposes of this are to "tightly" link campus T&L activities with real world scenarios (e.g., relevant exciting/interesting applications, current R&D activities, and the latest

information provided on the internet by various industries, government, research organisations and universities).

It is expected that the success of this project will expose students to the latest development of the technology and help smooth the pathways of the HE and TAFE geospatial programs. It is also an adaptable system that customises the contents for severing students with different backgrounds and levels.

2. A WEB-BASED GEOSPATIAL LEARNING ENVIRONMENT

2.1 Teaching and learning and industry needs of GNSS and surveying

Both satellite positioning and surveying are core components of the degree programs in Geospatial (e.g. Certificate III in Spatial Information Services, Advanced Diploma of Spatial Information Services, Bachelor of Applied Science (Surveying, Geomatics and Cartography), Graduate Diploma, Masters by course and Masters by Research and PhD) at RMIT University. There are 17 GNSS and surveying related courses at RMIT. The School of Mathematical and Geospatial Sciences (SMGS) has recently developed/re-designed Geodesy, Surveying and Satellite Positioning courses by combining satellite positioning, ellipsoidal geodesy, physical geodesy, topographic survey, geodetic datum, least squares adjustment and surveying etc contents into a set of 12 credit point courses. Similar changes have been made in RMIT TAFE Sector with the introduction of a new National Training Package for technicians this year. A practical effort is also underway to combine the traditional components in heavily practice-based field work into more lab/computer based simulation and demonstration of large data processing packages, "virtual" experiments and practice. Student feedbacks in past a few years (such as Student Staff Consultative Committee (SSCC) and Course Experience Survey (CES)) suggested that both GPS and surveying are a "hard core" to crack. The multiple dimensional (and dynamic) natures of GPS and surveying components (such as rotation, various coordinate systems, datum, and satellite signal propagation) cause problem for students to grasp. Many geodetic and surveying terms/concepts are not well visualised (in animated and dynamic scenarios) and hard to understand.

The surveying industry has embraced the GPS technology enormously for more than a decade. The shortage of skilled surveyors in Australia has forced the industry to find new ways to improve its productivity by reducing labour costs and increase work deliverables. GPS/GNSS is considered the core "enabling" technology for geospatial industry. Unfortunately, there is no published regulation or standard relating to survey undertaken using GNSS. For years, the Surveyor General of Victoria opposed the use of GNSS technology as the measurement is not "legally" traceable. In 2002, RMIT was commissioned by the Office of the Surveyor General to undertake a study on the use of GPS in cadastral surveys. Today, the legal traceability of GNSS measurements is still an issue. Too little investment is made on this issue. There is a dilemma – technology experiences a rapid development and heavy investment has been attracted, however, government authorities have to "hold up" the adoption of new technology. This project will be a good step forward for Victorian geospatial industry to confidently use, be informed, be taught and keep abreast of the latest developments of the enabling GNSS technology and help raise the standard, reputation and the knowledge base of the surveyors.

2.2 Needs analysis of this project

To keep abreast of the rapid change in the technology and reduce the impact of rich, but "unscrutinised" information widely available in the web, we realise that continuous updating and redevelopment of the course components, introduction of real-world applications and

hands-on demonstrations are critical to the successful delivery of the GPS/GNSS components in various courses/programs for both sectors. Therefore, an effort should be made to establish comprehensive course web pages that can serve dual functions: both as a teaching tool to assist lecture delivery and as a learning tool to guide students for learning and better understanding in the class and in the textbooks. This will also be a very useful tool for other geospatial science students at postgraduate level (both by course work and by research students). It is particularly useful for all students to acquire knowledge in a quick, interactive and reliable way which is well beyond-the-textbook experience. In addition, the project can help smooth the transition of TAFE students to HE.

The development of the 3-D/4-D interactive scenario will no doubt help students to better understand most geodetic/GPS terms and concepts. How to find the right information in the right way with minimal time is another problem students have often encountered across all levels (Advanced Diploma, Bachelor, Master and PhD). Due to the rapid development of GPS/GNSS technology, there is a "flood" of information which is often repeated and unscrutinised. Some information was published in different stages of the technology evolution/development and is obsolete and often misleads students (evidenced by student assignments and reports). The development of this project will help students get most reliable and up to date information with minimal efforts.

2.3 Development of this project

The following major components are proposed in the development of the ARTL project:

1. Course structure and T&L materials containing the usual course supplements such as the course syllabus, lecture notes, homework assignments, quizzes, available tools/programs, laboratory and project assignments, and solutions;
2. A learning guidance component that will provide a ROAD MAP to guide students by linking each topic discussed in the class with the help of internet hyperlinks to relevant references on the web;
3. An interactive section which develops selected 3-D and 4-D animation tools to help students to understand difficult terms/concepts, relationships and movement of multiple dimensional objects; and
4. Feedback and comments. It is recognised that the development of this project requires continuous improvement through the implementation process and feedback of students in different levels.

The above four parts will be developed in a way that reflects different levels of learners. The entry level is aimed for TAFE students who have less theoretical background but demand a higher level of practice, whilst the advanced level is aimed for HE students who have a relatively high level of theoretical skill, but have less practical experience. The system will be adaptable to match the different needs of different students with various levels of knowledge.

This project will help student to strengthen work-integrated learning due to its close connection and relevance to industry and practice. SMGS is currently working with a few overseas universities for joint articulation programs and satellite positioning and surveying are again a core component of the proposed programs. Obviously, this project will be a significant milestone to internationalise RMIT satellite positioning and surveying curriculum, particularly in HE sector.

The learning system is a database-based dynamic website. The GNSS knowledge and resources are organised and maintained by an open source MySQL database environment.

The information items can be text, hyperlinks, graphs, animations and video clips. Each information item is a record in the database with a unique ID number and parents-child relations.

Mind map has been identified as an effective teaching tool to manage the knowledge concepts and their relations (Farrand, Hussain & Hennessy 2002; Passmore 2004). It helps students to understand (and remember) the structure of complex information. In this system, information notes, GNSS relevant knowledge and resources, are organised by mind maps and Figure 1 presents a prototyped schematic flow of the mind mapping scenarios.

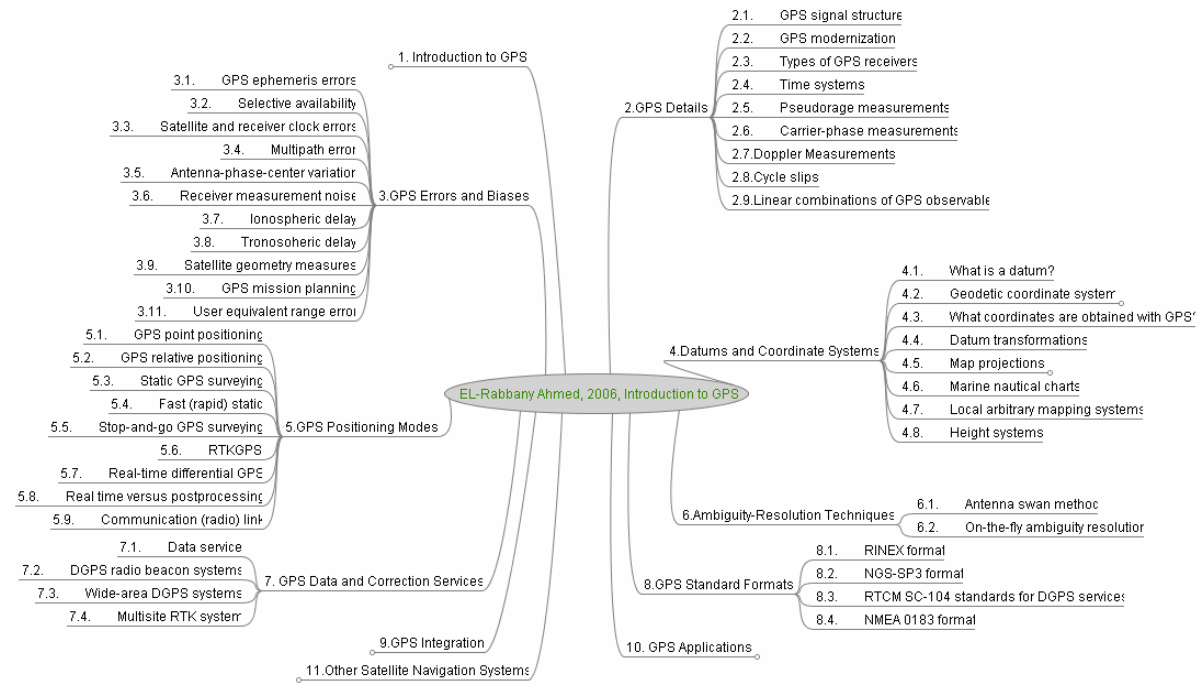

Figure 1. A schematic mind map of GNSS knowledge structure (based on El-Rabbany (2006))

These notes also have attributes for indicating their knowledge levels and related courses. By these attributes, contents can be easily filtered and adapted for different users with different backgrounds and needs. For examples, students enrolling to a specific course can obtain the course related information and resources by specifying the course in the web. Figure 2 illustrates an example of the adapted concept map and the tree structure of a typical outline of the GNSS contents.

2.4 Evaluation design of the system

An initial questionnaire has been designed to collect necessary information and feedbacks from students and staff during the early stage of the project. A follow-on questionnaire is being designed to seek feedbacks for further improvement of the system at a later stage through both staff and students (e.g. SSCC, CES). Each questionnaire will take about 10 minutes. The data collected from these questionnaires will help the design of the project and evaluate the effectiveness of the web-based system. Participants are the students who are undertaking GPS and surveying related courses in both HE and TAFE sectors at RMIT. The number of participants is about 100 for each questionnaire. Their age range is approximately from 19 to 25.

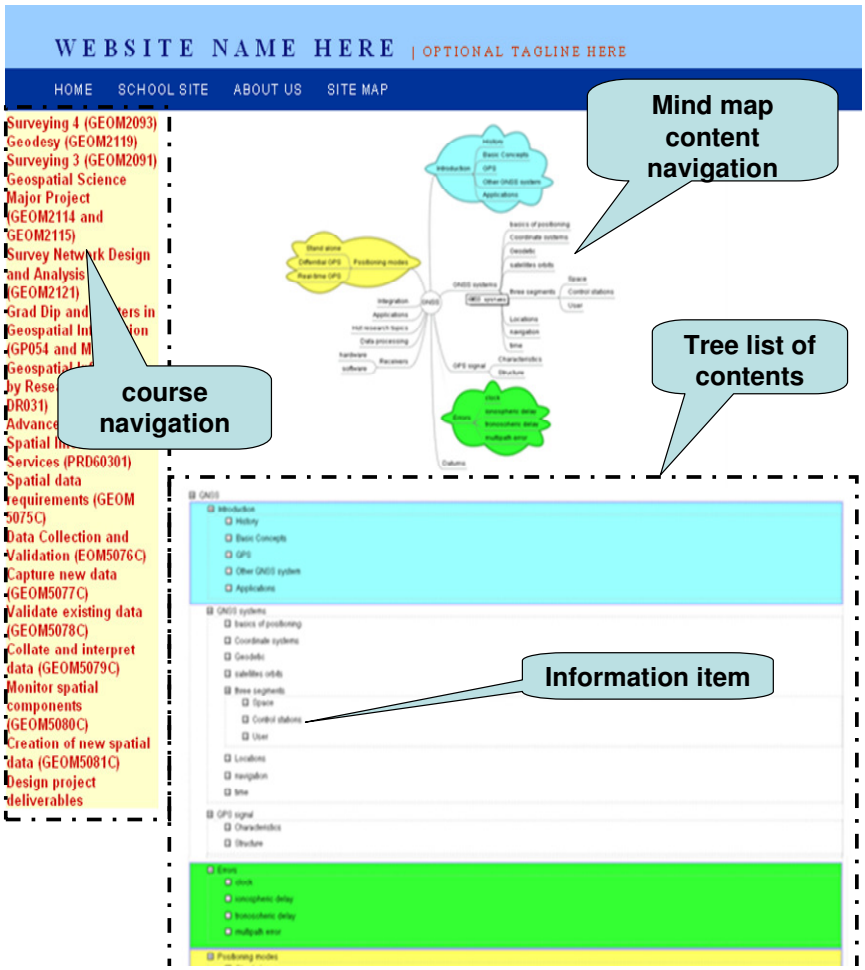

Figure 2. A schematic web page information with a mind map navigation and tree structure

4. CONCLUSION

This contribution introduces a recent Action Research in T&L (ARTL) project being undertaken at RMIT University and its preliminary outcomes are outlined. The main idea of the project is to combine mind-map method with internet and web-based technologies to enhance students learning experience. A new mind mapping system using both IT and web-based technique is being built to supplement RMIT on-line learning system (learning hub). It is anticipated that this system will provide an easy access platform for students across all levels at RMIT to acquire categorised, reliable and pin-point information and learning resources. The cross-sector collaboration nature of the project requires the use of the latest collaboration tool. The research team is currently using a "Wiki" collaboration environment available on the Distributed Learning Systems at RMIT University to compile the information. The ultimate goal of the project is to offer a well-designed and adaptable knowledge structure to help students to know, to think and to understand more effectively.

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REFERENCES

Brusilovsky, P, Eklund, J & Schwarz, EW 1998, 'Web-Based Education for All: A Tool for Development Adaptive Courseware', *WWW7 / Computer Networks*, vol. 30, no. 1-7, pp. 291-300.

Don, ED 2003, 'Web-based Organizational Tools and Techniques in Support of Learning', *Library Trends*, vol. 52, no. 2, p. 362.

El-Rabbany, A 2006, *Introduction to GPS : the Global Positioning System*, 2nd ed., Artech House mobile communications series, Artech House, Boston, MA.

Farrand, P, Hussain, F & Hennessy, E 2002, 'The efficacy of the mind map' study technique', *Medical Education*, vol. 36, no. 5, pp. 426-31.

Greenhalgh, T 2001, 'Computer assisted learning in undergraduate medical education', *British Medical Journal*, vol. 322, pp. 40-4.

Passmore, GJ 2004, 'Extending the power of the concept map', *Alberta Journal of Educational Research*, vol. 50, no. 4, p. 370.

Yunus, A, Kasa, Z, Asmuni, A, Samah, B, Napis, S, Yusoff, M, Khanafie, M & Wahab, H 2006, 'Use of webcasting technology in teaching higher education', *International Education Journal*, vol. 7, no. 7, pp. 916-23.