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Sustainable Curriculum for Geomatics Higher Education

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Key words: geomatics, curriculum, higher education, subjects, modules, sustainability

SUMMARY

Sustainable curriculum is currently being advocated in many educational disciplines and professionals in an attempt to 'solve' many of the employment problems confronting higher education. In this contemporary approach, subjects of the geomatics curriculum are being developed for providing double-profession programmes and multiple-disciplinary studies by applying a combination of the outcome-based approach, the social reconstructivist approach and the research-informed approach. Key stages of the curriculum development are explained including aims and objectives, the blended models, the need of swapping cognitive/knowledge-centred and social/student-centred instructional activities, and the use of both formative and summative assessment in the teaching and learning activities.

1. INTRODUCTION

This paper attempts to illuminate how curriculum designers go about the process of developing a sustainable curriculum for geomatics higher education. After 'curriculum' has been defined together with its relationship to pedagogy and assessment, the paper discusses the sustainable approach to the design and planning of the curriculum by combining the traditional outcome-based approach, the social reconstructionist approach and the research-informed approach. The process of curriculum development is then examined from philosophical beliefs and aims of geomatics education to specifying curriculum and instructional objectives, implementing the curriculum and instruction, and assessment of instruction and the curriculum. Because the primary focus of this paper is on curriculum development, less emphasis is given to the subject contents and the instructional process. However, such contents and instructional process are illustrated in (for example, Lam, 2006a).

Geomatics higher education encompasses the process of curriculum, pedagogy and assessment supported by and integrated with the values, beliefs and culture of society (Berstein, 1971). Berstein (1971) defines curriculum as what counts as valid knowledge. Pedagogy is the instructional process by which knowledge is delivered and assessment indicates the achievement of valid learning outcomes from acquiring that knowledge. Putting into the context of geomatics education, their aims and relationship can be determined by answering the following questions:

- What is an educated land surveyor or geomatics engineer?
- How to design and plan a sustainable curriculum in order to fulfill societal demands?
- What should learners learn?
- How should the curriculum be learned, taught and assessed?

2. A CRITICAL REVIEW ON THE DESIGN AND PLANNING OF CURRICULUM

What is an educated surveyor? Through the processes of schooling, independent learning and professional practice, successfully educated surveyors are knowledgeable lifelong learners, physically and mentally fit for the jobs and for economic self-sufficiency, and respecting to the rule of law. Major orientations to the design and planning of a curriculum can be grouped into the following approaches: outcome-based approach (Tyler, 1949), the social reconstructionist approach (Eisner and Vallance, 1974), research-informed approach (Corey, 1953; McKernan, 1996; Senaratne et al., 2006), and sustainable approach by combining appropriately the aforementioned ones (Eisner and Vallance, 1974; Skilbeck, 1984).

In the outcome-based approach, the curriculum encompasses aims and objectives, expected learning outcomes, curriculum content, organization of teaching and assessment, and continual evaluation (Tyler, 1949; Wheeler, 1967). The curriuclum emphasizes applications, core/basic skills, background/pre-requiiste knolwedge, and independent self-study (Gagne, 1974, 1985). Its main contribution is the improvement of teaching and learning, organising sequence, and assessment of learners' outcomes. Its main weaknesses, however, are probably the negligence of: school and resources management; changes of school organization, teacher character and community values; changes of learning outcomes in cognitive domain (e.g., changes in learners' thinking), affective domain (e.g., changes in levels of values and attitudes) and psychomotor domain (e.g., changes in perceptive abilities of learners). In the social reconstructionist approach, the curriuclum emphasizes social interests and individual needs. It is difficult to apply among vast amount of learners in the present role of education and school but possible in workplace learning and in learning organizations. In the research-informed approach, curriculum contents and practices are continually updated and improved by action research (McKernan, 1996) (see Figure 1).

In the sustainable or ecological approach, knowledge and practice are first agreed by members of society under social reconstructionist model for environmental protection, ecological coherence with the natural systems and for fulfilling the needs of society or particular community. Wheeler (1967)'s outcome-based model is then applied in the design and planning of the curriculum by having the following key cyclical stages: (1) aims and objetcives (learning outcomes) determined from the needs of society, needs and prior knowledge of students and needs of teachers; (2) selection of learning experiences; (3) selection of curriuclum content; (4) organization of teaching and assessment; and (5) curriculum evaluation. Continual improvement of the curriculum will be undertaken by applying the reserach-informed approach as shown in Figure 1.

This approach has less emphasis on individuals' needs and has the difficulty of understanding the relationships between the subjects and integrating their knowledge to solve real-world problems. The latter can be conquered by integrating the curriculum in either multidisciplinary approach in teaching a thematic unit which relates individual subjects to a singular topic without making direct connections across the subject areas, or connecting the subject areas and relating them to real-life problems in learning and teaching (Fogarty, 1991; Beane, 1997). Thereafter, knowledge are constructed through problem-based learning or workplace learning so that learners can understand and integrate knowledge from different perspectives and different subjects in an active environment. The overall quality of the curriculum can be evaluated under the categories of staffing qualification, learning environment and accommodation, students' access to equipment, teaching and learning quality, standards achieved by students (including employment rate), and management and quality control (Ashworth and Harvey, 1994).

3. WHAT SHOULD LEARNERS LEARN?

Valid knolwedge is what learners should learn. To be valid, the knowledge associated with the geomatics curriculum must be expert knowledge or justified to have high status. Subjects and modules of a geomatics curriculum for higher education is illustrated in Table 1. Period of study for each module is one semester or 14 weeks, with a total of minimum 42 hours of lectures and tutorials for each core module. Core subjects with two modules are having ordinary and higher levels. The ordinary-level core modules can become minor subjects serving other departments. The programme would be accredited by professional organizations, both local and overseas. So that, on completion of the programme of study and professional training, students are qualified for the award of Professional Land Surveyor Licence and/or Professional Information Engineer Licence. Along with the double-profession degree strategy, the geomatics programme is heavily loaded with subjects of computing science and information technology (IT) so that graduates can achieve a second Bachelor Degree (BSc in Computing/IT) in one year of further study. More undergraduate degree programmes for raising multi-disciplinary professionals are under collaborative devlopment with other departments, for exmaple, Departments of Computing, Logistics Management and Geography within the same university or with other universities. The Department of Land Surveying and Geo-informatics of Hong Kong Polytechnic University found that the launching of these two value-added strategies in Year 2005/06 Admission resulted in increasing number of applicants and that better quality of high school graduates were admitted into the Department. We also foresee more emplyment opporutnities for our future graduates in areas of land surveying, geo-IT, GIS, real estate and government services (e.g., security forces).

4. HOW SHOULD THE CURRICULUM BE LEARNED, TAUGHT AND ASSESSED?

What are the learning experiences? Blended learning environment is most effective for supporting experiential and situated learning by combining different disciplinary models with different media to create optimum teaching and learning programme (Bersin, 2004). The blended teaching and learning models recommended by Bersin (2004) are e-learning blended with media or events, instructor-led programme blended with self-study and e-learning, on-the-job training, and use of simulation systems. Effective learning is also found with directed instructional method in the situation where revision or re-teaching of the topics is needed by swapping the cognitive/knowledge-centred model and social/student-centred model back and forth as shown in Figure 2. Formative or continuous assessment helps to communicate lecturer's expectations and standards to students and to improve students' knowledge level by providing them with answers of the assessment. At the end of the session, summative assessment in the form of written examination is organized to assess the effect of the completed programme and compare the performance of students for selecting successful learners to receive awards, scholarships and advanced level of studies. Teacher performance can be assessed by the overall student performance, student feedback questionnaire, teaching portfolio, in-class peer evaluation by colleagues or academic advisors, and the teaching and learning committee. Further evaluation of the curriculum is anticipated in the form of research-informed approach in which assessment is related to the specific measurable learner, process or outcome objectives of the curriculum.

5. CONCLUSIONS AND FURTHER DEVELOPMENT

This paper has presented the development of a sustainable curriculum for geomatics higher education by applying the two value-added strategies of providing double-profession programme and multiple-disciplinary studies so that geomatics graduates become multi-disciplinary professionals and have better employment opportunities in their careers. Moreover, geomatics education should not be bounded inside educational institutions only but extended to informal and non-formal education to support lifelong learning under the models of workplace learning, learning organizations, knowledge management, organizational learning, communities of practice, social learning systems and the learning cities (Reeve et al., 2002, p. 1). Future development of the curriculum will continue with emphases on multi-skilling, problem-solving skills and management and social skills required of individuals. Curriculum research on geomatics is on-going, and the authors would appreciate receiving comments from readers who might have on any aspects of geomatics education.

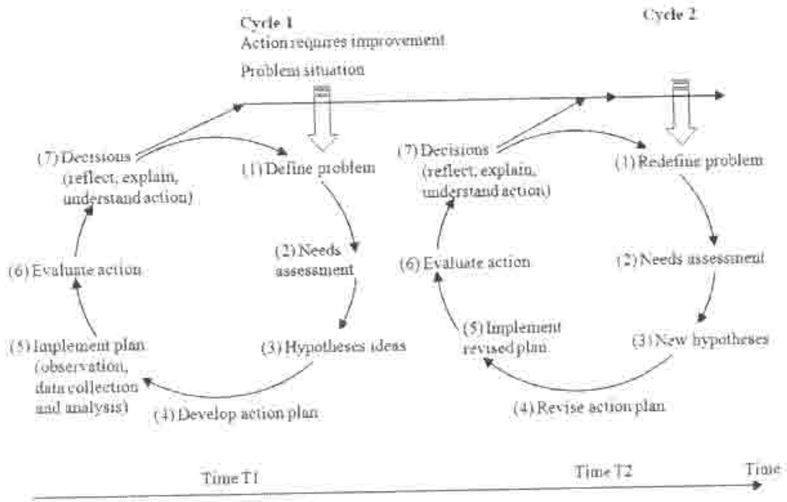

Fig. 1: The spiral-cyclical model of curriculum research. Modified from (McKernan, 1996, Fig. 1.6)

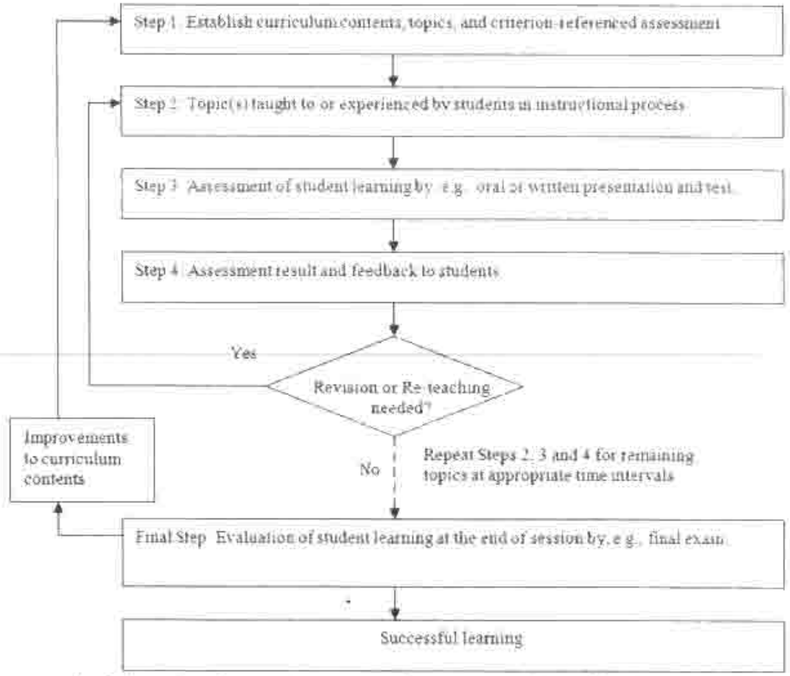

Fig. 2: Formative and summative assessment that supports a teaching and learning process (Lam, 2006b, Fig 1)

Table 1. Subjects and modules of BEng/BSc programme in Geomatics

Major subjects	No. of Modules
Geodesy and Global Navigation Satellite Systems (GNSS)	2
Photogrammetry	2
Remote Sensing and Image Analysis	2
Engineering Surveying	2
Cadastre, Land Registration Information Systems (LRIS) and Land Administration	2
Spatial Information Management and Geo-Information Technology (Geo-IT)	1
Applications of Geographic Information Systems (GIS)	1
Cartography and Map Production	1
Hydrographic Surveying and Hydrographic Information Systems (HIS)	1
Statistical and Adjustment Analyses for Geomatics	1
Geomatics Business Management	1
Geomatics Research Methodology and Dissertation	1
Survey Camps/Projects (Control Network, GIS Mapping, Photogrammetry, Hydrography, Boundary, and Metrology/Construction)	2
Sub-total:	19
Minor Subjects	
Advanced Engineering Mathematics	2
Computer Programming and Data Structures for Engineers	2
Information Systems and Internet Technology	1
Construction Technology and Management	1
Environmental Engineering Systems	1
Property Appraisal, Development and Finance	1
Urban Economics	1
Real Estate and Facilities Management	1
Second Language	1
Subjects of humanities and introductory knowledge of other professions/disciplines	2
Sub-total:	13
Total Modules	32

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BIOGRAPHICAL NOTES

Steve Lam, BTech, BA, MSc, MPhil, FICE, FInstCES, MRICS, MCIOB, worked as construction engineer and Canada Lands Surveyor (CLS) in construction, land boundary and GIS projects in several countries from 1971 to 1997. Since then, he has been a Lecturer in the Department of Land Surveying and Geo-Informatics at The Hong Kong Polytechnic University.

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Some Experiences of the Bologna Process in Geodesy and Geoinformatics Undergraduate Study in Croatia

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Key words: Bologna process, geodesy, geoinformatics, undergraduate study, Croatia

SUMMARY

The introduction of the paper features a brief presentation of the Faculty of Geodesy of the University of Zagreb as the only high education institution in Croatia at which one can study geodesy and geoinformatics at undergraduate, graduate or postgraduate levels.

The focus of the article is the description of undergraduate study of geodesy and geoinformatics at the Faculty of Geodesy of the University of Zagreb. This study started according to the new curriculum in academic year 2005/06. The paper notes first experiences of applying the Bologna process on first two generations of students. Some characteristics of this study are: a large number of students, simultaneous introduction of academic institutions information system, beginning of e-education, absence of Study Regulations, execution of continuous assessment of students' knowledge and skills, partial or complete exam removal for some students, financial problems, etc.

Besides the student survey, which is being carried out in the same way for the whole University, results of surveys by the Ministry of Science, Education and Sport were interpreted, as well as the survey by the vice-rector for education of the University and the survey that was recently conducted independently by students of the Faculty of Geodesy.

1. INTRODUCTION

Croatia has a rather long tradition of higher education in surveying and geodesy. The textbook written by Martin Sabolović *Exercitationes Gaeodeticae* was printed in 1775 in Varaždin. The first diplomas young graduates were presented certifying they passed all necessary exams to acquire the academic degree and authorizations to act as surveyors were handed in 1811.

After the Royal Forestry Academy had been founded in Zagreb in 1898, geodesy was taught there among other technical subjects. The Geodetic Course (Geodetski tečaj), whose 'learning basis' was completely identical to the curricula of the geodetic studies at the high schools in Prague and Vienna, was included in the Forestry Academy program. At the moment of the foundation of the Technical High School in Zagreb in 1919, the Geodetic Course moved to a newly founded school, and then its academic status was defined.

It was in 1962, when the Faculty of Geodesy of the University of Zagreb was founded. Since the, the Faculty of Geodesy has organized the university undergraduate studies for acquiring