

Evolution of Geomatics Curriculum : Adding new knowledge without lengthening studies

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Key words: Education, Sciences, Knowledge, Curriculum renewal, Pedagogical methods

SUMMARY

Science is based of accumulation of knowledge. New discoveries, original questionings and technological progress all contribute to the continuous renewal of scientific-base disciplines. As such, geomatics is also behaving in an accumulative way, even more that it is constituted by many disciplines such as geodesy, photogrammetry, topography, mapping, GIS, remote sensing, land law, cadastre, ... This “scientific” characteristic places a constant burden on the shoulders of those in charge of geomatics programs: adding new contents without lengthening the duration of studies. The challenge is to educate future professionals, keen to address and resolve tomorrow’s problems. Thus, geomatics programs must regularly go through revision processes to keep in touch with social, environmental and economical challenges of the 21st century.

This situation is even more important that geomatics is highly concerned with current issues as climate change, disaster risks management, environmental protection, sustainable development, access to land, information enabled society, land use planning, ... But there is a critical condition to do so: geomatics programs must integrate new contents, without unduly extending in length. This is easy to write, but hard to achieve because the adjustment of curriculum is not an easy task.

A first avenue would be to mitigate the addition of new courses with the withdrawal of “less important” courses. This question exposes a fundamental debate: What is the knowledge that future practitioners do not need anymore? Otherwise could a core course become an elective? This kind of discussions often leads to a dead end: everyone (especially the entitled professor) considers that his discipline (and course) is the most important.

A second avenue seems more successful. It consists in developing a new program approach where the transmission of new knowledge does not result into a new burden (new courses, contents and duration) for students. At Laval University, we think that this issue can be mastered with a new pedagogic approach, involving the integration of case studies, problem solving approach and competencies development. For example, a field project on monitoring coastal erosion could be integrated into a topography or land-surveying course; a practical exercise of geodesy could take place in a region affected by land-slide or earthquake; a semester project in land administration could be focused on a developing country’s cadastre reform. Even though this pedagogic approach takes time and effort to implement soundly, we think that it will contribute to our geomatics programs evolution and especially respond to our students’ expectations.

RÉSUMÉ

La science est basée sur l'accumulation du savoir. Les découvertes, les nouveaux questionnements et le progrès technologiques contribuent tous au renouvellement continu des disciplines scientifiques. Comme telle, la géomatique se comporte selon une approche accumulative, et ce d'autant plus qu'elle est constituée de plusieurs disciplines scientifiques comme la géodésie, la photogrammétrie, la topographie, la cartographie, les SIG, la télédétection, le droit foncier, le cadastre, ... Cette caractéristique place un poids appréciable sur les épaules des responsables de programmes de formation en géomatique, soit l'addition de nouveaux contenus sans rallonger la durée des études. Le défi est de former les futurs professionnels, en les habilitant à faire face et à résoudre les problèmes de demain. Ainsi, les programmes de formation en géomatique doivent régulièrement faire l'objet de procédures de révision afin de rester au diapason des défis sociaux, environnementaux et économiques du 21^e siècle.

Cette situation est d'autant plus importante que la géomatique se retrouve fortement concernée par les enjeux actuels relatifs aux changements climatiques, à la gestion des risques de catastrophe naturelle, à la protection environnementale, au développement durable, à l'accessibilité des terres et du foncier, au développement d'une société de l'information géospatiale, à la planification de l'aménagement du territoire, ... Mais il y a une condition importante, sinon critique, pour faire cela : les programmes de géomatique doivent intégrer de nouveaux contenus, sans allonger indûment leur durée. Cette condition est facile à énoncer dans un texte mais difficile à respecter en réalité, car l'ajustement et l'évolution des contenus des programmes de formation ne sont pas des tâches faciles.

Une première avenue serait de mitiger les effets inhérents à l'addition de nouveaux cours par le retrait de cours devenus moins importants. Cette question soulève un débat fondamental : Quelles sont les connaissances que les futurs professionnels n'auront plus besoin dans le futur? Autrement, est-ce qu'un cours obligatoire peut devenir un cours optionnel? Ce genre de discussion mène souvent dans un cul-de-sac : chacun (surtout les professeurs attirés d'un cours) considère que sa discipline est la plus importante!

Une seconde avenue semble davantage porteuse de succès. Elle consiste à l'élaboration de nouvelles approches de programme où la transmission (et le développement) de nouveaux savoirs et connaissances ne résultent pas automatiquement en un fardeau supplémentaire pour les étudiants. À l'Université Laval, nous croyons que la question peut être maîtrisée (du moins en partie) en utilisant de nouvelles approches pédagogiques, basée sur l'intégration d'études de cas, la résolution de problèmes et le développement des compétences. Par exemple, un projet-terrain sur l'érosion des côtes pourrait être intégré dans un cours de topographie ou d'arpentage; un exercice pratique de géodésie pourrait être appliqué à une région ayant subi un glissement de terrain ou un tremblement de terre; un projet de session en gestion foncière pourrait avoir pour thème principal les réformes cadastrales dans les pays en développement. Même si l'implantation d'une telle approche pédagogique exige du temps et des efforts constants, nous croyons que cela contribuera positivement à l'évolution des programmes de formation en géomatique et répondra aux attentes de nos étudiants.

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1. INTRODUCTION

Education in Geomatics relies on fundamental scientific knowledge as topography, geodesy, photogrammetry, mapping, ... At the same time, there is strong pressure to make it complies with evolving societal and human needs, referring especially to how humanity interact with geographical space. Then academia offering education and training programs in geomatics must balance these somewhat contradicting trends: to renew continually the curriculum with new disciplines and contents without leaving aside fundamental sciences and concepts.

At Laval University, the geomatics program's direction try to deal with this challenge by keeping a sound scientific basis in fundamental disciplines combined with a constant adjustment to new fields of application. So it is mainly because geomatics is spreading rapidly to new fields of application. It is no more limited as few decades ago to land surveying and topographic works. Then the task of equilibrium between fundamental disciplines and new application fields is not so easy to fulfill, because our bachelor degree program is already complete: a four-year program (120 credits) with 85% of core-courses and a mere 15% of electives. In this context, adding new courses appears impossible (and eliminating existing courses seems even more impossible!). Then it is an everyday concern to find and create to new approach and methods to increase our curriculum content without lengthening its duration in time.

Some initiatives have been developed and applied. We still think that much more can be done. It is still not easy for our students to personalise their own curriculum because of the constraints on elective courses. This paper presents some initiatives and few observations (from a program's director point of view) on the subject. The objective is not to formulate a "to-do" list of actions or a magic formula, but to express some concerns and contribute to the exchange of experiences and ideas.

2. SCIENCES AS A PROCESS OF ACCUMULATION

No one contests the scientific status of geomatics; this broad field relies on fundamental scientific disciplines such as mathematics and physics and their empirical application in topography, geodesy, photogrammetry, mapping and more recently GIS, GPS and remote sensing. Earth measurements and cartographic representation are at the core of geomatics notwithstanding technological progress and new fields of application (many in the humanities and social sciences). We can then recognize that geomatics is a modern scientific discipline and must be characterized as such.

This scientific status implies that geomatics is based on a rational process of knowledge production and accumulation. It is just a normal situation that there is more knowledge today

than there were 10, 25 or 50 years ago. And the pace of production is accelerating constantly, thanks to public and private investments in sciences and more efficient (and accessible) technological instrumentations. We could say the same about scientific knowledge dissemination: our modern information and communication technologies make it easier and faster for anyone (especially academics and students) to find and access scientific literature, research results and rational knowledge. And this can be done from a personal computer, merely for free. It is quite paradoxical that our students are in touch with an ever growing scientific knowledge, without needing to go anymore to the university library (and, in some cases, not knowing how to search and find book on the shelves).

Current geomatics curriculum could not ignore this fundamental characteristic of modern science. It must integrate new knowledge to stay tuned with societal needs, desires and evolution. But academic institutions cannot lengthen their curriculum, by adding extra semester(s) or year(s) of studies as a requisite for getting a diploma. They cannot either operate this integration by simply eliminating “old” knowledge. The question must be asked. What is “old” or “obsolete” knowledge? In some cases, the answer is obvious: 20 years ago, initiating students to computing (and to word-processing software) was important. Nowadays it is a skill assumed to be mastered by all students. But what about calculus, considering that calculating devices do that quasi instantly with a quasi zero-error risk? Is it still important that our students know at least how these devices work (to go beyond the “black box”)?

Some public discourse focus on the utilitarian aspect of education, that is to produce an immediate and efficient workforce. But I still think that the role of universities is much broader than this. One must not forget that beyond mere knowledge transmission, our academic curriculums aim also at shaping Scientifics, researchers, professionals and citizens. Yes, universities produce knowledge, but they also shape and train people. They deal with the most important resource of a society, its people. In the specific case of the geomatics program at Laval University, the institutional education and formative objectives are clear about the “outputs”: we “produce” university graduates (that can be eventually admitted into professional corporation) rather than professionals. This means that the university curriculum is much more larger than the sole professional requirements.

Applied to geomatics, this means that our curriculum evolution is not only a matter of knowledge transmission, it is also and foremost a matter of training people suited to contribute to evolving societal needs (like sustainable development, climate change, low energy consumption, global urbanisation, transportation policies, ...). This issue will not be solve only with a “substitution” approach (new knowledge instead of old knowledge). This would certainly prove unsatisfying. Instead, I think that a solution would be to improve and adapt of pedagogical approach and methods.

3. RENEWAL OF PEDAGOGICAL METHODS

Modern geomatics curriculum is not only about knowledge transmission to the next generation. It is dedicated to shaping and training people that will contribute positively to the evolution of human societies. In the last decades, the pedagogical methods of knowledge transmission have changed at a rapid pace. The classical theoretical “lectures” given to students are completed with many hours of laboratories, field works, practical exercises, case

studies, ... Some academics are now critical to the status of “lectures” as teaching method. Before the invention of printing, when books were merely inexistent, lectures were the principal way of knowledge transmission from a scholar to his students. Nowadays, with printing and even more with Internet, the transmission of knowledge is no further limited by physical reproduction process and mechanisms. Knowledge is accessible everywhere and anytime.

Then, as long as time in class is precious, it should be used more to consolidate and strengthen knowledge rather than to only transmit it. The era of the blackboard for strictly recopying notes, contents and equations should be over. That does mean that any form of lectures or the use of blackboard should be prohibited. This is not the point. Rather it should be used to explain theoretical concepts, to show examples of empirical applications, to analyse case study, to express critical reasoning, to animate discussion and to answer to questions. Pedagogy must be dynamic and facilitating knowledge appropriation by working on contents (and not merely presenting contents).

Otherwise, pedagogical innovation should contribute to integrate new issues, problems and social concerns into classical disciplines. For example, real problems of post-earthquake reconstruction (as it the case in Haiti and New Zealand) should be used to teach geodesy concepts. While strengthening their understanding of geodesy, students are initiated with practical problems to natural disaster risks and impacts and to think about their future role in society. Cases of coast erosion and flooding could be used to teach remote sensing and digital imagery processing.

Geomatics is also a well-fitted discipline to apply a problem oriented pedagogical approach. The evolution and periodical renewal of curriculum contents could possibly be fulfilled, at least in part, by asking students to work, with a disciplinary focus, on thematic problems. This goes along with the developing social status of geomatics: an integrated set of concepts, methods and techniques that can be applied to assist problem resolution in many fields: urban planning, environmental protection, health services programming, geo-business, natural resources management, natural disaster recovery strategy.

Hence, our students could be initiated to current issues related to geomatics, and develop new sets of solutions using our classical disciplines knowledge. In doing so, geomatics curriculum could achieve more educational and training results, without adding necessarily new courses.

Team teaching could also be a good option to broaden the scope of knowledge. It gives some deepness and new horizons in the way of presenting and working on contents. This method has been experienced at least twice: one course in remote sensing and one course in regional and urban planning. The results were successful conclusive: it permitted the interaction between two professors and also the integration of two groups of students from different programs (geomatics and geography).

4. PERSONALIZING CURRICULUM WITH EDUCATION PROFILES

Some students are interested in developing their own knowledge, interests and skills by personalizing their curriculum. For those students, Laval University offers some opportunities by the way of education profile. Three profiles currently exist: an entrepreneurial profile, an

international profile and a newly created profile in sustainable development. These profiles propose a somewhat different elective courses options, permitting a differentiation of our graduate's personality. Not every student can be admitted to a profile; they must be self-disciplined and autonomous in the way they work and study.

Briefly, the entrepreneurial profile aims at developing the basic skills that will be necessary to those becoming self-employer (their own boss), independent worker or businessman. The international profile is about studying one or two semesters in a foreign university. The sustainable development profile wish that students develop their own critical thinking about their field of study, by studying different sets of issues concerning their future professional practice. These three profiles can be selected by our students in geomatics sciences. Even tough few students go on with these profiles, they have this opportunity to personalize their education curriculum and then contribute to the evolution of their future profession.

5. COMPETENCIES AND PROFESIONALS QUALITIES

Scientific and engineering related careers have been concerned in last decade with the development on competencies. It is no more satisfactory that someone has just persevered to acquire and memorize knowledge, without giving due consideration to use this knowledge to resolve problems or apply it in certain practical situations. The students must "know", but they must also "know-how". But a competency approach is somewhat particular, because one doesn't teach competency as a scientific discipline. Competency is a personal skills to use abstract knowledge and putting it in action.

Hence, some competencies have been identified like communication skills, professionalism, integrity, leadership, open-mindedness, ... Once again, competency development will have be integrated in existing courses, and by working on practical problems, on case studies, on societal issues, ... Teachers will have a new role to play by evaluating their student's progress in developing and strengthening their competencies. Our modern societies, professional corporations, public agencies, companies and private firms expect that universities will "produce" graduates that are able to apply their knowledge in practical situations and that they will behave with high standards of quality and ethics.

At Laval University, our geomatics programs are evolving according to these expectations. It is hard work, mainly because these competencies must be developed within the existing curriculum and they must be evaluated with rational criteria. It is possible, but it supposes a great effort by everyone in the renewal of pedagogical methods.

6. CONCLUSION

The evolution of geomatics curriculum is a constant concern at Laval University. But this task is not the sole responsibility of the program's director. It is a collective challenge, shared also by the professors and teaching assistants, the students and the geomatics' professional community. This task is not be easy but surely not impossible. It represents a wonderful challenge of thinking about the future (as for societal needs and expectations) and the renewal of pedagogical methods and the ways we teach geomatics!

BIOGRAPHICAL NOTES

Francis Roy is professor at the Department of Geomatics Sciences at Laval University (Quebec, Canada) since September 2003; he is also the program's director of the bachelor degree in geomatics sciences since 2007. He teaches and leads research in the fields of cadastral systems, land administration, law of land property, and land use planning. His research projects focus on land and cadastral reforms, with a particular interest for Latin American countries, as well as for problems of conflicting integration of the private right of land property with public laws of land use planning. After receiving a Bachelor's degree of Geomatics (Laval University, 1990), he succeeded in realising graduate studies in land use planning and regional development for a master's degree (Laval University, 1992) and a Ph.D. (University of Montreal, 1999). He was hired as a research professional in forestry in 1999. From 2000 to 2003, he worked in private business as a specialist in land administration. Then he participated in several projects of cadastre and land use planning in different Latin American countries. He is also a Quebec land surveyor since 1991 and regularly participates as a trainer, to professional continuing education courses of the Quebec Land Surveyors Order.

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