

Remote Sensing and Geographic Information System Training Requirements in Arctic Canada

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(Received 5 September 1990; accepted in revised form 19 March 1991)

ABSTRACT. There is ample evidence of the need to expand the North's natural resources information base. It is equally important that this information be made available and accessible to the people of the North. Remote sensing and geographic information systems technologies will be important tools in this effort. To fully meet these objectives, however, significant efforts will be required in the area of training.

This paper considers the unique training challenges that will have to be met in the North. The authors discuss a training strategy for remote sensing and geographic information systems (GIS) in northern Canada. This strategy attempts to make maximum use of existing training resources and recognizes the practical need to develop operational skills rapidly enough to fuel the broader effort to supply timely and reliable resource information over all of the Northwest Territories. The strategy stresses the special needs of native peoples to participate fully in the development process. To achieve this, the authors draw on the experience of the Canada Centre for Remote Sensing (CCRS) Technology Transfer Program and Arctic College.

Key words: Arctic, remote sensing, geographic information systems, community-based training, resource development

RÉSUMÉ. Il existe de nombreuses preuves à l'appui de la nécessité d'accroître la base d'information des ressources naturelles du Grand Nord. Il est d'égale importance que cette information soit offerte à la population nordique et que celle-ci puisse y accéder. Les technologies de la télédétection et des systèmes d'information géographique vont s'avérer des outils de grande importance dans cette démarche. Pour répondre pleinement à ces objectifs, il faudra cependant mettre beaucoup d'efforts en ce qui concerne la formation.

Cet article se penche sur les défis uniques que présente la formation dans ce domaine, et auxquels il faudra répondre dans le Grand Nord. Les auteurs discutent d'une stratégie de formation dans le domaine de la télédétection et des systèmes d'information géographique (SIG) dans le Canada septentrional. Cette stratégie s'attache à utiliser au maximum les ressources en formation et reconnaît le besoin pratique de développer les habiletés fonctionnelles assez rapidement pour alimenter l'effort général visant à fournir en temps opportun de l'information fiable sur les ressources de toute l'étendue des Territoires du Nord-Ouest. La stratégie accentue la nécessité particulière touchant la pleine participation des peuples autochtones au processus de développement. Pour parvenir à ces fins, les auteurs s'inspirent de l'expérience du programme de transfert technologique du Centre canadien de télédétection (CCT), ainsi que du *Arctic College*.

Mots clés: Arctique, télédétection, systèmes d'information géographique, formation s'appuyant sur la communauté, développement des ressources

Traduit pour le journal par Nésida Loyer.

INTRODUCTION

As Canada's northern citizens assume greater responsibility for the development and management of their natural resources, direct and full access to the benefits of remote sensing and the new mapping technologies will become increasingly important. These technologies will allow northerners to remotely monitor wildlife populations, to map changes in various environmental conditions, and to more accurately compare past and current land uses, for example. It is important that northerners establish continuing mechanisms for data exchange, technology transfer, and training coordination. This will require a concerted effort at all levels of government, in the private sector, and in the educational community.

The physical infrastructure can now be established rapidly and at a cost that has declined significantly in recent years. Establishing and sustaining the necessary human infrastructures is now widely recognized as the most challenging task. The approach taken to developing this infrastructure should fully integrate available technology with evolving environmental employment situations and existing training structures. If this approach is followed, it will be possible to avoid many of the mistakes experienced by those developing training in other employment areas (Abele, 1989; Rigby, 1988). While there is a large literature base on the development of training in Canada's North, this paper focuses more specifically on the development of training opportunities in environmental fields.

Over the years, a large number of academic institutions, government departments, and public interest groups have attempted to develop learning opportunities in environmental studies for northern Canadians. The programs have exhibited varying degrees of success and, for the most part, have resulted from the good intentions of an individual or organization rather than from any coordinated approach to the delivery of environmental educational opportunities (Aquitaine, 1979, 1980; Balt, 1978; Nunasi Report, 1986; Rigby, 1982, 1987; Rigby and Pattimore, 1986; Rose, pers. comm. 1987). Some programs have been designed to help fulfill a condition imposed on a development project or to help deal with affirmative action programs (Abele, 1989; Rigby, 1982, 1987).

These courses and training programs have had some of the following elements in common: 1) Courses were usually of a short duration and were offered mostly during the summer. 2) Student selection was not rigorous, as the goal was to involve as many northerners as possible in the program. Success was measured in numbers of participants, not necessarily in terms of the quality of the candidates. 3) In many cases, the lack of formal student evaluation procedures made it difficult for graduates to transfer their training to other institutional or employment settings. Without well-documented and accepted evaluation procedures, any certificates given to participants have been of questionable value and utility. 4) Many courses have not led to long-term employment or to the prospect of further education. Training opportunities have related specifically to the situation at hand

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and have not considered the academic requirements of the student. The result is that once the employment or the program was finished, the skills learned by the participant were difficult to transport elsewhere. 5) The demand for the training did not come from within the community. This situation did not foster much community support for programs or their participants. 6) The delivering agencies and their consultants assumed that educational programs designed for consumption outside the North had to be simplified and standards lowered for northern participants, rather than developing programs to fit a northern context (Balt, 1978; Rigby, 1987).

The result of this haphazard approach to the development and delivery of environmental training opportunities has contributed to the creation of a group of semi-trained, semi-educated individuals interested in obtaining employment in environmentally related areas. While many moved from community to community in the North, the skills and knowledge they developed did not find stable markets either in the Northwest Territories or elsewhere. In future, a broader and more fully integrated approach to the role of training in technology transfer must be encouraged.

APPROACH TO GEOGRAPHIC INFORMATION SYSTEMS TRAINING

Two recent initiatives provide good examples of how modern technology and methodology are being successfully integrated into the northern training environment: the Canada Centre for Remote Sensing (CCRS) Technology Transfer Program and the Geographic Information System (GIS) stream of the Environmental Technology Program of Arctic College. The CCRS is a branch of the federal Department of Energy, Mines and Resources. The Technology Transfer Section (TTS) with the Centre's Applications Division is responsible for a broad spectrum of remote sensing technology transfer efforts. Two of the most prominent efforts are the section's Technology Transfer Program (TTP) and the Training Unit (TU).

The TTP's mandate is to assist in the adaptation, evaluation, and transfer of remote sensing technology from the federal level to the provinces and territories. Currently the TTP has completed several successful programs in the Maritimes, Manitoba, Newfoundland, Saskatchewan, Alberta, and the Northwest Territories. It has also developed special radar-oriented programs with several provinces. The TTP carries out its work under the terms of a memorandum of understanding drawn up between the two participating agencies. Part of the program's success lies in its flexibility, although all cases have many common elements.

Each program is based on the selection of a set of cooperative test projects. CCRS normally contributes a specialist and loans image analysis equipment for the duration of the program, normally two years. Technology transfer is a complex process and necessarily involves much more than simple technology promotion and trial. The TTP field officer works actively on all elements of technology transfer, including training. Each program incorporates a wide range of training opportunities and a field officer is supported in this effort by the TTP Training Unit.

The TU develops training curricula and training aids based on the principles of adult learning and presents the resulting workshops directly to the user or in cooperation with the

field officers. The resources are made widely available to TTP personnel and anyone involved in training in remote sensing and related technologies. The TU is also actively involved in the design and modification of training aids for customized workshops to meet the training needs of companies, institutions, and international organizations, such as the Geomatics Industry Association of Canada and the Food and Agriculture Organization of the United Nations.

A Technology Training Program has recently been completed in the Northwest Territories. Its main objectives were to increase awareness of the proven potentials of remote sensing and related technologies, such as GIS, and to develop self-sustaining capabilities for the application of this technology. In cooperation with the Department of Renewable Resources of the Government of the Northwest Territories, a portfolio of pilot projects has been undertaken and numerous training opportunities provided.

Training is one of the most critical prerequisites for the success of the Technology Transfer Program. In addition to conducting workshops for professionals, the TTP has been cooperating with Arctic College to evaluate the existing training needs and the resources available to deliver courses. The overall result of this initiative has been to better understand the unique training requirements of N.W.T. students and to begin developing appropriate curricula and training aids.

ARCTIC COLLEGE

In 1982, a five-member special committee of the Legislative Assembly released a report entitled *Learning: Tradition and Change in the Northwest Territories* (Special Committee on Education, 1982). This became the blueprint for the redesign of the territorial education system from kindergarten to university. Of its 49 recommendations, one prescribed the establishment of a decentralized college, to be called Arctic College. In August 1984, the Executive Council of the N.W.T. approved the mandate of the new Arctic College to coordinate and deliver all post-secondary adult education and training and established a strategic plan for its development (Cleveland, 1987; Stapleton, 1987).

ENVIRONMENTAL TECHNOLOGY PROGRAM

One of the two environmental and renewable resource training programs offered by Arctic College is the Environmental Technology Program. It is the first program in the Eastern Arctic based on a demonstrated need for post-secondary environmental training and marrying the rigour of southern academic learning with northern needs, interests, and cultural knowledge. The program was established in 1986 at the Nunatta Campus of Arctic College, located in Iqaluit, on Baffin Island. The ET Program complements the existing two-year Renewable Resources Technology Program offered in Fort Smith, N.W.T., which is based on a standard academic model but focuses on boreal environments rather than arctic/marine environments. As with other Arctic College programs, a detailed needs assessment was completed to ensure that the ET Program could realistically meet the expectations of potential employers, the needs of the community, and in particular the needs of the student, while maintaining a high-quality learning experience.

The result is a three-year program based on the cooperative educational model. The program links on-the-job work

experience with academics and skills training and leads to a diploma in Environmental Technology. Graduates possess the necessary skills and knowledge qualifying them for employment opportunities with the territorial and federal governments, private industry, and other agencies. Examples of environmentally related positions include renewable resource officers, water resource officers, land use planning technicians, community planning technicians, environmental protection officers, and park wardens. The use of the cooperative model allows students to get valuable work experience before graduating and allows potential employers to assess possible future employees.

In 1990 there were 37 possible student placements for 13 students. In addition to the application of the cooperative education model, efforts are made to match graduating students with employment opportunities and to track their success on the job.

NATURE OF THE STUDENTS

In addition to successfully identifying the knowledge gap and the resources needed to undertake training programs, all programs must consider the nature of the student or participant. Without a realistic idea of the background and experience of the participants in a training exercise, including potential cultural and social factors, it is likely that the best designed training program will fail.

Students entering the Environmental Technology Program can be characterized generally as Inuit men 25-35 years old (average age of 29), married, and with a family. Most students are bilingual, speaking English and Inuktitut, but require assistance in developing English written and oral skills, as English is their second language. Many are currently employed in environmentally related positions or are employed but wishing to make a career change into environmentally related work. All students have attended some high school but are likely functioning at a grade 10-12 level. In addition, many have attended some previous training programs for which they were felt to have some specific aptitude. The majority of the candidates for the program have expressed a desire to remain within the Eastern Arctic, close to home and family, and were unwilling to relocate to obtain further training or employment (Rigby, 1987).

We expect this profile to change as the program matures and younger students become available from high schools. Without "role models" currently employed in high-profile environmental work, younger students show little interest in following careers in environmental or science fields.

While the students are predominantly male, the number of female students is projected to increase as younger Inuit women become more actively involved in land-oriented employment. Currently, there are few women, particularly Inuit women, in environmental positions in the Eastern Arctic. This is in part a result of past training opportunities and career counselling offered women in the Eastern Arctic and in part because Inuit women have had difficulties being accepted in what are perceived to be male-oriented roles (Rigby, 1987).

GIS WITHIN ARCTIC COLLEGE

In November 1989, a workshop was held in Iqaluit, N.W.T., to discuss the future applications of remotely sensed infor-

mation and geographic information systems (GIS) in environmentally related employment in the North. Participants from across the Northwest Territories met and indicated that GIS knowledge will become essential in most environmental jobs in the next few years. This conclusion was further reinforced by an assessment of similar environmental training programs in Canada conducted by Environmental Technology Program staff.

In addition to the obvious need to introduce GIS and remote sensing directly into the main Environmental Technology diploma program, it also became clear that short training courses in GIS will be required for field workers in land use planning, for those involved in administering land use plans and in environmental assessment, and for professionals currently involved in various environmentally related employment that will soon require a working knowledge of GIS applications.

The Environmental Technology Program introduced GIS and remote sensing courses into its curriculum in the fall of 1990. In accordance with the recommendations of practitioners who attended the November workshop, these courses stress the "basics" in GIS and remote sensing. This includes areas such as an introduction to GIS and its various applications, a familiarity with remotely sensed data, a knowledge of computer mapping, a basic familiarity with computers, and a knowledge of various data management programs. Participants also stressed that students should not become "apostles" of any one particular computer or data-handling system, but should feel comfortable with many basic aspects of GIS programs (the Environmental Technology Program uses IDRISI from Clark University, EPPL7 from Minnesota State Planning Agency, and OSU from Ohio State University as its current GIS training programs).

Second, in cooperation with the N.W.T. Centre for Remote Sensing, GIS and remote sensing training will be offered at a more advanced level on specific systems or topic areas. These courses will be designed for graduates of the Environmental Technology Program and for other professionals in environmentally related employment. Short courses of this nature will ensure that specific needs of user agencies are addressed while providing flexibility to take advantage of rapidly changing technology. Also included in this category of training will be "training for the trainer" workshops to allow for the better integration of the technology back into the workplace.

Third, the November 1989 workshop also highlighted that, in addition to the specific training needs of Environmental Technology graduates and other professionals, there is also a clear need to provide access to training for those who must collect data for use in the various computerized planning systems and for those who must make decisions based on this information. With this in mind, the Environmental Technology Program plans to develop a series of workshops that will familiarize field workers and board members alike with GIS and allow them to better use the evolving technology. These workshops will be held in conjunction with specific user groups and government agencies, taking advantage of the wide-ranging knowledge base that already exists in the N.W.T.

The strength of these program options has also been increased through an arrangement with the Geographic Information Systems Program of the School of Natural Resources of Sir Sandford Fleming College (in Lindsay, Ontario). This

link will provide residents of the N.W.T. with access to training opportunities designed specifically for northern needs and will deal with the most current technology.

TRAINING CANNOT DO IT ALL

This paper has described the ways in which training in remote sensing and GIS are being developed to meet the needs of the northern community. However, it is also clear that the success of any program cannot rest solely on training. Training will fail if the audience assessment is inaccurate, participants' motivation is low, management support for innovation or training is lacking, the infrastructure for application of the training is missing, or sustained access to training is not planned. Training will succeed when it supports the mandate of the organization and the perception of the employee that the training will be of benefit in discharging his or her responsibilities, when the knowledge gap is clearly defined and the training is tied to the participant's knowledge and skills, when management supports employee training, and when there is an immediate application of the skills learned by the employee in the workplace.

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