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EDUCATING UNIVERSITY STUDENTS IN REMOTE SENSING: ISSUES AND APPROACHES

S.E. PIPER

University of Natal/Department of Surveying and Mapping
Durban, South Africa

ABSTRACT

The Department of Surveying and Mapping at the University of Natal has been involved in running remote sensing courses both for students and the user community since 1980. The complex nature of our society, its ethnocentric structure and varying educational systems yield an amazingly varied student population. In this paper their strengths and weaknesses are detailed. The current structure of our curriculum is examined and its deficiencies are noted. Some thoughts on teaching methods and also on "hands-on" computer training are offered.

1 INTRODUCTION

A remote sensing course has been part of the formal programme of the Department of Surveying and Mapping at the University of Natal for two years. Prior to that it formed part of the photogrammetry course, on a trial basis for two years. In addition half a dozen one week remote sensing courses for the general user community have been run both at the University of Natal and at the University of Cape Town since 1980.

The comments offered in this submission refer only to the student training programme. The problems encountered with the extra-mural course are of a different nature.

The format adopted here has been to take the four questions posed by the seminar organizer and after expanding them to five questions, they have been answered one by one. Because of the complex nature of our society I have taken the liberty of expanding on some of the background issues, mainly for the benefit of the non-African reader.

(Lest any modern feminist take umbrage, when I refer to students as "he" I also include the feminine students under that masculine appellation.)

2 KEY QUESTIONS

A. WHO SHOULD WE TEACH?

Well who should we teach? My first reaction is that that is an arrogant question to pose in a third world environment. Our need for educated people with technological skills is so great that we cannot afford the luxury of being selective. Our rôle is to take those students who are interested and make good the gaps in their education whilst we train them in our own specialities.

However, the question has a second facet to it. Our Department has, by virtue of its being a surveying and mapping department, taken a very strong numerate approach to remote sensing. This has tended to be at the expense of an interpretive approach. So I would pose the questions: "Should we be teaching the interpretation of imagery as well as the purely geometric and numerical aspects?" Furthermore: "Should we not get the biologists/geographers/geologists to teach their own applications?" This is not the first time that we have faced this problem. It has arisen before in photogrammetry, where the surveyor and photo-interpreters have drifted apart. The possible solution will be for us to continue with both until such time as the application disciplines have built up sufficient numerate skills. An example of this is the manner in which statistics is now taught by user departments, within their own contexts. Departments of mathematical statistics tend to teach theory now and concentrate less on service courses. (Perhaps remote sensing will one day become so mature that it will be just another service course!)

B. WHAT ARE OUR STUDENTS' STRENGTHS AND WEAKNESSES?

In no aspect of public life in southern Africa is it possible to escape from effects of the ethnocentric political philosophy of both the previous colonial and present nationalist regimes. In the post-world war II decade some educational institutions began to move away from racial exclusiveness. However, this was harshly curtailed in 1959 with the cynically named "Extension of Universities" Act which introduced total racial segregation within Universities. During the subsequent score or so years this policy has been slowly eroded away to the point now where have nearly 25% of our students who come to us as "permit students". (The use of a permit is the time-honoured solution to the dilema of allowing practical progress while maintaining an inflexible political stance).

Thus we have coming to us as students,young folk who have been through one of four "ethnic" educational systems.Each system has its own problems and only one is adequately financed. So our students vary tremendously in the skills that they bring to us. Perhaps the most noticable difference, in the undergraduate years is the ability to communicate adequately.For many of our students English is not the mother tongue but nevertheless they have had nearly all their secondary education in English, usually from teachers who are themselves not English speakers. These students come mainly from the isiZulu and isiXhoza language groups. We also have students coming from the Urdu, Gujarati, Hindustan and Tamil language groups for whom English has been a mother tongue for less than two to five generations, and who may have a restricted vocabulary and improper grasp of English grammar.

If we add to this, the fact that most of those entering the numerate sciences tend not to value communication skills, we have a group of students who tend to be both illiterate and inarticulate. On the other hand some of our remote sensing students come to us from the biological and geographic sciences. Those students tend to be articulate but do lack numerate skills (often they have chosen the life sciences because of low mathematics passes). It is still possible to complete a three year degree in geography, biology or geology, amongst others without any formal training in mathematics, statistics or computing. Though I should add that this is currently changing.

To summarize then, we have students who have weakness in the areas of articulation, writing in clear concise English and in handling numerate concepts.

It has been said that Durban is the microcosm of the world. In this city is found the meeting place of the occidental, oriental and African cultures. Each embodies a view (or views) of life which differs from the other. Added to this, is the fact that there exists an industrialized, comfortable minority in the midst of a third world poor majority. (However, as result of its "mixed" nature the city is well liked by many because it is easier to move about in Durban. The racial barriers are less harshly drawn than in other cities in southern Africa).

From a philosophical viewpoint our students range from those who have an interest in techniques applicable to third world environment to those who are quite willing to become enamoured of high technology for its own sake.

We have students who may lie anywhere on a two dimensional spectrum. The one dimension has students ranging from the third to the industrialized worlds and the other with a range from the literate through to the numerate. It is mixture that we find particularly stimulating. Within two other courses run in our department (law and land tenure)this mixture has proved to be particularly valuable, to both staff and students (Jenkins Pers.Comm.). Furthermore, the opening up of our University has started to free it from its European fascination so that it can turn toward the real problems of Africa.

But enough of my political philosophy!

The general comments given above tend to hide some of the less dramatic weaknesses.

Students without a mathematical and/or survey background have difficulty in understanding the principles of geometric correction. An uncorrected image can pose so great an obstacle to them, that they are not able to navigate their way around it and producing even a crude map from it is just not possible. (I must however state one counter-example. An ecologist, A.R. Palmer, related to me the manner in which he geometrically rectified a satellite image. He put a negative in a micro-fische reader and projected it down onto a map. Then he loosened all the bolts and fiddled the lens around until the image and map coincided. Holding the lens in that position he retightened the bolts, took the map out, switched the lights off, put in a sheet of photographic paper, flicked the light switch and got himself a geometrical "true" image!)

Those students who have not done geography or survey do have difficulty in visualizing spatial distributions and spatial processes.

The survey and physics students because of their strong numerate background, are inclined to belittle the interpretive aspects of remote sensing. However, they are happy with numerate classification procedures, seemingly unaware of the hidden and often arbitary judgements that the analyst must make.

3 WHAT TOPICS ARE BEING OVERLOOKED IN THE CURRICULUM?

Firstly and most importantly is "visual interpretation". Because of (i) the natural numerate bias of our department, (ii) the contact we have had with L.A.R.S. and (iii) our use of Swain and Davis (1978) we have mounted a very strongly numerically orientated training programme. However, we are in a third world country and computers (and computer people) are costly while we have many unemployed, or under-employed hands. Thus we are of the opinion that we need to put considerable effort into the training of interpretive skills. At present black and white imagery at a scale of 1/1000 000 is about 1/16 the cost of digitial imagery. We feel that much of the elementary rural land cover mapping could be undertaken purely visually.

Our teaching philosophy of remote sensing has been that of inculcating technical skills. The skills and the third world problems that surround us are two separate arenas. We now feel that we need to re-orientate our teaching so that we develop these technical skills within the context of our local needs.

In terms of pure techniques our course(s) must always lag behind the new world. Firstly we must wait for a period of 12-24 months before literature becomes available to us. (This is especially true of conference proceedings). Secondly, as new techniques become known to us they have to be evaluated under local conditions before they can be incorporated in the teaching programme. Thirdly, we are working within a bourgeoning science in which the rate of growth is so fast that no course could include all that is relevant, let alone all that is known.

Currently I am aware that there is a "hole" in my course in the areas of multi-temporal studies, crop calendars and various indices of greenness. I also feel a certain lack in the area of data compression techniques.

4 WHICH TEACHING TECHNIQUES WORK AND WHICH DO NOT?

I have always believed that a good teacher discovers his students' interests and fosters them, at the same time building upon existing knowledge and experience. Yet he should also not be afraid of flights of fantasy nor of being entertaining. However, care should be taken not to stick religeously to "rules", "formulae" or to constantly introduce pedagological gimics.

Most students are parochial in outlook, appreciating local examples and local solutions to local problems. If by way of example I say "You know, the Americans have solved problem 'A' with technique 'B', they all start suffering from megorism (M.E.G.O. = my eyes glaze over). I might as well have told them about the Irish leprechauns in Scotland. Anyway, they all know that the Americans have so much money that they can solve any problem, except perhaps how to formulate a foreign policy that is consistent for more than one presidential term).

The use of slide/tape presentations has had a mixed reception as has video material. If used as an adjunct it is often useful, especially if the lecturer is himself unfamiliar with the material. However, its use as a lecture substitute is not acceptable in our environment. It is viewed as faintly insulting to set up a "lecturer substitute" then to leave the students on their own. My own feeling is that the lecturer who uses such techniques has abrogated his right to learn from his students. In general I would argue that the more formalized the lecture notes and audio-visual aids, the more inertia there is in the course and the harder it is to change, grow and mature.

Remote sensing is the most visually stimulating course to teach. Its very nature is to produce beautiful illustrative material. In fact there are very few aspects for which it is not possible to find some attractive examples. However, therein lurks an evil temptation.

The temptation to show "gee-whiz" results and to grossly overstate the actual capabilities of the art of remote sensing.

Until this year we have structured the course so that all the fundamentals are introduced at the beginning of the course. However, we now feel that this may have been a mistake as the students find the course too disconnected. Possibly a better approach may be to structure the course in a linear fashion with branches, or digressions to fundamentals only when they are required and have been properly motivated. As an example: the students are given an overview of cameras and aerial survey near the start of the course, however they only appreciate the material once they ask for aerial photography in order to evaluate their classifications.

5 HOW DO YOU GIVE STUDENTS HANDS-ON EXPERIENCE?

I was interested to see that this last question was stated in such a way as to imply that hands-on experience was taken for granted. We have recently debated the topic: "Do students need hands-on experience". Our former students are all of the firm conviction that it is only "in the doing that comes the knowing". It is one thing, in theory to know how to ride a bicycle, it is another thing to actually do it.

Our approach has been to run the hands-on experience in parallel to the lectures. We have three parallel streams, viz: (i) the theoretically orientated lectures, (ii) lectures on how our remote sensing suite (called P.I.P.S.) works and (iii) the practicals themselves. The student receives both a P.I.P.S. Primer and a set of P.I.P.S. Exercises. The Primer contains one or more examples of everyone of the remote sensing tasks and this is accompanied by a print-out showing all the control cards, parameter) etc. As well as a full set of the results from that task. The student then sets up a run identical to that in the Primer and gets it to run on the computer. Once he has achieved this he turns to the Exercises and performs them. The Exercises force him to change one or more parameters in his runstream and furthermore, force him to consult the user manual.

The Examples are structured in such a way that they build one on top of another and all focus on the final product, a classified area which is evaluated in terms of the available surface reference data.

The computer is initially set up with a set of images which are bigger than the area that has been chosen for the Examples. The student is encouraged to select an area that interests him. By way of example, a mangrove swamp, an industrial area, a "spontaneous settlement" (i.e. a squatter slum) or a small forest. The student will then follow through his examples using "his area". This allows each student to follow his own particular interests.

(The P.I.P.S. manual is documented in O'Donoghue et. al. (1983 a), the P.I.P.S. Primer in Piper (1983 a) and the two Exercises in Piper (1983 b,c). The P.I.P.S. digital remote sensing suite is described in O'Donoghue et. al. (1983 b)).

In teaching digital remote sensing we are faced with three separate problems, viz:-

i) Teaching the student how to communicate with the computer,

ii) Teaching the student how our particular suite operates, and

iii) Teaching the student the fundamentals of digital image processing.

The students who have never seen a computer before are given a crash course in how to use it.

The other two problems are handled simultaneously in the way outlined above.

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S.E. PIPER has lived nearly all his life in, or near the City of Durban in the Province of Natal, South Africa. He was educated at Kearsney College and read Chemical Engineering at the University of Natal. Thereafter he worked in operations research until moving to the University of the Witwatersrand, Johannesburg, to begin research in mathematical biology. A lecturing post in applied mathematics and environmental studies at the University of Cape Town then followed before he returned to his hometown. Interludes in a soap factory and as an independent computer consultant preceded his return to his alma mater, first in the Department of Mathematical Statistics and later in Surveying and Mapping. He teaches Geodesy, Remote Sensing, Numerical and Computer Methods, Statistics and Co-ordinate System while his research interests are in Remote Sensing, Geodesy and Ornithology.