

THE ECOLOGY OF AN ECOLOGY PROJECT AND SOME SUGGESTED ADAPTATIONS FOR PROJECT SURVIVAL

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Mere dissemination of ecology teaching materials is likely to be ineffective in making the classroom teaching of ecology more meaningful. It may be necessary to take a more comprehensive view of the processes by which teachers change their practices. The article addresses both private sector and education department methods of innovation.

INTRODUCTION

This paper arises from discussion at the workshop, held at Spioenkop in November last year, on producing ecology teaching materials. If it sounds terse and prescriptive in places, that is because I have limited space, not because I believe in ready-made analyses. I write in my personal capacity. Colleagues in my project do not necessarily share my views.

My major concern at the workshop was that the task of such a project should be conceived more widely than production of new materials and their dissemination. The experience of other projects has shown that it is more costly but much more effective to think in terms of *teacher professional development in which ecology materials should be tools*.

I'd like to consider not only the mooted ecology project but other innovations as well, and innovations that are born both inside the education departments and outside them.

There are many who would say that new projects in S.A. should make no compromises with government-controlled education systems because they are geared for racial segregation and white domination. To them I'd point out that the great majority of teachers and children are still inside classrooms. Very many children and parents still believe that schooling and certification offer a route to a more fulfilling life. It is perhaps too easy to say that private sector projects should have no dealings with The System.

As regards those innovations that are born within education departments, it seems from the literature (e.g. Marsh & Huberman 1984) that many of the issues which I'll try to sketch do apply to innovation that works through the normal channels of departments. For education departments, it seems that the trap to avoid is a position where teachers feel uncommitted to the innovation and it must either be 'pushed' unendingly or abandoned as a lost cause.

In the U.K. and U.S.A., the 1960s and 1970s saw the large, well-funded, prestigious, research-development-and-diffusion curriculum projects such as Physical Sciences Study Curriculum, Biological Sciences Curriculum Study, Science Curriculum Improvement Study and Nuffield Physics, Chemistry and Biology. The subsequent history of these projects convinced most observers that placing new learning materials in classrooms produces little or no change in teachers' practices and childrens' learning. Courses which show teachers

the aims and methodology of the materials do little to improve matters.

There is good reason why materials plus training in their use should not produce noticeable change in the classroom. They are inserted into a highly complex environment which is holding many tensions in equilibrium.

The school environment, like natural environments, has been there for a long time and it's not going to change easily or quickly, unless there is a social earthquake or flood. Such an environment is not to be taken lightly.

One can picture the project as a species. Species have to adapt to their environment or become extinct.

A typical promising species will have these characteristics:

- a. An analysis of what is presently wrong with the teaching of ecology at some level of schooling.
- b. A theory about what good ecology teaching (or learning) *should* be.
- c. A methodology for this better teaching. (Incidentally, if the elements (a), (b) and (c) can't be spelled out in detail, should the project be producing materials or training teachers at all?)
- d. A set of materials which will support this methodology.
- e. A mechanism to supply these materials.
- f. A plan for training teachers to use the materials.
- g. A decision about where to obtain people with suitable *attitudes and skills* as well as knowledge to do the training.
- h. A plan for obtaining information from teachers (and others) on whether the project is having the desired effects.

The successful project (species) lives both as a physical presence (its charts, kits, workbooks, teachers guides etc.) and as a set of ideas. Teachers believe in these ideas; the ideas have shaped the way they interact with their classes. The species has members in many schools; it is able to reproduce itself in new schools and new teachers. In time it shows successful variations and adaptations.

However, some other species (projects) have a marginal existence. A few isolated members survive for a while in a niche in the school system, tolerated by the dominant practices, but separated and unlikely to reproduce. They can be found by diligent researchers.

And then other species, the majority, become extinct. The bodies of some are preyed upon immediately (terrariums become filing trays, mobile laboratories become cupboards in the staffroom,

charts become drawing-paper, to quote some actual examples). Others find the choking air hard to breathe, and their spirit quickly and quietly departs. They leave their dusty fossil remains on pinboards and shelves, in cupboards and storerooms. These species failed to recognise the realities of the school ecosystem; they would not adapt or they did not have the resources to survive while their adaptation was taking place.

To lift up some of the factors in the school environment I'd like to use a convenient framework, namely the roles that a teacher must play. Sociologist Dave Gilmour (Macdonald & Gilmour 1980) gets the credit for this framework.

We can view the teachers in their schools as the actors who take roles in a traditional drama with a well-known script. The usual performance may be uninspired but at least it is known and understood by children, teachers, principals and parents. There is often a lot of security in it for teachers and children.

Now here comes the project!

The project invites or puts pressure on the teachers to take up a new script, understand its lines, understand its plot, appreciate its high points, step into its roles and perform it in front of a class who may not at first understand (or like) what's going on.

There is not just one role. There are at least four roles worth looking at:

- The teacher as subject specialist
- The teacher in the classroom
- The teacher as professional
- The teacher as employee.

THE TEACHER AS SUBJECT SPECIALIST

The existing script requires the teacher to understand many concepts in science, and in ecology in particular. It also requires him to know how ecologists reason with those concepts, that is, to understand the logical connections between them. It also requires him to expound these connections fluently.

The new script which the project introduces may add further concepts and, very likely, will re-structure the connections between concepts to give a more up-to-date understanding of ecology.

For our biology or geography teacher, there may be a lot of stress in this role. He may know all too well that he does not understand even the existing script and cannot perform. In many school situations in S.A. the students anxiously demand that their teacher be a "mobile textbook" (Millar 1984) and open the door to exam success and social mobility.

Professional Development Issues

Much teaching either (a) wrongly assumes that pupils understand the concepts the teacher talks about or (b) expounds the concepts but fails to differentiate them from other related concepts.

- *On (a)*: This point deserves an article to itself. There is a mass of evidence that people interpret new information in terms of an individual framework of ideas which they already have. These frameworks of ideas exist before the lesson begins; they are astonishingly resistant to change; they may be the most important factor in what the person learns.

For example, the majority of over 300 British pupils, age 15, from various schools, saw plants as consumers of food and energy, in most cases *after being taught a unit on plant nutrition by usual methods* (Bell & Brook 1984). The concept 'energy', and many others, are understood in non-scientific ways *after* normal teaching. See also Stepan (1985).

- *On (b)*: Unless concepts are made part of a coherent structure they do not become useful thinking tools. The current work of Novak and Godwin (1984) on cognitive mapping deserves a close look by the developers of any new ecology project. The way many pupils 'learn' in school is to collect fragments of a subject, without much understanding of how or when each fragment should be used.

THE TEACHER IN THE CLASSROOM

The existing script for this role requires the teacher to perform as instructor, classroom manager and disciplinarian. Instead of looking at these sub-roles separately (done in Macdonald & Gilmour 1980) I'll just point out the importance of *teacher influence* as a central concept that tells the teacher whether she is doing her job (Olson 1981). In most traditional performances, the teacher has a clearly central position in the classroom. She expounds the subject knowledge, repeats it, tells children when and what to write, controls children's speaking and movement. She is quite clearly *teaching*. She is quite clearly exerting *influence* on the class.

The new script may ask the teacher to change the way in which she exerts her influence. It may emphasise what the *children* do, that is, *learning* activities. The new script requires her to organise learning experiences to a much greater extent. The project introduces new materials. In many classrooms the new materials represent a huge increase in the complexity of what happens before, during and after the lesson. The new script requires skills and effort in labelling, storing, handing out, checking-in and monitoring children's use of the new materials.

One can't assume that all children will welcome an emphasis on learning activities; some children *want* the teacher to be a 'mobile textbook'.

Role stress is obvious in the teacher's attempt to manage such a lot of activity. A less obvious cause of role stress is the teacher's feeling that she is working harder but feeling that she has less *direct influence* than before, even though the children may be learning more effectively.

The effort of adjusting to a new performance is often negated by

- exam questions that do not reward teachers and pupils for using new teaching/learning methods.
- lack of double periods on the timetable and the apparent inability of some principals to correct this
- headmasters who do not allocate a room for major-time biology/geography use, where teachers can accumulate displays or set out experiments that require several days or weeks
- no provision made for using school funds to replace consumables or broken items
- demands of in-service training courses for other subjects which take the teacher away from her school

an unsupportive subject head teacher who can easily squash the innovation.

Professional Development Issues

- In the light of the factors above, do the project teachers fatalistically say to themselves "That's the way school is" or do they begin to say "The way school is, is a problem and we want to do something about it"?
- Are the project teachers learning new skills in managing the increased amount of pupil activity described above? Are they able to accept that children make sense of the subject by talking to each other about it? Without practice in skills to handle the new teaching style, the teachers may soon find the materials inappropriate.
- Are the teachers setting up procedures for handling and storing the materials? One well-designed maths project failed largely for lack of these procedures (Cundy 1978).

THE TEACHER AS A PROFESSIONAL

The existing traditional script for this role of the teacher as a professional is exceedingly weakly written for most S.A. school situations. It also blurs into the very much stronger script for the teacher as employee, and these two roles create conflict for the teacher.

The new script which the project introduces may touch this role or shy away from it. A fairly strong script may include Hoyle's (1969) characteristics of a profession.

Hoyle says that, in general, a profession (a) performs an essential social service, (b) is founded upon a systematic body of knowledge, (c) requires a lengthy period of academic and practical training, (d) generates in-service growth, (e) has a code of ethics and (f) has a high degree of autonomy.

There is an argument that the movement toward professionalisation in fact does little to improve teachers' standing in society or their satisfaction in their work; what it does instead is to give their employers a handle on them by which the employers can subtly control them.

However, let's use Hoyle's characteristics to highlight one issue in each category.

Professional Development Issues

- The issue of teacher-generated in-service growth.

In the normal school, teachers are professionally isolated; that is, only the children know what a teacher does in her classroom. Good teachers are not able to be models for others. Teachers are also anxious about having other adults see what they do in class. Traditional in-service courses seem to have an incorrigible tendency to stifle teacher participation and debate.

However, if the project can create a new ethos which allows *teachers* to say it's OK for them to watch and discuss each others' lessons, we can be into a new realm of in-service learning. (Projects such as Primary Education Upgrading Programme, Molteno and Science Education Project as well as In-Service Education and Training programmes in Britain have all made use of this approach.)

- The issue of ethics.

Though an ecology project may be only a knowledge-base for later environmental education, it is hard to imagine value-free ecology materials being produced. The teacher is the focus of any contra-

diction between the needs and ethics of the parent-student community and the values of the ecology project.

As an example, one can expect difficulty for teachers in, say, a KwaZulu community if they are asked to teach the causes of erosion, but where forced removals of people from 'white' areas has put 100 000 people on their land which used to support 10 000.

- The issue of autonomy.

This involves some form of the question, "Who owns this project?" To whom are the project trainers *accountable*? To the department? To the teachers? To the sponsor? Unless the teachers have an actual stake in the project's management and success there may be not much reason for them to maintain their efforts after the early years of the project's activity.

It also involves the question, "Who decides what will be evaluated?" Do the teachers have a say in what should be evaluated?

THE TEACHER AS AN EMPLOYEE

The existing script for this role is very strongly written. Education departments are demanding increasingly faithful performances from teachers in the present education crisis.

A more normal script has been described in detail elsewhere (Macdonald & Gilmour 1980); I'll lift up just a few aspects of relevance to a project's implementation.

- There is great pressure on most teachers to 'cover the syllabus', often irrespective of whether the children have understood its major themes or not.
- An atmosphere of regulations tends to create a 'work to rule' ethic among the staff of a school. A teacher who puts in extra work can face pressure from colleagues to stay with the norm, so as not to raise the minimum performance level for all of them (Macdonald & Gilmour 1980). Therefore, teachers have many ways to tame an innovation which calls for more work.

The new script from the project may ask teachers to spend longer on teaching ecology while they practise new methods and give the section more attention. This can create tension with the demands of completing the syllabus. Projects' teachers sometimes report that while they like the new approach, it takes too long, and they have regretfully dropped it.

The new script almost always requires extra effort from teachers at least in the beginning. Teacher enthusiasm often gives rise to an informal group which is not recognised in the formal hierarchy of the school system. Those who control school systems are often threatened by the existence of informal groups and may take steps to bring them within normal control (while still enthusing over the value of the project).

Professional Development Issues for Teachers and Employers.

- Just how important is it for every project class to 'cover the syllabus' in comparison with reaching a clear understanding of some key sections? (Some projects have found that even where all schools write an external exam, those project children who learned only certain sections did not score lower than children who 'covered the syllabus' e.g. Cundy 1978). Is it not teachers' professional responsibility to negotiate with inspectors for teaching

a well-motivated selection of syllabus topics, when it is obvious that there is not enough time to teach all the topics meaningfully?

- Some projects use a strategy of establishing teacher groups in order to create a structure for the continuation of the project; in other cases teacher groups have self-started without aid from the project.

The professional development issue for teachers and their employers is to recognise and use the potential of such groups. To illustrate, let me quote a recent negative example. A science advisor visited some schools where a self-started science teacher association has operated for several years. The association members have made numerous sacrifices to help new teachers in the subject. The advisor, who had detailed knowledge of this association, ignored it and conducted an in-service course for a group of new teachers in a way which undercut what the association was doing.

There is a dire need for a more on-the-level, problem-solving relationship between teachers and officials.

- Several education departments are making professional development of teachers a high priority. Unfortunately, the concept of 'professional development' is being trivialised in many cases. To quote a teacher, "The advisor told me it is unprofessional to hang my jacket behind the door and have my tie loose."

So a final issue: is it appropriate for teachers' professional development to be almost entirely in the hands of their employers? Is there not a conflict of interests between the employer's needs to control its employees and any profession's need to be autonomous and self-evaluating in specific ways?

SOME SUGGESTED PROJECT ADAPTATIONS TO THE SCHOOL ENVIRONMENT

The major adaptation I would recommend is that the project employs travelling implementers, and invests heavily in their training and support.

It is naïve for a project to say, "the inspectors will keep an eye on the innovation in the schools". Inspectors/advisors already have a great load of administrative and disciplinary tasks. Also, their actual power to reward or censure teachers generally puts them at a disadvantage in comparison to the project worker who is willing to operate without any power beyond his own enthusiasm and empathy.

The four teacher roles outlined above represent an increasingly deep involvement of the project implementer with the teachers.

INVOLVEMENT WITH THE TEACHER AS SUBJECT SPECIALIST

- Plan for a long series of short in-service courses based on what teachers will teach in the following few weeks, rather than a course which tries to cover all the ground for a whole term or a year (Rogan & Macdonald 1985). It is essential that the trainers use the same teaching methods that the project wants the teachers to use in their classrooms (McDermott 1976).

- Before designing the materials or training teachers in their use, invest in research to find out what conceptions teachers and pupils already have of the topic. Take these pre-existing conceptions very seriously because they are going to modify the message of the materials in the classroom. In-Service Education and Training programmes

must sensitively address these misconceptions which teachers hold, not attempt to overlay correct teaching on top of them.

INVOLVEMENT WITH THE TEACHER IN THE CLASSROOM

- If the project does not do adequate work in the professional development issues around this role, it can be completely pointless to put new materials into the classroom.

Most projects that become extinct go under in the classroom, not the committee room. Training courses cannot effectively tackle the problems the teachers face in their classrooms; the project implementer must get in there with the teachers. New implementers should teach in schools in the project region for at least a term, part-time, in order to understand the problems of timetabling, accommodation, non-co-operation of principals and fellow teachers, replenishment, school petty cash, storage, theft etc. There's no reason to believe that teachers will solve these problems unaided.

Teachers are busy people. Teachers share facilities with other teachers; it can take a great deal of nervous energy to negotiate a new use of facilities with colleagues; it can take even more energy to learn the new use and to sustain the arrangement.

However, the project can often make an adult learning event out of teachers' attempts to negotiate for solutions.

INVOLVEMENT WITH THE TEACHER AS A PROFESSIONAL

- People in the private sector who are thinking of starting a project should read K.B. Hartshorne's paper (1986).
- Be ready to discuss with teachers the question "Who stands to gain what out of this project? What's in it for sponsor (if any), authors, publishers, department, implementers, teachers, children and parent community?"
- Take a strong view of professionalism. Guard against thinking of a teacher as the technician who is being trained to operate the system which the project installs.
- Does the project plan to foster critical discussion of the environmental values that lie behind the materials? If not, are the reasons good? At the same time; it's OK in the early stages to say "This is a well-tryed set of materials; use them in the way we suggest; they work." Many projects find that teachers are first concerned about managing the materials, then about whether children are learning better, and only later about the broader educational aims. This progression can take two or three years (Gray B.V. 1984 pers. comm. and Guskey 1986). It's important, therefore, to ensure early on that teachers (and pupils) get reliable information on the pupils' achievement (Guskey 1986). In general, teachers should be informed of as much of the evaluation data as possible (Macdonald & Gilmour 1980).
- Adopt adult education rather than in-service training as an overall frame of reference. Adult education (I don't mean night-schools) uses concepts such as: help people to evaluate their own experiences and learn from them; empower people by helping them understand the ways they relate to others; give them confidence in their ability to shape and control their own work situation.
- Invest in developing teacher leaders and a structure in which they can operate.

● A major project should go in with enough resources to stay at work in a region for at least five years. Even if ecology were only a term's worth of teaching, teachers must accumulate know-how year by year. This means project support at the right time each year. This should create a sense of building up to a goal of really high quality teaching. The effect of raising the standards in the project topics is to raise expectations of teaching in other subjects as well (Curry N.O. 1985 pers. comm.). The usual three-year funding policy for projects can do actual harm; teachers make commitments and sacrifices, project staff work hard at building a structure to support development, and, often, when things are beginning to gel, the funding runs out (Gray B.V. 1983 pers. comm.; Morphet, Schaffer & Millar 1986).

INVOLVEMENT WITH THE TEACHER AS EMPLOYEE

It is in this role that the teacher faces the problems caused by unresolved tension between the project and (the rest of) the Department. He is also least able to do anything about the problems.

To name just one of many issues: perhaps the most serious problem facing some projects is the way teachers are moved from subject to subject. The project may invest several years of effort in a teacher and when the teacher is growing in skill, initiative and leadership, the rug is pulled from under his feet as his headmaster orders him to begin teaching another subject for most of his week.

Of the reasons given for this sort of event, some are quite understandable and others barely believable. The point is that the project must seek commitment from the teachers' employer about the subject they will teach or the project will see its work eroded as fast as it is built up.

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