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VENTURING INTO CURRICULUM CHANGE*

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TWO NEW DEGREES in education were introduced in 1976 by the University of Rhodesia: the B.Ed. and the M.Ed. Both of these degrees are centred on curriculum studies. Also, the second chair in the Department of Education has been allocated to this field of education. These are three domestic expressions of the prominent, even dominant, position that curriculum development holds for educationists today; a fourth resides in my own department, the Science Education Centre.

Recommendation for the establishment of the Centre included a clear remit to be engaged in the appraisal and development of school science curricula. Paragraph 96 of the 'Plan for the Triennium 1970-72' drawn up by the University College of Rhodesia in February 1969 states:

> The Science Education Centre exists at present as a 'cell' within the Department of Education. Since it is of the first importance that the flow of adequately qualified science entrants to the College be increased over the years, it is clearly essential that problems be tackled at the roots rather than that various remedial operations should be mounted . . . in or just before the first University year. It is therefore proposed to 'hive off' the unit [the Science Education Centre] as a separate entity . . .

Such were the beginnings of autonomy for the Centre seven years ago. Since that time we have been engaged on two fronts — with teacher education and with contributing to the renewal of school science curricula. The latter area of activity we have regarded as being a proper response to our brief that problems in science education 'be tackled at the roots' and tonight I shall describe very simply something of what we have been attempting in the field of curriculum development.

In this account I shall virtually ignore the issue of *what* science should be taught in schools, and of *how* it might be taught. This is because whatever course is designed to be taught, its translation into action, its success and its evaluation is dependent on factors additional to — and sometimes more significant than — its intrinsic soundness conceptually and methodologically.

* An inaugural lecture delivered before the University of Rhodesia on 20 October 1977.

My account will have two different focal points. Firstly, I hope to establish some of the main considerations of a curriculum study venture and to illustrate the operational effect on them of the context or setting in which it is intended the proposed curriculum change should be brought about. My first example of our work, relating to secondary school ecology, has a relatively simple context; my second example, relating to African primary science, has a much more complex and sensitive context. As a result the method of attack adopted in the two projects differs accordingly.

The second generality which will emerge from my description of our personal experience in curriculum development, is that the pivotal role of the teacher in the implementation of curriculum change cannot be overestimated. Change in a subject course, by definition, must require teachers to understand new content and to adopt new teaching styles. In so doing a threat is made to their confidence and to their control of the situation. This is so even when the change is sought and regarded as desirable by the teachers; still greater must the disturbance and threat appear to be when the change is not so welcomed.

I say this not deprecatingly of teachers, but sympathetically and realistically. The day-to-day life of a teacher with his class of pupils is intricate, idiosyncratic and private. It is here, the world over, where the prescribed *de jure* syllabus operates as the *de facto* hidden curriculum — a circumstance which serves to remind us that an educational project directed to effecting curriculum change can never have the control and confidence of a scientific investigation: at best it will be a venture.

We can note then that the intended curriculum of developers becomes the operational curriculum of the teachers. But interpretation does not end there, of course; the pupils will also make *their* interpretation of what the teacher offers. Work of the Ford Teaching Project, based at the University of East Anglia, has revealed that in a 'discovery learning' situation a very large communication gap

> generally exists between teachers trying to innovate and pupils accustomed to traditional patterns of teaching . . . For example, they tend to assume that when a teacher 'asks questions' he is wanting them to display knowledge they already possess, rather than to develop new lines of reasoning (Elliott and Andelman, 1974, p.18).

In such instances pupils misinterpret a teacher's message not necessarily because they cannot understand, but because 'they feel impelled to act out roles they have come to expect of themselves in classrooms' (Munro, 1977, p.38). The customary patterns of interaction between teachers and pupils are particularly conservative in African schools, and thus become an important consideration when innovation is designed for these schools.

SCHOOL ECOLOGY PROJECT

Our first completed curriculum development project culminated in 1974 in the production of a school text, *Studies in School Ecology;* its originator and author is my colleague, Sylvia Parker. Is this book another example of a school textbook written by a single author, or can it be regarded as an end-product of a curriculum development study? The answer lies in applying to its origins and development certain criteria which can characterize a curriculum study. I will pose these criteria as questions.

Criterion 1. As an essential preliminary, has the context of the proposed change been examined? It is essential before getting down to the real business of designing a curriculum change to assess the market place, to find out as much as possible about the setting into which the curriculum change will be eventually introduced. The first of these contextual aspects is the origin of the mooted change. Is it the response to needs expressed by teachers, or is it something to be imposed upon teachers?

In our case the project came about in response to a professional call from the Biology Committee of the Ministry of Education. Ecology, although prescribed as a topic in current biology syllabuses, was in fact neglected by most biology teachers. The reasons for this were understandable. The ecological studies suggested by the examining boards were unnecessarily time-consuming, they were ecologically old-fashioned and offered little satisfaction or purpose, and they inspired students to write purely descriptive reports, sometimes adorned by rather spurious and glib association of cause and effect. If ecology was to be meaningfully taught in Rhodesian secondary schools, some examples of ecological investigations needed to be worked out which (a) had national relevance through reflecting the interests of local, practising ecologists and the methods that they were using; and (b) could be completed in the few weeks that biology teachers would be able to spare from their heavily committed time-table allowance. This was the daunting brief which was passed to Sylvia Parker. In accepting it was it necessary for her to explore further the needs of biology teachers? On the whole, No; for she knew already from her visits to schools and from science teachers' meetings that most biology teachers were dissatisfied with their teaching of ecology and sought assistance, although it was doubtful whether a consensus of opinion existed about how the situation could be improved. Accordingly, it was justifiable to go ahead and produce some tangible, provisional suggestions which subsequently, as we shall see, teachers could try out and comment upon, before they were put into print.

What other contextual aspects did Parker need to examine? Again probably, none in her case, because it could be said in positive terms that she knew the standards of competence of the teachers and their teaching styles; she was familiar with the target pupil population; she was acquainted with the content and rationale of the biology syllabuses and with the examin-

ing format; she was *au fait* with the range of technical facilities available in schools; she could safely assume favourable attitudes of parents, if only because most secondary school parents admit that what their children learn at school these days is quite beyond them! More generally, she was aware of the growing expression of concern by authoritative institutions in Rhodesia with the protection and utilization of the environment and of the positive climate this public concern created for any renewed study of ecology.

Criterion 2. Has the intent of the study been specified? Before the advent of modern curriculum development, curricular change was mainly brought about by modification of the prescribed examination syllabuses and by the issue of new textbooks. One of the hallmarks of modern curricular studies has been the formulation of aims and objectives of the mooted change with greater precision than that characteristically put forward by examiners and authors. Although examining boards are slowly improving on their poor record, we can note with some dismay that of 20 prescribed subject syllabuses studied by O-level candidates in Rhodesia, 17 set out content-to-be-learned only and give very little or no indication of the *purpose* of the course in history or whatever subject it may be.

Ralph Tyler, who can be regarded as the father of pupil-orientated behavioural objectives, said in 1949 (p.44):

> since the real purpose of education is not to have the instructor prepare certain activities but is to bring about significant changes in the students' patterns of behaviour, it becomes important to recognize that any statement of the objectives of the school should be a statement of change to take place in the students.

Tyler saw the need to state any desired change as precisely as possible in order to give directions to the development of that change and to provide a basis for its evaluation. Many curriculum studies have followed this advice. However, other workers such as Stenhouse (1975, pp.70-83) have argued that prior and detailed specification of aims and objectives and close observance of them can seriously restrict the creativity of the curriculum developers and that it can discourage re-statement of purpose in the light of experience. In fact, tightly worded prescriptions of intent may serve to deflect attention from the unexpected when the new proposals are introduced — and it is the unforeseen responses which are so often as important as those which have been anticipated or hoped for. As a consequence, there has been some move away from the formulation of detailed aims and objectives as an essential preliminary exercise to curriculum development.

I will not comment further on this debate, which runs high in curriculum development theory, except to say that our experience supports the cogency of the second viewpoint and that we would disagree with Tyler in his relegation of teachers' actions as of secondary importance. Apart from other obvious considerations, teachers hold a more lasting position in curriculum progress than do pupils; and, if behavioural objectives are to

be pre-specified at all, it would seem to be eminently desirable to direct them, as Stenhouse (1975, p.90) has suggested, to the behavioural responses of *teachers* as well as to pupils.

In Parker's case, as we have seen, her brief was a clear cut one. Rightly she made no attempt to refine this mandate into more specific aims and objectives until she had made herself familiar with Rhodesian ecological activity. In the final version of her text each chapter is prefaced by a short statement of intent.

Criterion 3. Has comprehensive considerattion been given to the means to achieve prescribed ends? The end-products of curriculum projects can cover a wide range, especially in science; there can be a text, a laboratory manual, specially designed apparatus, films, film strips, audio-tapes, worksheets, background readers, batteries of tests, a teachers' guide and an in-service programme for teachers. However, greater volume and range of curriculum project end-products do not necessarily bring about greater saleability in the school market-place, and there is no doubt that judicious selection of appropriate products is one of the necessary arts of curriculum development.

What did Parker do and what did she produce? First of all, as I have said, she made herself thoroughly acquainted with the wide range of ecological work going on in Rhodesia and with the ecological workers in Government departments and at the University of Rhodesia. The co-operation she received in this regard was unstinting, and was constantly reinforced and disciplined by the fact that her office-laboratory was housed in the complex of the University Division of Biological Sciences. As a result she not only gained a wide and up-to-date technical knowledge about natural resources, conservation, veld management, wild life and afforestation, but also a new understanding and a new commitment relating to the complexities of our Rhodesian eco-systems and their exploitation. Armed with this background, Parker now set about extracting what might be of value and practicable in the classroom. She eventually devised seven practical investigations which met the criteria that she had been given, and which between them were suitable for each level of secondary schooling from Form I to Form VI.

The aim of these investigations was to encourage teachers to use their available surroundings to purposeful ecological ends for their pupils, by having them practise techniques, obtain data and speculate on the meaning of the data, both biologically and from the national conservation point of view. The production of a comprehensive teachers' guide seemed to fit this particular bill and *Studies in School Ecology* does so in providing background information, practical suggestions, lists of required equipment, sample field worksheets, course outlines, discussion points, achievement testing questions and references. No apparatus kits have been prepared as all requirements are either readily available in schools or can be assembled there. No packages of slides, audio-tapes and films have been prepared. Their provision

would have conflicted with the very purpose of the investigations, namely, to gain first-hand information about a specific local site.

Criterion 4. Has the provisional form of the project been evaluated? A characteristic feature of modern curriculum studies has been the trying out of provisional new materials in schools. In the United States this has been conducted on a very extensive scale using hundreds of teachers and involving tens of thousands of pupils. In Britain school trials are now less extensive and place far less emphasis on measuring the learning gains of pupils. They are as much concerned with the interpretative imponderables I referred to earlier — with the analysis of teacher reaction, pupil reaction and their classroom interaction, and with the wider reaction of heads, administrators and parents. The implications of introducing curriculum change, it is argued, are not confined to, nor revealed by, pupils' scores on tests set to behavioural objectives. More 'illuminative', albeit less objective, evaluation must be made of a wider range of human responses to change.

Parker taught her provisional investigations in six different schools. Although she used no formal tests, questionnaires or checklists in these trials, she was able to identify the successful and unsuccessful aspects of the practical exercises and, more importantly, she gained evidence about the response of the pupils — what captured their interest, what difficulty they had in understanding, what sort of questions they asked, how long it took them to complete the exercises, and what were reasonable and effective questions to assess their understanding of the work. Thus she now had a better idea of the sort of information teachers would require to teach the investigations effectively. She taught all the classes herself and obtained only impressionistic observations from the school-trial teachers, so that the next step she took in her refinement and evaluation of her provisional schemes aimed to offset this omission. It was also a novel one, which could be undertaken readily only in a small country such as Rhodesia; she invited all the O and A-level biology teachers in the country to take part in a five-day practical workshop with the schemes she had devised. At this workshop teachers provided a great deal of constructive criticism and collectively declared that there was an acute need for the sorts of investigations which had been designed and for the general information backing them.

From the three inputs which I have described — that from the professional ecologist, that from the school trials and that from the teachers' workshop — *Studies in School Ecology* was compiled.

Criterion 5. Has the final form of the project been evaluated after its adoption by schools? Until a new curriculum plan has been adopted by schools its content has been artificial, however realistically the school trial stage has been managed. Even when it has been accepted by a school it will take several years before the staff teaching it will feel fully familiar with its

rationale and with the skills required of them. Accordingly, evaluation of the ecology enterprise and has a very different and more complex contextual setting, the essentials of which were and still are:
evaluation will have provided, at best, some assessment of its *potential* worth. No summative evaluation has been made of *Studies in School Ecology*. Five hundred copies have been sold, there is a demand for more and it has prompted amendment of the ecology section of a public examination syllabus. So far so good, but as curriculum developers we need to have answers to the following sort of questions:

(a) Where schools are not using the text, what are the reasons?
(b) Is the background information sufficient? Is it understood by the teachers? Are most teachers using it? Or are they merely teaching the practical investigations, without reference to the national implications? Do pupils read it? If so, should the style be changed?
(c) Is each of the seven practical investigations equally popular? If not, why not? What modifications have teachers made to them and which of them ought to be incorporated in the text?
(d) Have the examination questions changed in any way?
(e) Are more biology teachers teaching ecology than before? And are more biology candidates answering the ecology questions? (In the event these last two questions are not answerable as no comparable data were gathered in a pre-development survey.)

Thus we see that Parker's curriculum project in school ecology meets some of the criteria which can characterize curriculum studies. The fact that it does not measure up fully to all of them does not detract from its merit, nor is it surprising. The considerable variation in purpose, scale, nature and context of curriculum ventures forbids the application of a set formula, *in toto*, for operating and assessing every individual case.

AFRICAN PRIMARY SCIENCE PROJECT: ITS CONTEXT

Our engagement with African Primary Science began at the end of 1967 when the embryonic Science Education Centre was still enwombed in the Department of Education. It came about through a benefaction of some £25,000 from the Baird and Tatlock Company. This enabled us to appoint Mike Robson, who has been the chief designer of the programme since its inception.

The project has been concerned with developing a science course throughout the seven years of African primary schooling. The end-products of the study, a series of teachers' guides, *Discovery Science*, are now used in Grades 1-5 throughout the country. Work on a course for Grades 6 and 7 has been proceeding for two years but is now in abeyance, whilst decisions are being made regarding the possible amalgamation of science, history and geography in the primary school curriculum as environmental studies. As

such, this project is a much bigger undertaking than the secondary school ecology enterprise and has a very different and more complex contextual setting, the essentials of which were and still are:

1. *Science would be a new component of the primary school curriculum.* In 1967 science was represented in Rhodesian African primary schools by a rather bookish form of nature study in the upper two Grades only. Thus any course we proposed would not be replacing or extending something which was already part of the curriculum. Starting a subject course *do novo* has its disadvantages, but on the credit side no established teaching habits or attitudes have to be challenged.

2. *The vast majority of primary school teachers would have received no form of science tuition in their own schooling or professional training.* What little they might know about the subject would have been gained largely from hearsay from friends or relatives, who had attended secondary school, and, as a consequence, science might well be held in awe, or even as a frightening proposition to teach. Even worse, a very distorted and unfortunate image of the needs of primary science may have been acquired. Since 1967 the educational qualification of teachers entering African primary schools has much improved, but the bulk of teachers will have little, if any, background in science.

3. *Teachers and pupils would be members of a society more inclined, perhaps, than Western societies to attach theistic interpretations to many cause and effect relationships.* Their cultural beliefs would be less conducive to the questioning of authority through recognition of its dependence upon evidence and not so much upon the status of the person who voices it.

4. *The science course would be imposed.* During the period we were developing the courses it is doubtful whether any call had come from the classroom for the introduction of science into the primary school curriculum.

5. *Many teachers had not yet become familiar and confident with the 'new approach' to teaching* being vigorously inroduced by the Ministry of Education at the time. The keynote of this approach — and of our science course to be — was more purposeful child activity and less teacher exposition.

6. *The provision of equipment in schools would be limited.* In many parts of the country even items such as newspaper, offcuts of wood and string would be unavailable or difficult to obtain for reasons of cost. As a consequence, simplicity and improvisation of materials would be necessary. Even where it would not be a problem to supply everyday materials in sufficient quantities for activity by all the pupils in a class, teachers would be required, more than they had been before, to collect, construct and store items of equipment and to acquire the habit of planning well ahead of their lessons.

EVALUATING THE EFFECTIVENESS OF A TEACHERS' GUIDE

In the context that I have described, the role and response of the teacher to the introduction of a new science course is critical. To introduce any science course, of whatever merit, in this situation requires the authors of it to communicate to the teachers with the utmost clarity, but succinctly, the purpose, rationale and working details of the course. In the event our sole agent of communication was the series of teachers' guides, and so it was imperative that each of these guides should be an effective communicator.

In 1975 after the guides had been in use in schools for a few years an evaluative survey of them was conducted by the Ministry of Education in association with ourselves. Findings intimated that teachers in general approved the *Discovery Science* series for Grades 3 to 5, but found it difficult to understand (Robson, 1975, p.1). As one Education Officer wrote (pp.2-3): 'I am firmly of the opinion that there should be an objective survey to ascertain directly what part of the course teachers fully understand. Where more than say, 25 per cent do not understand, that topic should be re-written'. This was constructive criticism of the effectiveness of the teachers' guides, and interestingly enough, echoed an investigation I had already begun into the effectiveness of the Grade 3 guide.

Each of the guides for Grades 3-5 aims to provide pupils with opportunities to gain some knowledge and understanding of natural phenomena commonly found around them, through acting and thinking scientifically, i.e. through observing properties, classifying, measuring, asking questions, learning to ask useful questions, and quantifying (making histograms), etc. To support this scientific approach, the actual content is presented to the pupils not as a long list of isolated topics such as 'burning', 'food and its sources' and 'germination', but integrated under unifying themes of which the main ones are Properties, Change, Systems, Measurement, and Locations. This approach, which does not exclude the learning of facts and concepts, we borrowed from the Minnemast scheme for primary school mathematics and science produced at Minnesota University from 1964 onwards. We also incorporated their idea of reinforcing children's learning with story-telling.

From this brief description it will be seen that a teachers' guide had to communicate effectively in at least three ways, namely:

(a) in establishing and in distinguishing between the purpose of pupil activity, the facts which could be derived from a set of activities and the main idea or concept illustrated by the facts;
(b) in enabling the teacher to appreciate the scientific point of a story;
(c) in indicating to the teacher how to promote purposeful pupil activity, i.e. by not just providing and managing pupil activity, but by giving it educational productivity through the asking of thoughtful questions, through the use of pupils' questions to promote further activity and, on occasions, through the giving of hints rather than instructions.

To attempt to assess these three dimensions of effectiveness I had the co-operation of two teams of colleagues in the Faculty of Education to determine with me, independently and then collectively, the main ideas presented in the first five chapters of the Grade 3 teachers' guide, the points of the five related stories and the teaching skills which were operating in these chapters. The two teams then scrutinized the pencil-and-paper test items which I had constructed to assess effectiveness of communication in each of these three areas. The whole of this procedure was repeated with a team of six African teachers in Umtali.

This group activity was a necessary preparation to the compilation of a 'test' to be sent through the post to a number of teachers of Grade 3 classes for their completion and return. In reality the 'test' would be an assessment of the guide, *not* of the teacher: if the majority of the teachers failed to show an understanding of the point of a story, for example, it would not be their fault but the failure of the guide to communicate the point. My faith was that teachers would accept this argument, despite the fact that considerable apprehension is traditionally attached to the setting and sitting of tests in schools and that it is not usual, to say the least, to test (or appear to test) teachers. This faith was further stretched by the final form of the 'test' becoming nineteen pages in length (Gilbert, 1976a). It had three parts, each directed separately to the three aspects of communication described above.

Illustrative Test Questions

PART A: RECOGNITION OF MAIN IDEAS

For each chapter a set of ten statements was provided (seven examples are given below), Each statement had to be marked with a tick or cross to indicate whether or not it represented to the recipient a main idea — as opposed to an activity or fact.

1. Pupils to discover that different types of cloth have different amounts of roughness.
2. Pupils to discover that similar objects may have diffent amounts of the same property.
3. Pupils to learn how to heat things gently and safely.
4. Pupils to discover that a piece of ball-point pen changes its properties when heated.
5. Pupils to discover that some properties can change or can be changed.
6. Pupils to discover that milk and cabbage leaves go rotten if left in the open air.
7. Pupils to discover some properties can be changed permanently, others can be altered and then changed back again.

PART B: RECOGNITION OF SCIENTIFIC POINT OF A STORY

Story: Warthog and the Pumpkins

Which ONE of the following statements describes *best* the scientific point of the story for the children? Circle the capital letter of your choice.

A. Hare quickly showed Warthog how easy it was to sort ripe and unripe pumpkins.
B. Hare quickly showed Warthog that he had many more good pumpkins than he had bad ones.
C. Hare showed Warthog a quick way of seeing the quantity he had of good pumpkins and the quantity he had of bad pumpkins.

PART C: RECOGNITION OF APPROPRIATE ACTION IN A TEACHING SITUATION

Ten teaching situations, based on the lessons given in the guide, were posed. Teachers were required to select from a choice of responses that which they judged to be the best and the worst response. The teaching skill operating in the example given below is the ability to pose a question which appropriately consolidates the activity the pupils have been carrying out.

TEACHING SITUATION 4

Topic 3. Lesson 1. p.28. See paragraph in right-hand column headed *'DISCUSS'*

The boy/girl histograms have been made by all the groups. They have been coloured and they have been pinned up for all the children to see. As this is the *first* time pupils have made a histogram, the teacher wants the children to understand the sort of information which can be gained from these coloured histograms.

Teacher Response

The FIRST question the teacher asks the class is:

A. Which group has the least number of girls in it?
B. Is there a group with as many boys in it as there are girls?
C. Which group in the class has the largest total number of pupils in it?

BEST response A B C
WORST response A B C

In view of the length and demand of the test the quantitative response of teachers was surprisingly high. As Table I indicates, a large proportion not only completed the questions but also chose to volunteer comment and to request receipt of another copy of the 'test' with the adjudged correct answers.

Table I

QUANTITATIVE RESPONSE OF TEACHERS TO TEST OF EFFECTIVENESS OF GUIDE

Teachers		%	% Respondents	
Set	*N*	*Replying*	*Completing Open Page*	*Requesting Answers*
Y	150	77	60	NA
B	99	78	NA	98
B	113	60	71	94

The exercise was repeated with more than one group of teachers because it became evident from the first set of returns that distinction between the two concepts, 'a main idea and 'a fact' had not been made sufficently clear. Most teachers in the first group had hopefully ticked *all* the statements of the tests indicating 'main ideas'. By the introduction of two simple, illustrative Main Ideas Recognition tests, this practice of wholesale ticking was reduced in the completion of the substantive tests by subsequent groups from 60 to 20 per cent of the individuals responding. However a teacher was only deemed to have understood the demands of the Main Ideas Recognition test when he or she made not more than one mistake in each of the two illustrative tests. Such teachers are referred to as 'unconfused' respondents in Table II, which summarizes the results of the investigation. An arbitrary level of acceptable effectiveness in communication for each of the three aspects under consideration was taken to be: *50 per cent of the responding teachers achieving 50 per cent or more for the relevant test.*

Table II

EFFECTIVENESS OF TEACHERS' GUIDE
PERCENTAGE OF TEACHERS ACHIEVING 50 PER CENT OR MORE PER SECTION OF THE TEST

Section of Test	*Of Total Respondents (N=66)*	*Of 'Unconfused' Respondents (N=32)*	*Effectiveness of Guide*
Recognition of Main Ideas			
Chapter 1	NA	63	satisfactory
Chapter 2	NA	34	unsatisfactory
Chapter 3	NA	34	unsatisfactory
Chapter 4	NA	44	unsatisfactory
Chapter 5	NA	25	unsatisfactory
Recognition of point of stories	69	NA	satisfactory
Understanding of teaching skills	67	NA	satisfactory

This way of assessing the effectiveness of a teachers' guide is clearly subjective and, in this instance, involving a very small number of teachers. Nevertheless the approach must be viewed with the acceptance that an evaluator can rarely provide proof about any aspect of a curriculum study; he can only supply information with limited validity and reliability for decision makers to take into account as they think fit.

I have dwelt at some length on this method of assessing the effectiveness of a teachers' guide through the teacher understanding of key concepts and skills. I have done so because it seems to me that the making of such an assessment is a vitally necessary step to take in situations where the curriculum change makes particularly heavy and new intellectual demands on teachers. Of course, there is the rub, what is to be regarded as a particularly heavy and new intellectual demand? Perhaps they occur more often than we think, but resort to an evaluation technique which asks teachers to complete tests is a rare practice in curriculum development. I know of only two other cases. In 1974 B.L. Young required his school-trial teachers in the northern states of Nigeria to sit cognitive tests before and after using the provisional science materials he and his team were producing at Ahmadu Bello University. About the same time John Brooks, in Bombay, assessed the effectiveness of training workshops in raising the level of mathematical and scientific understanding of teachers called upon to teach a very much revised curriculum in these subjects. It is noticeable that these two cases of testing-through-teachers and our own have taken place in less developed national settings. Have curriculum developers in Britain, for example, regarded such an undertaking as unnecessary or unprofessional? In those cases where content revision has been marked, have they over-estimated the capabilities and enthusiasm of their target teachers? I have put these possibilities to the three organizers of the original Nuffield O-Level Science projects. All three — Professor W. H. Dowdeswell (biology), Frank Halliwell (chemistry) and John L. Lewis (physics) — have replied similarly to the effect that they had not over-estimated the qualities of their teachers, almost by definition, because they were all graduates. With due respect, I regard this assumption as dubious: degrees gained vary in nature, class and vintage. Rather than debate the point here, however, it is more profitable to take up a related one made by Dowdeswell in his reply. Having described the general beneficial influence the Nuffield Science project has had on science teaching in Britain during the past decade, he makes an important qualification:

> But the influence has been very largely in the area of the material taught, the kind of experiments used, the type of apparatus made available, facilities in laboratories, and all this kind of thing. Where we have been much less successful — indeed it is questionable whether we have achieved any success at all in certain areas — is in altering attitudes. Attitudes are very difficult things to change . . . They are part of human personality. It is very questionable whether you can change attitudes by writing something in a book,

the teachers' guide, for example. Attitudes tend to be transmitted from one person to another by human interaction. And this I think is where the big difficulty comes if in a curriculum project you were going to try to change attitudes, because you are faced with an enormous problem of human communication.

AFRICAN PRIMARY SCIENCE PROJECT: CONTEXT CONTINUED

This important matter of attitudes raised by Dosdeswell leads me to draw attention to another — the seventh — important contextual element influencing our primary science project. I refer to *the viewpoint that parents, heads, teachers and pupils — the community at large — have about the purpose of primary schooling.* This consideration presented itself when we were trying out our ideas at the Grade 6 level in 1975 in schools in the Chiota Reserve, south of Salisbury.

Our motives, proper ones I feel, were that young children should learn some useful scientific information and something of what it is to act and think scientifically by tackling some real-life problems, such as (a) what happens to the properties of sand and cement when mixed in different proportions and treated in different ways, and (b) which variety of tomatoes grows best in our school grounds? In the former investigation, children made small slabs of different mixtures of sand and cement, dried some slowly, some quickly and some under water and then tried to think of simple, standardized means of comparing 'hardness' or 'scratchability' and breakability. In the second investigation, we had teachers and pupils occupied for a term growing tomatoes of different strains under different conditions of trenching, manuring and spraying. In a few schools all went well — in hindsight remarkably well — but in most schools, after perhaps an initial start, excuses were now offered for failing to acquire materials or tools. There was an air of unreality about these excuses. One very blatant case was when we were told that no compost had been prepared for the tomato trials, as manure was difficult to obtain in the district. Robson and I had just driven through a veritable sea of cow dung right at the school gate.

The story behind all this eventually emerged. It had two themes: firstly, the community held firmly that the main purpose of primary schooling is to get their children at all costs into the F1 High Schools, i.e. passing the Grade 7 examination at a high level. Insofar as only a small percentage of Grade 7 leavers cross this hurdle, this strongly held viewpoint is fully understandable. Anything which obstructs this achievement will not be tolerated, so that it was regarded as quite immoral to waste children's time during formal nature study lessons in making bricks (as they thought) and in pursuing intensive horticulture (as they thought). Presumably the parents thought that such practices made inroads into their studies of 'Horses and Their Kind', 'Plants that Eat Insects', 'Swallows' and 'Milkweed' — to take some of the more exotic topics, presented in the nature study textbook — and reduced their chances of correctly answering a question which might be asked in the

Grade 7 public examination. Secondly we gained the hint that teaching what appeared to be 'building' and 'agriculture' in Grade 6 lessons was to offer the wrong sort of education: it smacked of training for second-class, menial careers. Both of these reactions showed clearly that Robson and I had been remarkably unintelligent in not foreseeing that they would arise, and for not going to greater lengths in explaining the true purpose of the two investigations to heads and teachers. It was a typical example of the disease to which curriculum developers can so easily succumb — an evangelical euphoria that causes the sufferer to imagine that all other teachers in his field are as fanatically enthusiastic about his subject interests as he is, and that they hold the same educational aims as he does.

From these experiences it was decided in 1976 that the approach to our development and school trial evaluation of our schemes must be put on a very different basis. In short, we needed to

(a) make some assessment of the acceptability of our provisional teaching units *before* the school trials took place;
(b) make greater efforts to gain the support of teachers and heads *before* beginning the school trials;
(c) formulate far more precisely the information we sought from the school trials.

This prescription we attempted to meet in the following ways.

Initial Evaluation. We contacted a sample of Grade 6 teachers and school supervisors by postal questionnaire to assess to what extent a change from nature study to a science course would be welcomed and, if so, what sort of science course. Within the severe constraints of this questionnaire, the response was just what we wanted! In essence, it was that a change would be welcomed which offered the child a better practical knowledge of familiar, natural and man-made phenomena (Gilbert, 1976b).

For some years Robson and I have had the benefit of the services of a Consultative Committee made up of senior members of the African Division of the Ministry of Education. This committee has not only given us invaluable advice about our provisional ideas and materials, but it has also advised on and supported our requests to the Secretary for African Education to hold school trials and for a teacher to be released to assist with the trials. I take this opportunity to express in public our deep appreciation of the professional and tangible support the Science Education Centre has consistently received since 1967 from this Division of the Ministry. We decided that this committee needed to be augmented by another made up of primary-school heads and teachers who would give us firsthand information and opinion about our proposals for the Grade 6 science course. This Advisory Committee, as it has been called, has also rendered invaluable service. Essentially we have been concerned with these questions: Is this teaching unit worth teaching? Is it within the grasp of the teacher? Is it within the grasp

of the pupils? Does it in any way run contrary to African customs or beliefs and is it feasible in terms of materials and time required? Our often heated, but always amicable, discussions have ranged from the acceptability of learning about sex organs, animal and human, in primary schools to the construction of a pupil's activity book which would usefully supplement lessons without becoming the be-all of the lesson in the teacher's eyes.

Prior support of all concerned. Before the school trials began we brought together all the teachers, heads and supervisors concerned, with senior members of the Division, to discuss what the school trials would entail, to meet any worries schools may have and above all, to foster a feeling that this was a corporate exercise in curriculum development.

Formative Evaluation. With our centre of interest on the teacher we devised an evaluation scheme which would focus upon four facets of the teacher during the school trials, namely, his attitudes (what was his general impression about a teaching unit initially on reading it and later after teaching it), his understanding of the material (more correctly, as underlined earlier, the effectiveness of the unit to impart understanding), his classroom response to the unit, and, finally, his criticism and suggestions. The scheme outlined in Table III indicates the method we introduced to these ends.

Table III

DISCOVERY SCIENCE, GRADE 6: EVALUATION SCHEME, 1976

Initial Evaluation	Advisory Committee Consultative Committee
Formative Evaluation	
Teacher Understanding	Main Ideas Recognition Test Cognitive Test
Teacher Acceptability	Teacher Ratings
Teacher Reaction	Teachers' Notes Post-teaching Discussion
Teacher Action	Field Assistant Reports
Pupil Understanding	Cognitive Test
Pupil Action	Field Assistant Reports

I will comment briefly on two of the methods that we employed. Firstly, with regard to the promotion of teacher understanding, I can report, with admiration once again, that all the trial teachers were prepared to complete cognitive tests before they taught the unit and afterwards. I would not pretend that they did this with alacrity and smiling faces, but not one of the twenty-one teachers missed the pre-teaching sessions or post-teaching sessions when these tests were given, despite the fact that after the first of such meetings had been held the news must have been passed around.

Secondly, it must be stressed that the job of a field assistant during school trials is a very exacting one. He has to be *fully* conversant with the rationale of the course which is being developed; in a situation such as ours where no science course has existed in schools previously and our proposals were relatively *avant garde,* this demand on the field assistant was virtually an impossible one. He had to be a diplomat and attempt, by his natural charm and tact, to dispel the feeling of the trial teachers that *they* were on trial. He had to be alert to the unexpected and he had to refrain from regarding any discrepancy in the classroom between the expected and the reality as being automatically detrimental to the teacher; accordingly he had to be alert to where the provisional teaching unit was deficient. All of the three primary school teachers who have been seconded to the project as field assistants have met these demands surprisingly well and have supplied perceptive information. However, I would not be honest if I did not say — with no criticism implied of them whatsoever — that their greatest contribution has been to foster the idea amongst the trial teachers (and further afield) that we, the curriculum developers, were genuinely attempting to fit the science course to the prevailing context, particularly to the teachers.

CURRICULUM PLANNING IN RHODESIA

But enough said of the production of courses and materials. I should like, in conclusion, to broaden my frame of reference from the level of curriculum designing to the level of curriculum planning and to comment briefly on its current position in Rhodesia.

Curriculum planning embraces curriculum designing and much more. It is concerned with the holistic view of the school curriculum; with what its educational purposes should be; with what disciplinary pattern it should have; with the contribution to the whole of its individual components; with the alerting of teachers, teacher trainers, supervisors, examiners and others of the various rationales emanating from these considerations and, above all, with the institution of measures to assist each of them to understand and practise the dictates of their particular responsibility within the overall curriculum rationale. Thus curriculum planning has two fronts : on the one hand it has a *productive front* which aims to activate and co-ordinate curriculum renewal and on the other, an *implementation front* aimed at narrowing the gap between the planned curriculum and the taught curriculum.

In Rhodesia levels of operation on these two fronts have been particularly marked in the field of African primary education. The Committee of Enquiry into African Primary Schooling which sat in 1974 put forward comprehensive guidelines for re-orientating and re-structuring the curriculum for this level of schooling at this stage of its development in this country. In its wake the Educational Development Unit was established in the African Division of the Ministry of Education and during the past three years it has carried out a remarkable set of curricular revisions which are being

disseminated to the teachers through a newly established and vigorously active force of 117 school supervisors. The entry qualification for primary-school teacher education has been raised from junior certificate to O-level and a more intellectually demanding training programme is to be introduced from the beginning of next year. One primary teachers' college has acquired associate status with the Institute of Education and as a consequence its successful candidates will receive the Certificate in Education of the University of Rhodesia. It is probable that in the near future other colleges, through the rapid internal re-adjustments they are making, will soon measure up to the requirements of associate status. All in all, these recent developments in African primary education illustrate a commendable example of concerted curriculum planning. There are other positive manifestations of the attention which is being given to curriculum planning in Rhodesia. A happy situation, indeed; however, I must voice the question — directed particularly to my educational colleagues within and outside the University — have we an *organizational structure* regarding curriculum planning which is sufficiently co-ordinated to meet the strident call for educational expansion and change which is imminent? *Ipso facto* are we operationally marshalled to determine with confidence the priorities of action in these regards?

The history of educational development has shown that expansion and change proceed hand in hand. Expansion involves the admission to schools of a wider range of talent which, in turn evokes curricular issues such as the need to broaden the variety of subject areas (academic and non-academic, if we must use the terms) and the introduction of streaming, setting or mixed ability classes. Slower academic streams — to pick on one issue — do not merely require a longer time to reach the same end point by the same means; they need different approaches. The nub of our problem, as it has been in all newly independent African countries, will be to reconcile the acute desire of politicians and the public at large for rapid educational development with the fact that sound educational change can be designed and truly effected only with time. Of these two aspects of the problem — curriculum design and curriculum implementation — the former, given money and personnel, is intrinsically easier to effect in a reasonably short time. The implementation aspect, which is the more fundamental because, as we have seen, it is concerned with the development of teachers' understanding and with re-orientating their attitudes, is far less conducive to being hastened. There is no instant method whereby teachers can be *told* what to do; they have to be *shown* and they have to *practise* new activities before using them in the classroom. Morever, there is a limit to the frequency and intensity of change that teachers can withstand.

The main bottleneck to true educational expansion will be the implementation of curriculum proposals through the teachers already in service. There is no slick formula for removing this bottleneck. So — to give a specific example of a curriculum planning issue facing us — would we advise that the problem could be best alleviated in the primary school sector through

the extension of the supervisor force, or by the creation of teachers' centres which have proved to be very effective agencies elsewhere in consolidating curriculum advancement, or through radio broadcasts which directly reinforce lessons as opposed to merely supplementing them? In the secondary school sector the most potent influence for good or ill on the curriculum and on teacher behaviour is the examination system. Are we satisfied that our examination system adequately reflects the aims of the curricula the country requires? Are we too subservient to what others offer? Although regular discussions take place between representatives of the two overseas boards examining in this country and members of the respective Divisions of the Ministry, how often has advantage been taken of the facility extended by all examining boards of presenting our own syllabus for approval, and even our own papers? Do we need an examination branch which not only administers public examinations but which, through the services of full-time professional officers, would also tackle more concertedly than it can at present the very exacting tasks of revising syllabuses and of scrutinizing the validity of papers set, both by local authorities and by overseas boards, in terms of locally prescribed aims and objectives?

Turning to the production front of curriculum planning, would we suggest that our school system should no longer continue to rely solely upon the endeavours of curriculum developers permanently appointed by and situated at head office or upon temporarily engaged groups selected by head office? What about teachers colleges? Should not they also aspire to be centres of curriculum innovation? I can imagine our redoubtable, one-time colleague, Professor Roger Bone, putting it: 'No teachers' college which does not dirty its hand at the coalface is worthy, by God, of associate status with my Institute!' Do we agree that the potential of teachers as curriculum innovators should not be overlooked? Elsewhere individuals and small groups, with encouragement and support from educational authorities, have produced materials well worthy of wider distribution. The Carribbean Mathematics Project is a notable example. The benefits accruing from such encouragement are considerable: a wider and more active interest is engendered in the curriculum itself and in its renewal; the inevitability of curriculum change in response to social change is emphasized and teachers come to review their role as not being to accept, to imitate and to conform but also to innovate, whether it be in their own classroom or with wider reference.

Curriculum planning is multifaceted and calls on a wide range of educational personnel. To be effected and effective it requires co-ordination. The establishment of the Schools Council in Britain is one witness of that need. I have briefly hinted that there may be a case for the advent of a Rhodesian Schools Council, as a national co-ordinating body of curriculum planning. In fact, there is an added urgency. It is more than probable that in the near future we shall have to be prepared to withstand the abundance of international aid for educational development. It has been shown to be a mixed blessing. As one of our external examiners has put it:

> Hell is proverbially paved with good intentions. Tropical Africa is littered with the debris of well-meant but badly conceived, externally identified and funded, educational projects. These projects founder because new governments are reluctant to look a gift horse in the mouth. But in their own interest they must. They must have the *organisation* [my emphasis], the clarity of purpose, and the determination to channel external aid into the projects they themselves have identified and not those identified for them from external agencies . . .

Vice-Chancellor, I have ventured far enough. I think it is appropriate that we began this discourse with a review of Sylvia Parker's curriculum development project. I say this because when we look at the whole canvas of curriculum planning we see that essentially it is concerned with a human eco-system which, like the veld around us, is a complex of interacting elements which can withstand only a limited pressure of imposed change before it rapidly and irretrievably deteriorates to our harm. Conversely, with the application of expertise and sensitivity it can be harnessed for our welfare. As such curriculum planning may well be styled educational ecology, and may we in Rhodesia in the formative years ahead be as conscious of its conservation as we are of our material natural resources.

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