Edited by Keith M. Lewin
with Janet S. Stuart

# Educational Innovation in Developing Countries

## Case-Studies of Changemakers

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# 3 Science Education as a Development Strategy in Nigeria: a Study of Kano State Science Secondary Schools

Abdalla Uba Adamu

## INTRODUCTION

The early 1960s and early 1970s witnessed massive science education reform activities aimed at a more utilitarian interpretation of science education for pupils in both developed and developing countries. Two basic strategies can be identified. The first, which was predominant, focused attention on the nature of the science curriculum. The second focused on improving teaching and learning in schools and other institutions without large-scale reform of materials. Reforms of the first type were carried out mainly as science teaching projects aimed at improving school science curricula through reform in content and methods of teaching.

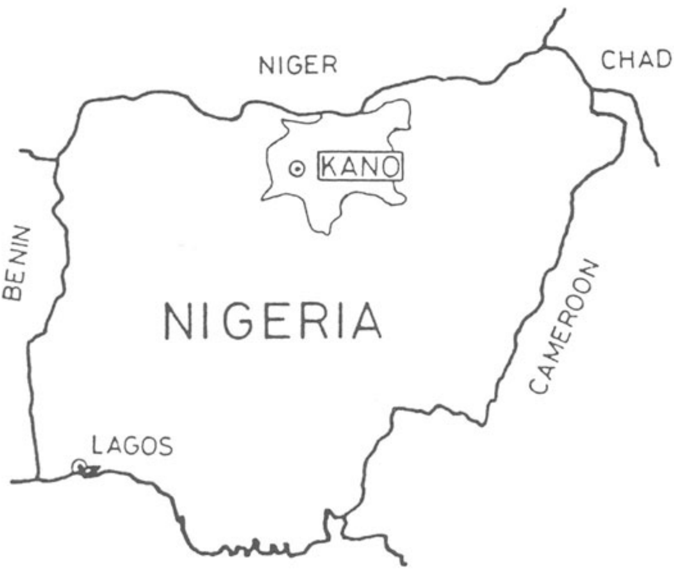
Such reforms occurred in both developed and developing countries such as Japan (Imahori 1980), Thailand (Sapianchai and Chewprececha 1984), Malaysia and Sri Lanka (Lewin 1980), Lebanon (Za'rour and Jirmanus 1977), Australia (Lucas 1972), Germany (Millar 1981), Holland (Hondebrink 1981), Malawi (Moss 1974), Nigeria (Ivowi 1982), and Canada (Ste-Marie 1982). However, the science education reform activities were not without their critics, who analysed the extent to which these reform activities did what they set out to do, and urged a clearer distinction between academic rhetoric and the socio-political realities of the project in action (Tisher *et al* 1972, Jackson 1983 and Lazerson *et al* 1984).

An added dimension to this strategy in both developed and developing countries (although more so in the latter), was an emphasis on an orientation to the labour market in some of the reforms, aimed at national self-reliance in scientific and technological disciplines through science education. This was inspired by the view that only a radical reform in science education could lead to national development and self-reliance (Bude 1980, Commissiong 1979, Knamiller 1984 and Maddock 1981a). Many school administrators and political leaders saw this as particularly important because it was expected that the students produced by these reforms would constitute a source of highly skilled manpower in science and technology, especially after having passed through higher education institutions.

The second science education reform strategy focused not on the science curriculum directly, but on the improvement of the conditions of schooling aimed at achieving similar goals to the project-based curricular reforms. This second approach, usually part of long-term educational planning, was aimed at the continuous production of school leavers with positive inclinations towards science as a subject of study, and consequently as a career. Examples of this category of science education efforts included the Turkish Science Lycée (Maybury 1975), the Philippines Science Education Center (now the Institute for Science and Mathematics Education) (Maddock 1981b), the Fitz-mat Preparatory Science School in the Soviet Union (Baez 1976), and the Kenya Science Teachers College (Gumo and Kann 1982).

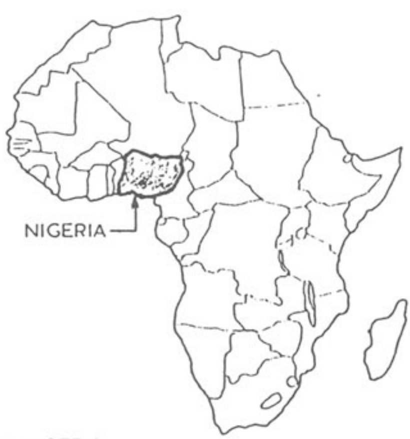
In Kano State, Nigeria, a science education development strategy belonging to this last category was introduced by the state government in September 1977. This was the Science Secondary Schools Project, created to offer science education to specially selected senior secondary school students (Grades 10–12) under different conditions from conventional senior secondary schools in the state. The main objective of establishing the Science Schools was to provide an educational framework where Kano State students with a high inclination and aptitude for science and technology disciplines could be developed into a large stock of skilled manpower for the effective social development of Kano State.

This chapter traces the development of the project from two perspectives. The first is the genesis of the Science Schools Project as an educational change strategy. In this respect the chapter investigates the rationale and mechanism behind the establishment of the Science Schools. The second focus analyses the implementation of the project with reference to the classroom dynamics in the schools. This provides the opportunity to investigate the institutional realities of the Science Schools and to examine the extent to which the Science




Map of NIGERIA showing KANO State

200 miles




Map of Africa with NIGERIA

Schools have contributed, or can be made to contribute, to the development of skilled indigenous manpower in science and technology for Kano State.

## Considerations of Method

The overall data collection procedures for the study were inspired by the illuminative research tradition as proposed by Parlett and Hamilton (1972). Illuminative evaluation as an approach to studying educational innovations is rooted in social anthropology and seeks to describe and interpret, rather than to measure and predict. It also takes into account the contexts in which educational innovations must operate. The approach is characterised by a process of three-phase progressive focusing.

In the first, exploratory, phase investigators observe the general process and become familiar with the context of the change in a fairly unstructured and open way. The second phase begins with the selection of a number of phenomena and themes associated with the change, which emerge from the perceptions of the actors and from their actions, for a more sustained, focused and intensive study. The third phase consists in seeking general principles underlying the organisation of the change process, by spotting patterns of cause and effect within its operation and placing individual findings within a broader explanatory context (Parlett and Hamilton 1972).

In general terms therefore the defining features of the illuminative approach are to study the innovatory project; how it operates, how it is influenced by the various school situations in which it is applied, what those directly concerned regard as its advantages and disadvantages, and how students' intellectual tasks and academic experiences are most affected. It also hopes to discover and document what it is like to be participating in the scheme, whether as a teacher or pupil, and in addition to discern and discuss the innovation's most significant features. Thus the illuminative approach seeks to inform those with an interest in the innovation and assist those who have to make decisions about it.

The basic limitation associated with the illuminative approach is the subjectivity imposed by its interpretative nature. The interpretative paradigm of analysis, according to Burrell and Morgan (1979) is informed by a concern to understand the world as it is, to understand the fundamental nature of the social world at the level of subjective experience. It seeks explanation within the realm of individual consciousness and subjectivity, within the frame of reference of the participant as opposed to the observer of the action.

Thus lack of objectivity – or more appropriately, predominance of subjectivity – and assumed potential research bias are the main weaknesses of this approach. Some researchers who have used this approach, especially in evaluating science education programmes, have attempted to rationalise the process by introducing what they see as 'objective' elements in their strategies in order to balance out the subjectivity of the approach. For instance, Boud *et al.* (1985) used this tactic in an evaluation of the Western Australian Physical Science course. In explaining their analytical approach, they stated:

> Although attracted by this novel and different approach [of illuminative evaluation], we were reluctant to eschew elements of the established, traditional positivist methodologies. We were also acutely conscious of the possible charge of subjectivity, which is frequently leveled at interpretative research and from the very inception of the project took a number of steps to counteract this possibility. We tended, for example, to validate our impressions and observations by the collection of quantitative data if appropriate. Visits to schools were made on rotational basis by each of us in turn, major interviews were undertaken by two of us together. (Boud *et al.* 1985:88)

Further steps taken include separate preparation of field notes on observations, interviews and perceptions so that they can be cross-checked. A basic flaw in all these precautions is the implicit assumption that objectivity is evidenced by masses of quantitative data. In any event, subjectivity does not imply lack of empirically verifiable evidence. Subjective insights often capture the essence of different people speaking with different views. Moreover, some projects can be more effectively analysed from a subjective perspective, rather than from a standpoint which distances the researcher from the mechanism of the process.

Nevertheless, due to its flexibility, the illuminative approach can incorporate a wide range of techniques, which provide a powerful tool in conducting any enquiry with significant emphasis on social dimensions.

Using this framework, data for this study was obtained during seven months' fieldwork in Kano State, Nigeria, during which four schools – two Science Schools and two non-science – formed the main focus of the study. Structured classroom observations in these four schools, and interviews with science teachers, school administrators and policy initiators of the project all contributed to providing primary insights into the development of the project (see Adamu 1988).

## THE GENESIS OF THE SCIENCE SCHOOLS PROJECT

Kano State was created in 1968 out of the then Northern Region of Nigeria. With a population of 10 million (Kano State 1981), of which 97 per cent were Muslim (Kano State 1970), the state emerged as the most populous and one of the most Islamic in Nigeria. However, the creation of the new state in 1968 was not without some problems for the state administration, because Kano State lacked the indigenous (that is, of Kano State origin) expert scientific and technical manpower considered essential for social development.

This situation arose because modern schooling, as the main agency for manpower training in Kano, was still to gain wide acceptance among the populace. This was caused by historical antecedents which linked the development of modern education in Nigeria with Christian missionary activities (Williams 1960, Graham 1966). Education therefore was viewed with suspicion as a forum for conversion to Christianity in a predominantly Islamic society (Kano State 1976, 1983). From 1968 to 1978 two successive Kano State governments had tried all sorts of strategies to ameliorate the situation. These included the provision of generous scholarship facilities for any student from Kano State to study any discipline of their choice, virtually free education at all levels of education, and even open threats of incarceration if parents did not allow their children to go to school. But despite these measures, the eventual educational output – both in its quantity and quality – was far less than that which the state government wanted, especially in scientific and technological disciplines.

This was the situation in Kano when the oil boom era exploded in Nigeria in the early 1970s, which saw the initiation of massive projects, based on the new-found wealth and aimed at the rapid social transformation of Nigerian society. The Kano State government, as part of this process, launched a very ambitious development plan in 1971. The strongest feature of this plan was its attention to agriculture and industrial development. As stated in the introduction to the Plan:

> It is a farmers' plan; and this is as it should be considering the fact that agriculture is the backbone of Kano State economy. . . . But, while agriculture is given due priority, it is realized that industry is the hope for the future considering the density of population and the natural limitation of horizontal expansion in agriculture. . . . Industry is therefore given equal priority with agriculture in the belief that only balanced growth could serve our desired economic and social objectives. (Kano State 1971:4)

The responsibility for the implementation of the development Plan was given to the Kano State Ministry of Economic Planning. However, the major obstacle – or 'bottleneck' – to these ambitious plans was expert manpower, especially in the scientific and technological fields necessary to guide the implementation of these projects. With the vibrant Nigerian economy of the early to late 1970s, the Kano State Civil Service Commission could afford to recruit the required manpower from overseas, but the government was also aware such manpower could not be relied on to remain for a long period.

To compound the situation, local personnel (especially those from Kano State) that could be relied on to stay on a permanent basis were not available either in the number required or in the necessary disciplines. This is reflected in the overall manpower situation in Kano State at that time, shown in Table 3.1, which reveals a shortage of indigenous manpower in all fields necessary for social and economic development in Kano State since its creation in 1968.

What was politically disturbing to Kano State policy makers at the time was the awareness of the vulnerability of the various development projects in Kano, should all the expatriates and other Nigerians decide to withdraw their services for whatever reason – as did indeed happen during the Nigerian Civil War (1966–70).

This situation was complemented by the general feeling among government officials in Kano that schooling was not functioning in a way which matched the hopes for social and economic development. As a Kano State Government document stated in referring to the situation in the 1970s:

> The acute shortage of manpower in Kano State results largely from the lack of the right kind of educational facilities. In most of our secondary schools, the available science teaching facilities, laboratories, equipment, materials compared against actual school requirements are far too inadequate. In almost all secondary schools

TABLE 3.1 *Kano State manpower strength in science and technological disciplines, 1968–71*

| | 1968/69 | | | | 1969/70 | | | | 1970/71 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Occupation | KI | ON | NN | TOT | KI | ON | NN | TOT | KI | ON | NN | TOT |
| Doctors | 3 | – | 22 | 25 | 3 | – | 28 | 31 | 5 | 1 | 29 | 35 |
| Pharmacists | 5 | 6 | – | 11 | 5 | 6 | – | 11 | 7 | 8 | – | 15 |
| Architects | – | 1 | 3 | 4 | – | 1 | 3 | 4 | – | 1 | 8 | 9 |
| Surveyors | 1 | – | 2 | 3 | – | – | 1 | 1 | – | – | 3 | 3 |
| *Engineers* | | | | | | | | | | | | |
| Civil | 1 | – | 5 | 6 | 1 | 8 | – | 9 | – | 2 | 13 | 15 |
| Water | – | – | 4 | 4 | – | – | 2 | 2 | – | 2 | 10 | 12 |
| Electrical/ Mechanical | – | – | 4 | 4 | – | 1 | 4 | 5 | – | 2 | 5 | 7 |
| Irrigation | – | – | 1 | 1 | – | – | 1 | 1 | – | – | 6 | 6 |
| Agric. | – | 1 | – | 1 | – | 1 | – | 1 | – | 1 | – | 1 |
| *Agriculture* | | | | | | | | | | | | |
| Vet. officers | – | – | 2 | 2 | – | – | 3 | 3 | 2 | 1 | 4 | 7 |
| Animal husbandry | 1 | – | – | 1 | 3 | – | – | 3 | 3 | 1 | – | 4 |
| Agric. officers | 1 | 1 | 3 | 5 | 5 | 2 | 2 | 9 | 8 | 2 | 3 | 13 |
| Pest control | – | 3 | 1 | 4 | 1 | 3 | 1 | 5 | 1 | 3 | 1 | 5 |
| Total | 12 | 12 | 47 | 71 | 18 | 22 | 45 | 85 | 26 | 24 | 82 | 132 |

KI = Kano indigenes
ON = other Nigerians
NN = non-Nigerians
TOT = Total
SOURCE Kano State 1970.

> there is a general shortage of qualified science teachers. The students going into secondary schools do not appear to appreciate the career prospects of personnel with the needed science qualifications. (Kano State 1979:138)

It was under these circumstances that a new military government came to power in Nigeria in 1975. One of the first acts of the newly appointed governor of Kano State was the reorganisation of the Kano State civil service. But because of the importance of the Ministry of Economic Planning in the implementation of the various projects in the state, its functions were further widened to include a ministerial committee called the Manpower Development Committee (MDC).

In the few months immediately after its establishment, this Committee concentrated on monitoring the implementation of the various development projects that had been started. During the meetings of the Committee in late 1975, it eventually emerged that in every project there was a conspicuous lack of scientific and technical manpower, especially from Kano State. The agenda of the Committee began to focus on this problem by attempting to determine the most viable strategy for producing more technical manpower from Kano on a long-term basis, to provide leadership for such projects as might arise in the future. During one of their meetings, as the then Chairman of the Committee recalled:

> A member of the Committee just suggested that one of the best ways of dealing with this kind of situation potentially is to set up a Science Secondary School which will be a specialist school with nothing but concentration in science training . . . so that instead of dissipating all resources in all the secondary schools, we would have a concentration of science students. (Interview 7/1/87)

Based on this rather spontaneous suggestion during a meeting, the Committee arrived at the tentative consensus that extensive and specialist schooling in secondary science education, which would be structurally different from the existing conventional schooling in Kano State, was the most viable solution to the problem of manpower development, although the Committee was not exactly sure what form it would finally take.

In arriving at the decision to propose the establishment of the Science Schools as a longer-term scheme for manpower production, the strategy set a precedent in that it was the first of its kind in Nigeria. But interestingly, the Science Schools emerged not out of professional dissatisfaction with the science curriculum – which was a major reason for the large-scale science education reforms in many other countries in the 1960s – or the way it was taught, but with the political need to increase the output of students with extensive science backgrounds from Kano State. As the Chairman of the Committee further explained:

> Many of us in the [Manpower Development Committee] were not science graduates. We were simple teachers of Arts and so on. Our main interest was to provide a situation where you give yourself the chance to select the best students that are endowed in science and develop that so that they could now perform better than they used to. The idea of being dissatisfied with the teaching of science at that time was not in anybody's mind. We were only dissatisfied with the

> performance ... we didn't bother ourselves even to look at the [teaching methods, equipment or syllabuses] because we were not experts. Our expertise is only in provisions. (Interview 7/1/87)

But this unorthodox origin of a major science education change strategy was not totally surprising since the decisions to establish the project were made not at the Ministry of Education, but at the Ministry of Economic Planning, which gave the project a different focus from those of the general science curriculum reform movements. Thus the Science Schools Project was determined directly by economic and political pressures, rather than by academic learning priorities. And although similar pressures contributed to the first generation science education reform activities in the United States (Harms and Yager 1981) and England (Waring 1979), nevertheless a significant focus of such science education activities in these countries, which provided models for the rest of the world, was on a radical reinterpretation of science teaching and its effects on the general development of the learner (Dowdeswell 1967, Gatewood and Obourn 1963, Goodlad *et al* 1966, Kelly 1963).

But although the Kano State Manpower Development Committee (MDC) had arrived at the decision that specialist training facilities were needed in Kano to produce the quantity and quality of scientific manpower needed, the Ministry of Economic Planning was not responsible for education or training. That was the responsibility of the Kano State Ministry of Education. As the next step, in early 1976 the Ministry of Economic Planning sent a memorandum to the Ministry of Education stating the recommendations of the MDC that scientific manpower training and production in Kano should be carried out by establishing Science Secondary Schools. The memorandum was discussed at a professional level at the Ministry of Education and, according to the Chairman of the MDC:

> they came back and said they were not interested. In fact they were kind of saying well this is not your business: this is our business and we know what we are doing. So the idea almost died at that time. (CTV 21/2/1986; also Interview 7/1/1987)[1]

And because the Ministry of Education had indicated its nonwillingness to consider the proposals establishing the Science Schools, and since there was no other mechanism for implementing the idea, that would effectively have been the end of the project in Kano.

It was at this point that other, more arcane and little understood aspects of educational innovations, not often included in theoretical models of educational reform, began to have their influence on the development of the Science Schools, providing further insights into the mechanism of educational policy evolution in Nigeria.

The events were as follows: in April 1976 the Commissioner for Education in Kano resigned. The Military Governor of the State then appointed the Commissioner for the Ministry of Economic Planning, who was incidentally also the Chairman of the Manpower Development Committee, as the new – at first acting – Commissioner for Education. As he recalled:

> So from April/May 1976 I was holding these two responsibilities [Education and Economic Development, although later he moved completely to Education], and of course the initial memo that I sent to the Ministry of Education [about the Science Secondary Schools] which was almost killed, was resuscitated at that time for me. But I discovered at that time there was a lot of opposition, both in the Ministry [of Education] and in the Kano State Executive Council because people were arguing that that kind of idea was not for us here. They said it was a elitist kind of thing. What we needed to do, they said, was actually to improve science in all the secondary schools. (CTV 21/2/1986)

But this rationale was not acceptable to those who supported the establishment of the Science Schools. As the new Commissioner for Education further recalled:

> The argument was of course weak. I said things were extremely limited. The science teachers that you can find now are of course not available. It would be impossible for us to man all the secondary schools, provide excellent equipment in science and excellent teachers. (CTV 21/2/1986)

But now having total executive control over the Ministry of Education, it became possible for the new Commissioner to present his proposals for the establishment of the Science Secondary schools at the Kano State Executive Council meeting. Before presenting the idea, however, he wrote to the major universities in Nigeria with the proposal for their assessment and comments. As he further recalled: 'We had to go to Universities, get professors to examine it and tell us what they thought about the system. They were in favour of it' (CTV 21/2/1986). Even though the proposal was now firmly a Ministry of

Education concern, this remained the only time an attempt was made to gain an academic assessment of the project. And when the necessary and favourable comments were received, the proposal was placed on the agenda of the Kano State Executive Council meeting in late 1976. But it was not easy to get it accepted because of strong, and anticipated, opposition from the Executive Council generally, and the Ministry of Education in particular. This was all the stronger because of the nature of the proposal concerning the Science Schools.

There were four main points of the proposal. Firstly, a new body called the Science Secondary Schools Management Board would be created to implement the project, and it would be independent of the Ministry of Education in most aspects of its operations. As the then Commissioner for Education rationalised:

> In order to avoid the problems of the Ministry of Education, the government bureaucracy, and to give the scheme the best chance of success, we said the best way is to take it out of the system. Not to operate it within the Ministry of Education, but to create a parastatal that would be independent of the Civil Service and the bureaucracy of the Ministry of Education ... We realized we couldn't get the best teachers, the best equipment under those conditions of the Ministry of Education. (Interview 7/1/1987)

However, financial control of the Board would be under the Commissioner for Education, who would have to approve its estimates before submitting them to the Ministry of Finance. To provide a legal backing to this Board, a Science Secondary Schools Management Board Edict was to be promulgated with effect from 1 January 1977. The Science Schools Management Board was to be controlled by its members which would include an Executive Secretary and Chairman.

Incidentally, the choice of the first members of the Board demonstrates the powerful effect of fellowship network interactions on the development and maintenance of the policy in Kano. As the new Commissioner for Education further stated:

> The first Chairman [of the Board] was Dr Sadiq Wali [a medical doctor], a science person, Dr Abdullahi [a mechanical engineer] who was a Commissioner later was also a member, and that had good repercussions later, because during the political days [1979–1983] the idea would have been killed again, if not for the fact that we had these people who had become Commissioners in the State. (CTV 22/2/1986)

Secondly, the Ministry of Education was to provide three secondary schools which would be converted into Science Schools. Two of these schools would be for boys and one for girls. All the schools should have boarding facilities. This was to provide the students with full opportunities for concentrating on academic work under structured supervision. The Ministry of Education would also, in future, have to release any school the Science Board might wish to take over for the purposes of conversion into a Science School as part of their expansion.

Thirdly, the Science School students would be drawn from academically excellent students selected from the Form II cohort of all secondary schools in Kano, after a selection examination. This meant the Science Schools, starting with Form III, would be Senior Secondary Schools under the newly envisaged National Policy on Education (Federal Republic of Nigeria 1981) which split secondary education in two tiers of Junior and Senior Schools, each of three years duration. At the end of the Senior years, the students would take the General Certificate of Education Ordinary Level examinations (replaced in 1990 by the Senior Secondary School Certificate Examination).

In the initial stage, each of the Science Schools was expected to have 720 students when fully operational, with 240 students in each of the three years. The proposal further stipulated the teacher-student ratio should be 1 teacher per 20 students (instead of 1 teacher per 35 students as in conventional schools). And subsequently, each of the Science Schools should have eight laboratories (instead of the three for the main science subjects available in conventional secondary schools), two each for biology, chemistry and physics, and in the boys' schools a technical drawing studio and a geography room.

Finally, each student would have to offer the following subjects only: biology, chemistry, physics, mathematics, English, geography, Hausa language or Islamic religious knowledge, and for girls, food and nutrition. Boys would take one elective chosen from technical drawing, further mathematics, or agricultural science. Interestingly, it was this rigid curricular offering that would characterise, in the main, the Science Schools.

The Kano State Executive Council accepted this proposal with all its attendant conditions, but persistent opposition was quite strong, mainly from the Ministry of Education. The latter, hitherto the sole educational power in Kano State associated with restrictive and conservative tendencies, saw its power base being eroded by the

Science Board over which it had no immediate control. The first Executive Secretary of the Science Board (1976–78), analysed the nature of this opposition as follows:

> All the opposition we had in the Ministry of Education at that time – and there was very very strong opposition – was surprisingly from people who should not oppose the idea of Science Secondary Schools at all. Their opposition, I am sure, had nothing to do with science being anti-Islamic. I think the opposition was primarily because they think we were trying to hijack some bright students from their schools and putting them in these prestigious schools – schools that one of us called elitist because he said we were only going to put the sons of who and who in the schools. This, when I know very well they themselves represent elitism in this country!
> (Interview 22/2/1987)

Despite the opposition to the concept, the Military Governor of Kano State accepted the proposals to establish the Science Schools. As he announced in April 1977 during a policy broadcast to the State:

> Two existing secondary schools have already been converted to schools of science. These schools will emphasise science in their curriculum so as to enable us to compete in gaining university places in the field of science in which we are very deficient.
> (Kano State 1977:4)

**The Establishment and Functions of the Board**

Based on the recommendations of the Kano State Executive Council, the Science Secondary Schools Management Board was established in March 1977 by the Kano State Government. The Science Secondary Schools Management Board Edict was published in January 1977 (but it later became the Science and Technical Schools Board Law in 1982 [Kano State 1982]), and the Science Schools started operations in September 1977. Once the Science Board was established as an administrative organisation, its objectives became much more clearly formed. According to an internal communication of the Science Board dated 5 April 1984, the Board is vested with:

> the responsibility for providing science education at secondary level, with the following hopes and aspirations in mind:
> (a) that more secondary school leavers with science backgrounds will eventually be produced;

(b) that the majority of those so produced will proceed to higher institutions of learning;
(c) that in the long run, a crop of high level manpower (doctors and engineers) will be available;
(d) that the expected insignificant few that might not necessarily be doctors and engineers might find themselves in the polytechnics for HND/OND courses in: (i) engineering (civil and mechanical); (ii) agro-allied, food technology and lab technology fields; health and nursing care.

It is significant to note the nature of the expectations placed on the Science Schools by the Kano State Government. These objectives must be kept in mind when analysing the development and outcomes of the Science Schools Project in Kano, as they become the criteria against which the outcomes are judged.

## The Science Secondary Schools

*(a) Initial preparations*
The first two boys' schools selected for conversion into Science Schools were the secondary schools at Dawakin Kudu (originally established in 1975), and Dawakin Tofa (1972). Each of these schools was well built and located in a pleasant rural pasture land. The Dawakin Kudu School was also relatively new at the time (1977) and built with financial assistance from the United Nations Development Project. But most significantly, both were exactly the same short distance away from the Kano metropolitan area (32 kilometres). This was important to the planners of the Science Schools Project because they did not want to locate the schools too far from Kano which would make them unattractive places to work for teachers, especially expatriate staff. As the first Executive Secretary of the Science Board explained:

> The two schools (Dawakin Kudu and Dawakin Tofa) were selected because we wanted schools that were very close to Kano, where we can literally leave the office now and get there within the next twenty minutes. And we needed centres where you can put international staff without them having to worry about coming to Kano. We also needed easy access to Kano because we thought if our laboratories could not operate we bring our staff and students to laboratories in Bayero University [in Kano] – because we were not prepared to allow anything to stop us from operating.
> (Interview 22/2/1987)

*(b) The Students*

There was no area in the establishment of the Science Schools in Kano that created more controversy with both principals and civil servants than the selection of the students for the Science Schools. Under the standard procedure, students considered academically good in Form II in all secondary schools in Kano owned by the Ministry of Education were given a selection examination and those who passed taken to the Science Schools where they continued with Form III.

The selection examination papers were in integrated science, mathematics and English language. A student had to pass each at a level determined by the Science Board to be eligible for interviews, after which if successful they were placed in one of the Science Schools. Not all the principals of the conventional schools were happy with this selection. As the principal of a feeder school explained:

> Believe me, not me alone but many people, the teachers, you see are grumbling that the best students have been taken away and as such nobody should blame us for having very bad students. There is nothing we can do about this. This is a government project and they can do whatever they want. (Interview 30/9/1986)

The possibility that the selection process could be influenced in favour of certain socio-politically powerful groups in Kano was raised with the officials of the Science Board. However, it was made clear that selection of students to the schools was based purely on merit and passing the examination. As the principal of one of the Science Schools explained:

> The criteria in selecting the students for this school is not based on any social class. Rather it is strictly based on merit, and therefore any averagely intelligent student, no matter his background, can be able to come here if he satisfies those criteria. And certainly, we have an aggregate of students from all sorts of backgrounds.
> (Interview 8/10/1986)

After the initial selection exercise in 1977, the first set of 240 students was selected from 22 secondary schools in Kano. A total of 120 students were sent to (each of) the (then only) two Science Schools in existence in September 1977. Subsequently, however, some of the principals in the feeder schools responded to the situation by presenting for the selection examinations their poorer, instead of their above average students. But the Science Board discovered this quickly, as a principal of a conventional secondary school explained:

> We cannot even substitute bad students for good students during the selection. These people come from the Science Board and they try to examine the files of my students and they may like to see my students physically. We have to be honest in this. The question of my opinion (as a principal) does not arise because nobody will ask for my opinion: do I like it or not? No, nobody will ask me ... Then there are many students who would like to go to these schools because they feel that the science secondary school is better than any school in which they are. (Interview 30/9/1986)

The principals of the feeder schools argued against the Science Schools on the main point that they take away their best students. Further, if it is true the Science Schools are special in the sense of having better equipment and teachers and other facilities, then it makes more sense to select not the best students from the feeder schools who, if they are good anyway would succeed no matter where they are, but to take students who are less than average, but very likely with latent abilities in science and allow the good environment of the Science Schools to develop them. In this way, the conventional schools will develop their good students, and the Science Schools will enable students with latent abilities in science to manifest themselves to the benefit of everyone. But the Chairman of the MDC did not agree with these arguments and pointed out:

> The system was not supposed to drain the schools of the best students. We are concerned with the students with a natural endowment in science. The teachers should not be feeling they have lost their best students unless you are saying only science students are the best. But of course that is not so.
> (Interview 7/1/1987)

But all these issues reflect the various stages any education reform policy undergoes before it becomes part of accepted tradition, especially if it had unorthodox origins. And despite the uncertain start, the Science Schools Project gradually stabilised, and in 1980, the first Ordinary level examinations in the school were taken. In 1981, a Girls' Science School was eventually established, even though there was initial opposition to it from the Kano State Ministry of Education. In 1985, another boys' school at Kafin Hausa was also started, while in 1987 a second Girls' Science School was opened in Jahun, bringing to five the total number of Science Schools in Kano in 1987, with a combined student population of over 3000 science students – the highest number of such a category of students since the establishment of modern schools in Kano in 1927.

## IMPLEMENTATION OF THE PROJECT: OBSERVATIONS OF CLASSROOM STRATEGIES IN THE SCIENCE SCHOOLS

To determine how aspects of the Science Schools Project were being implemented, I undertook a seven-month period of fieldwork which included studying two of the Science Schools (a boys' school and a girls' school) during which a substantial period of time was spent in structured classroom observations of biology and physics teachers. The observations were deemed necessary to the design of the main research because in the analysis of the antecedent factors that led to the development of the Science Schools, the specific academic emphasis of the Science Schools was one area where purposes and intentions were less clear than in the policy formulation of the entire project as described above.

For all the elaborate steps taken to ensure the survival of the project, neither opponents nor supporters based their arguments on a careful consideration of the science curriculum. And since no specific science curricular modules or packages were developed for the new Science Schools in 1977, they simply adopted the Nigerian science curriculum which, interestingly enough, was already under criticism as being inadequate to the aspirations of the contemporary Nigerian society (Ivowi 1982).

However, in September 1985 the federal government introduced a new science curriculum in all Senior Secondary Schools (NERC 1985) which contained similar themes to the predominant science curricular reforms in other countries, emphasising science as a process rather than content. With the implementation of the new science curriculum, the Science Schools assumed the unique property of combining two science education change strategies in one place.

My classroom observations therefore provided an opportunity to determine the extent to which carefully selected teachers (with high science qualifications), and equally carefully selected students (who had passed rigorous science aptitude examinations) interact with specialist provisions (given high priority by government policy) to create a medium for the successful interpretation of science learning objectives. Part of the results of these observations are summarised in Table 3.2.

TABLE 3.2 *Science teaching in Kano State science secondary schools*

| *Category* | | *Freq.* | *Minutes* | *Percentage* |
|---|---|---|---|---|
| 1 | Settling down | 31 | 155 | 11.7 |
| 2 | Teacher talks and | | | |
| | introduces topic, | 25 | 125 | 9.4 |
| | reviews topic, | 21 | 105 | 7.9 |
| | expands explanation of topic | 189 | 945 | 71.5 |
| 3 | Students ask questions | 1 | 5 | 0.3 |
| 4 | Teacher asks questions | 13 | 65 | 4.9 |
| 5 | Teacher refers to text | 0 | 0 | 0.0 |
| 6 | Teacher writes on board | | | |
| | for students to copy | 37 | 185 | 14.0 |
| 7 | Teacher demonstrates activity | 5 | 25 | 1.8 |
| 8 | Students carry out activity | 5 | 25 | 1.8 |
| 9 | Class discussion of activity | 0 | 0 | 0.0 |

It is interesting to note the teachers' emphasis during science teaching in the Science Schools. This is because the new science curriculum clearly expects teachers to teach science using the 'process' approach which inspired its development. For instance, in the introduction to the biology curriculum, it was urged by its developers:

> In accordance with the stated objectives, the contents and context of the syllabus places emphasis on field studies, guided discovery, laboratory techniques and skills, coupled with conceptual thinking. So teachers are strongly encouraged to employ the student-activity [method] based on an inquiry mode of teaching.
>
> (NERC 1985 Biology:ii)

Yet an analysis of the distribution of the performance objectives in the three science subjects of the new Nigerian science curriculum reveals that 90 per cent of the performance objectives were stated so as to test the cognitive domain, with only 10 per cent aimed at testing the psychomotor domain. None were stated in the affective domain (Adamu 1988).

Thus with a predominant emphasis on the cognitive domain in the science curriculum, it is not surprising that, despite the curricular rhetoric, teachers spend over 85 per cent of biology and physics teaching in predominantly verbal exposition. Student involvement accounted for less than 2 per cent of the student-teacher interactions (as indicated in Table 3.2). This is similar to the findings by Lewin (1981, 1984) of science teaching in Malaysia and Sri Lanka who observed that:

> Less than 16 per cent of the class time was spent with pupils actually undertaking experimentation as the main activity. Most class time – over 32 per cent – was spent with the teacher addressing the class as a whole ... Further analysis of the observation data indicated that the 'guided discovery' approach recommended in course materials was used by very few teachers. For example, on no occasion were pupils observed contributing to the design of experiments, and they were rarely asked to hypothesise, predict, interpret or infer. (Lewin 1984:40)

From both the strategic emphases of the teachers during the lessons in the Science Schools, and the opinions expressed, it was clear that not all teachers shared the same pedagogical views of science teaching objectives as those of the developers of the new science curriculum. As one teacher expressed it:

> They are not realistic, because if you follow the set down objectives, as far as the new science curriculum is concerned, you find that it is too demanding, too demanding. It is demanding on the teacher. You see so many demonstrations which you need to do, but when you look around you can't find what to demonstrate with. (Interview 25/2/1987)

In any event, the Science Board, itself none too clear on the specifics of the pedagogic emphases of the Science Schools Project, was not convinced that recommending any teaching style to its teachers would have been useful. As an official of the Board argued, there would be problems:

> ... if you recommend a particular technique [of teaching science to the students]. It may not be known to the teachers. You have to realise that in Nigeria today, it is not all teachers who are in the classroom who are actually teachers. They don't even have the basic qualification for teaching. They just wear degrees, you know, up and down; but they are not professionally trained teachers. Now if you tell him to adopt a particular technique or strategy, how does he do it? Now this is something totally unknown to him.
> (Interview 23/9/1986)

Thus the development of educational policies in Nigeria is often characterised by a considerable lack of correlation between policy expectation and achievement. This has significant consequences for implementation, as well as attainment of outcomes, in the sense that major parts of the policy rationale behind such change strategies were not incorporated in the methods of the implementation or monitoring mechanisms.

The relatively few instances where students were actually involved in experiments could not have been enough to expose them to the full range of potentialities of practical work in science as implied by the ethos of the Science Schools Project. And even in the few cases where students were engaged in some form of practical activity, the feeling generated for the observer was that the exercise was more of a routine task than a deliberate process designed to enhance a specific mode of scientific thinking in the student. This is illustrated by one practical I observed in the boys' Science School:

> Teacher comes to the laboratory about five minutes late. Spends another twenty-five giving a theoretical preview of the practical. The practical has two stated aims: to study the effect of heat and to see the difference between heat value and temperature. Since the experiment involved heating, one piece of equipment is a wire gauze.
>
> The group to which I attach myself (four students, each with a different 'assignment' – their arrangement, not the teacher's – concerning observation and recording of the experiment) has a faulty wire gauze which actually catches fire in parts whenever it is placed over the bunsen burner, and the group leader reports this to the teacher. But no replacement can be found and the teacher tells the group to 'manage' with the one it has. This it does, and obtains a far different result from those obtained in other groups.
>
> At the end of the practical students gathered their books and left. Interestingly, the teacher did not point to the significance of this situation to the students in our group as a background to scientific technique, and when I pointed out this potential source later, he replied there was no time to go into that.
>
> (Observation Notes 26/1/1987)

From this, and other observed lessons, it would appear that the messages about, or the curricular emphases in, the new science curriculum, important as they are to the educational planner, do not emerge as points of particular emphasis during the teaching of biology and physics in the Science Schools.

The relatively little amount of student practical activity during teaching (1.8 per cent as suggested in Table 3.2) is, ironically, explained by the insufficiency of materials and equipment which necessitates some regulation in both the frequency of the practicals and mass student participation in them. One teacher summarised the comments made by his colleagues about the laboratory situation in the Science Schools by explaining that, due to insufficiency of laboratory materials:

> Last year [1986] we had to compel students to answer certain questions in the GCE physics practical, which was unfair. But this is because the apparatus for each question were not sufficient if it were to go around. (Interview 25/2/1987)

The emergence of the lack of laboratory materials as a hindering factor to effective teaching in the Science Schools must come as a surprise considering the rationale of the entire Science Schools Project, and the investment of the Kano State Government in it.

When faced with the situation of a lack of sufficient materials and equipment for full practicals, or for involvement of students in an activity-based mode of learning, teachers resorted to largely theoretical expositions rather than organising practical events which might have involved the students, or at least the teacher, in some demonstration; this then became the established routine of teaching both biology and physics.

This had a burdening effect on both the teachers and students and was illustrated by several of the observed lessons in which, after a series of complicated explanations, the teacher promised a full practical at a later stage. A typical lesson with this characteristic which took place entirely in the classroom reflects this:

> The topic is 'Effect of Heat'. Teacher introduces topic by asking questions on the definition of heat.
> Teacher: What is heat?
> Student: It is a form of energy.
> Teacher: Correct, but can you explain further since there are many forms of energy? What about light?
> Student: (getting uncomfortable) It stimulates vision.
> Teacher: (to another student) What is the effect of heat?
> Student: Produces feeling of hotness or coldness.
> Teacher: What about substances like rubber. Do they increase or decrease with heating?
> Student: Decrease.
> Teacher: Actually it does not decrease in size, but changes shape. But we will consider that when we come to the side-effects of heat in the experiment. If you are vigilant you will see that the rubber

> does not melt. But I am saying its size must increase before melting. If you do the experiment you will find an increase in volume so do not say it contracts. (Diary 30/10/86)

This lesson was conducted without any specific aid which would communicate the concept more clearly. The adopted style of teaching in the Science Schools is always rationalised by the teachers by reference to the inadequacy of laboratory materials and equipment. As a teacher observes:

> The two labs are fairly equipped when compared to other [non-science] schools. But when it comes to the real consideration of whether a lab is equipped or not, I have to say that they are badly equipped, or perhaps poorly equipped. You find that if it is the day-to-day running of the teaching courses, then you can do with the few apparatus, and you can call the students around and you demonstrate something and you are okay. But when it comes to the GCE exams where you need every student to have an apparatus to himself, that is where you find the problems: that is when you find that the lab is so poor in terms of apparatus. (Interview 25/2/1987)

But disparity between what the curriculum developer (or administrator) aims at and what teachers do in the classroom is emerging as a standard feature of science education curriculum reform, in both developing countries (Lewin 1980, 1981, 1984, Maddock 1981b), and interestingly, in some developed countries such as Canada (Aikenshead 1984, Ste-Marie 1982). For instance the report of various case studies of observations of science teaching in many Canadian schools revealed:

> Senior-year teachers view science as a precise method and as a system of exact numbers, highly organized bodies of information and specialized terminology. Their concern is to provide students with the notes and with the practice in solving problems that will result in high marks on examinations and allow the student to move through high school to university. Work in the lab is geared towards illustrating facts and theories presented in the classroom, confirming what is discussed in class, obtaining precise facts and getting the right answers to problems ... Alternative approaches, such as those emphasizing inquiry processes or the relationship of science to social issues or technology, are not seen as central activities for the science classroom, but as a means of encouraging interest. (Orpwood and Souque 1984:23)

It would seem therefore that science education reform strategies, especially if perceived as part of a developmental process, are characterised universally by a considerable lack of correlation between policy expectations and classroom realities.

## THE OUTCOMES OF THE SCIENCE SCHOOLS PROJECT

A discussion of the outcomes of the Science Schools Project in Kano is not possible without some qualifier since 'outcome' has a different meaning for an analyst and a policy maker. In the policy maker's perspective, the term is used to emphasise the successes of the Science Schools Project, especially as there were two basic reasons for setting up the project. The first was to increase the number of qualified science students who graduated from secondary schools and who would continue their studies to higher institutions, as compared with the output of such students before the establishment of the Science Schools. The second was to increase the amount of scientific and technical manpower in Kano State through the Science Schools.

### Examination Outcomes

The first question about outcomes therefore focuses on the extent to which the establishment of the Science Schools has made any difference to the number of GCE Ordinary level science graduates from Kano. This is difficult to answer without accurate information about the number of science graduates produced by secondary schools in Kano before the establishment of the Science Schools. But according to figures made available by the Science Board, 2447 science students from the Science Schools have graduated between 1980 and 1987. And from various discussions with policy initiators of the project, this alone justifies the project since this number far exceeds the number that all the conventional secondary schools have produced since the establishment of Kano State in 1968.

However, a more important measure of success of the project is provided by the Nigerian General Certificate of Education Ordinary Level examination results of these students. The results are in five core subjects and are shown in Table 3.3.

Table 3.3 indicates an average pass rate of 56 per cent in the five core subjects in the Science Schools – results with which the Science Board is quite happy, since they enable a lot of the students to gain

TABLE 3.3 *Science schools general GCE ordinary level examination passes, 1980–1986*

| Subject | D/Tofa | | D/Kudu | | Taura | | Totals | | PCT |
|---|---|---|---|---|---|---|---|---|---|
| | No. | Pass | No. | Pass | No. | Pass | No. | Pass | |
| Chemistry | 1053 | 690 | 1235 | 849 | 127 | 63 | 2415 | 1602 | 66 |
| Maths | 1054 | 610 | 1269 | 892 | 129 | 34 | 2452 | 1536 | 62 |
| Biology | 1053 | 504 | 1238 | 858 | 129 | 100 | 2420 | 1462 | 60 |
| Physics | 1053 | 473 | 1237 | 924 | 129 | 50 | 2419 | 1447 | 59 |
| English | 1053 | 368 | 1237 | 432 | 128 | 35 | 2418 | 835 | 34 |
| Average | 1052 | 529 | 1243 | 791 | 128 | 282 | 2424 | 1376 | 56 |

SOURCE Science and Technical Schools documents. Figures exclude Taura 1986 results.

admission into higher institutions to study science and technological disciplines. As the Executive Secretary of the Science Board explained:

> Our achievements have been that we have produced the calibre of students envisaged in the programme. Obviously Kano State wanted to produce these kids who are rich in science background for their degree courses. Luckily enough, we have been able to produce these kids. I'll say on the average between 50–60 per cent of those students in the schools meet university admission requirements. In the past Kano State has been lagging behind in the science-based areas. But with the maturity of the Science Schools we have been able to get our students in all areas where our quota (in admission to Nigerian universities) is earmarked. In fact in some cases we even fill up the quotas of other states.
>
> (Interview 23/10/1986)

**Labour Market Implications**

The second question about the outcomes analyses the extent to which the project has provided a basis for specialised manpower production in the areas required. As with the first focus, this also has its problems, not the least of which is that follow-up services do not exist within the Science Board which would enable a more accurate investigation of the various careers of the former students to be carried out. However, a population check on the distribution of the former students in various degree courses in three universities in

Northern Nigeria, Ahmadu Bello University at Zaria (ABU), Bayero University, Kano (BUK) and Usman Danfodio University, Sokoto (UDU) provides an indication of the discipline specialisation of 308 of the former Science School students. This distribution is shown in Table 3.4.

TABLE 3.4 *Course distribution of Science School students in ABU, BUK and UNISOK, 1984–86*

| *Course* | No | % | ABU | *Graduation* BUK | SOK |
|---|---|---|---|---|---|
| Science | 87 | 28.2 | 1987 | 1989 | 1990 |
| Engineering | 40 | 12.9 | 1989 | 1988 | – |
| Agriculture | 39 | 12.6 | 1989 | – | 1990 |
| Human medicine | 22 | 7.1 | 1989 | 1991 | 1991 |
| Pharmacy | 13 | 4.2 | 1988 | – | – |
| Environmental design | 11 | 3.5 | 1988 | – | – |
| Veterinary medicine | 6 | 1.9 | 1989 | – | – |
| SBS-science* | 87 | 28.2 | – | – | – |
| *Non-science* Library science | 1 | 0.3 | | – | – |
| Education | 1 | 0.3 | | – | – |
| Business administration | 1 | 0.3 | | – | – |
| Total | 308 | 100.0 | | | |

SOURCE Science and Technical Schools documents.
* SBS – School of Basic Studies; preliminary and non-faculty.

The expected year of graduation of the most recent student in that course is also given. This means, for instance, by 1991 Kano State expects to have 22 medical doctors, since by then all of them will have graduated from their courses; 11 of the 22 potential doctors will graduate from ABU by 1989, and the rest from BUK and Sokoto by 1991. It should be emphasised the figures refer only to students in three universities. Other former Science School graduates from other institutions (Universities of Maiduguri, Ife and Nsukka where they are found) are not included. As such the figures in each course could be higher.

Similarly, by 1990, Kano State expects to have 87 scientists graduating in various disciplines ranging from biochemistry, microbiology and physics, to computer science and chemistry. Engineering, like medicine, is a discipline for which the policy initiators of the Science Schools expected a high turnout. It is therefore significant to note that 40 engineers will be available to Kano State by 1988 from two of the universities in various sub-disciplines which included civil, mechanical, agricultural and chemical engineering.

The impact of the Science Schools, especially in the production of so many science students from Kano State in institutions of higher learning has not gone unnoticed, especially in Northern Nigeria. This was indicated during the 1985 Macroscope event in the Ahmadu Bello University, Zaria. Macroscope is an annual event organised by the Faculty of Science of the university, and features several scientific activities designed to promote the teaching, learning and use of science at all levels of formal education in the catchment areas of the university. Not only did the Dawakin Tofa Science School win the third best position during the events, but the Permanent Secretary, Kaduna State Ministry of Education, who was an observer at the events, remarked:

> Having realised the fact that Kano State can now fill in its quota in the science disciplines in our higher institutions, as a result of the large number of scientifically sound students it graduates every year from its Science Secondary Schools, Kaduna State government has now completed plans to follow its footsteps. From the next academic year (1986/87), every Local Government Area in Kaduna State will have a fully-fledged Science Secondary School.
> (Quoted in a speech delivered by the Principal, Dawakin Tofa Science Secondary School during the Parent Teacher Association General Meeting of the School, 23 November 1985)

The importance of this for Kano State is seen in an appreciation of the rationale of establishing the Science Schools by a former member of the Committee that proposed the establishment of the project who observed:

> We had so many Uncle Toms, cold feet and the rest of it all along, but I think the end justifies the means. What we have produced with the Science Board has now cleared everything. Later on even those who were opposed to the idea saw that the salvation was in the Science Schools. We produced the best, we had the best. The next set of doctors we are going to have this year from the Ahmadu Bello University Teaching Hospital are going to be all 'yan Kano' (Kano indigenes), and Kano for the first time will have 20 doctors this year; all 'yan Kano', all 'Musulmi' (Muslims) and they were all

> from Science Secondary Schools. They will make impact because everybody will see doctors in Murtala Muhammad Hospital, very many of them 'suna *Assalamu Alaykum, sai an jima, wane*'.[2] And they are all from the Science Secondary Schools.
>
> (Interview 22/2/1987)

Interestingly, none of the officials interviewed was willing to consider any unexpected outcomes of the Science Schools Project. However, the Executive Secretary was able to state:

> Well, I anticipate the Science Schools will create positive and negative problems obviously. Now everybody is smiling; they are doing well, students are going into universities. They are being absorbed, they have started graduating and they are coming out. But certainly, within a space of ten years probably from today, there may be an over-production of science graduates in Kano State. In fact it won't be ten years. In the next seven to eight years there will be an over-production of science-based graduates from the Science Secondary Schools. (Interview 23/9/1986)

But although the official response to the outcomes of the Science Schools Project indicates satisfaction with these outcomes from a policy perspective, the change analyst would wish to reflect on the extent to which the outcomes of the project can be considered satisfactory.

This is because the evidence presented indicates that the Science Schools have not succeeded in changing the teaching and learning styles of teachers and students in the schools – despite the special resources created for them. It would seem therefore that in considering projects such as the Science Schools as part of a large-scale national development drive, policy formulators need to clarify the range of expectations and outcomes of massive participation in science education if they intend it to become an agent of intellectual and social transformation. Unless such purposes and intentions are shared by all participants in the scheme, there is bound to be confusion about whether the outcomes of such projects can be attributed to the students, to teachers or to the expensive learning contexts created by such projects.

## REFLECTIONS, CONCLUSIONS AND IMPLICATIONS

The purpose of this chapter has been to study the Science Secondary

Schools Project in Kano as a long-term scientific and technological manpower development strategy, to determine the rationale and mechanism of its initiation and to evaluate its outcomes.

Since completing the main work from which this chapter was adapted (Adamu 1988), the author has had a chance to go over the fieldwork strategies, and meet the central actors in the Science Schools drama again, but under less formal conditions than during the fieldwork (1986–87). These post-fieldwork encounters confirmed the usefulness of the analytical approach adopted for the entire research, which, in the main, was the illuminative framework (Parlett and Hamilton 1972).

Certainly, the wholeness of the picture of the project that emerged as a result of using this analytical approach would not have been possible if attempts had been made to use quantitative measures that involved, for instance, lengthy analysis of questionnaire responses from officials. The massive databank such analysis would yield would probably make the overall data presentation more impressive – but not much more useful than the naturalistic processes adopted under the illuminative framework. Further, there was absolutely no way by which the insights provided by the policy formulators connected with the project could have been extracted using any other method. Thus the subjective nature of the illuminative analytical framework does not seem to have hampered the data collection, analysis or interpretation of this particular project.

From the evidence presented, we have seen that the purpose of setting up the Science Schools Project in Kano State was to encourage a more effective understanding of science in social transformation, using specialised institutions of science teaching and learning. However, the intellectual advancement of the students of the Science Schools, which was a major part of the rationale of the science education reform movement, did not emerge as a primary concern of the project. This situation came about because, while there was extensive problem diagnosis in the process leading to the establishment of the project, there were no clear specifications of how the project could achieve those outcomes associated with the use of science in personal and social development.

This is because an analysis of how the science curriculum is applied in the Science Schools reveals a lack of correlation between the way the students are taught, and the emphasis in science teaching expected by the developers of the science curriculum. As the data suggests, science teaching in the Science Schools does not develop the students' abilities in terms of the acquisition of the intellectual characteristics envisaged by the new science curriculum. It merely identifies these abilities so that those who continue with education beyond the Science Schools and go to the University can do the sort of programmes expected of them by the progenitors of the Science Schools Project.

The development of the Science Schools also suggests that policy implementation in Nigeria is less reliant on the emergence of the policy as a rational strategy for social transformation than on the way socio-politically powerful individuals connected with the policy become committed to it.

Thus what emerges from the findings of this chapter is that a political rationale for educational change strategies in Nigeria provided a suitable basis for projecting beliefs about social progress, but little attention was paid to how these change strategies would be sustained, or how they fitted in with social realities. The issues facing any change strategist are not just those of needs, clarity, complexity or the quality of the materials used, but the constant production of personnel who identify with the rationale of the change strategy enough to see to its maintenance and to achieve a reasonable measure of its objectives. That is the essence of science education as a long-term service aimed at radical social transformation.

The findings in this chapter are significant in that most developing countries rely on administrative initiative for curricular reform. And if a practice is established whereby administrative priorities override academic considerations, then attainment of development goals through science education becomes susceptible to the instability of economic and political forces prevalent in developing countries. This will have a retarding effect on the achievement of national development goals.

## NOTES

1. Transcript of a Kano Community Television (CTV) documentary programme, The Dawaki Experiment, broadcast Kano 22/2/86. I am grateful to Mallam Aminu Mahmood of CTV for making available the mastertapes of the interviews, film footage and script. The latter part of the interview was based on my own transcripts from the interview I held with the former Chairman of the Manpower Development Committee.

These two interview sources are subsequently identified either by a date to indicate my own interviews, or CTV to refer to the interviews given for the programme.

2. Literally: 'peace on you, see you later'. This linguistic lapse was used by the interviewee to convey the impressions of identification between the doctors and the patients in the hospitals since they are now the same, as opposed to previous years when expatriates and other Nigerians beside Kano indigenes dominated the medical field in Kano.