Girl-Child Science Education in Northern Nigeria

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Introduction

Women studies understandably tended to focus attention on issues of access and expressions of opportunity especially in the work-place. Prejudice against women has been so long ingrained in the human psyche that it has become an institutionalized process: less girls and women attend schools not because of their dwindling number in the population, but because of the futility of their education. It is clear that only institutionalized interventionist processes can reverse the trend. Traditional parents in all cultural settings are more concerned with ensuring their daughters "get settled", which in most cases meant marriage immediately after the secondary school years. Accusations at the government for not doing enough, or not employing enough women might have led to re-thinking on the part of policy makers about the strategies to be employed to encourage greater participation of girls in the educational process. A specific strategy adopted by the Kano State government is in the area of provision of science education for girls in the State. To understand what makes the strategy significant, we have to look at the nature of science and scientific activities, and how it affects the learning of girls in at least the secondary stage of their learning processes.

The Nature of Science

Generally the term science is used in its broadest meaning to denote systematized knowledge in any field, but applied usually to the organization of *objectively verifiable* sense experience. The pursuit of knowledge in this context is known as pure science, to distinguish it from applied science, which is the search for *practical* uses of scientific knowledge, and from technology. Science defined *simply as knowledge of natural processes* is universal among mankind, and it has existed since the dawn of human existence

Science is thus the process by which men (and women!) create knowledge in which they can place a high, and often *measurable*, degree of confidence. It is not, in principle, the only path to knowledge. Supernatural revelation, poetic insight, and feminine intuition are other possible ones. They, however, have been found wanting in *reliability* where and when they are open to such tests as science accepts for itself. For this reason they are no longer appealed to in matters of any consequence for the material welfare of mankind. Science, for its part, recognizes *no final* boundaries to its domain. The inorganic universe, living matter, the history and the behavior (both rational and irrational) of man himself, are all fit subjects for scientific inquiry.

The power of scientific method is not mysterious, and at its heart lies experience in framing efficient questions and experience in devising efficient ways of obtaining answers to them.

Attributes of Scientific Activities

Having seen the nature of science, let us explore some of the characteristics of scientific activity which ought to be ingrained in *every* budding scientist, regardless of gender. These characteristics are what are generally called the scientific method. The term *method* refers to the specification of steps which must be taken, in given order to achieve a given end. This is not different from the similar methodology followed in the verification of other forms of knowledge. However, in science the scientific method as a means of carrying out scientific activities is measured through the following the display of specific attributes, of which some are explained below.

In the first instance, no matter the field of investigation, the true scientist is always seeking to extend the bounds of knowledge (*scientia).* In so doing he tends to follow a common path, the first step of which is the all-important one of ***observation***. He observes, for instance, that a certain chemical solution changes color when heated or that a plant, fed with some fertilizer, grows more rapidly than others not so treated. Qualitative observations of this sort are usually of little value unless they are accompanied by measurement and thus become quantitative. The scientist will therefore endeavor to determine the exact temper-ature at which the color changes and to measure the volume of gas given off in the process or, in the case of the plants, he will record the difference, in millimeters per day, between the rates of growth of the treated and untreated plants.

Having observed a phenomenon and recorded his observation in quantitative terms, the scientist needs to assure himself that he has not been misled by some freak of nature and so he will wish to ***repeat*** his experiment under identical conditions a sufficient number of times to satisfy himself on this score. This replication is sometimes comparatively easy to arrange. For example, instead of comparing the rates of growth of two plants, the researcher can take a hundred, all raised from seed planted at the same time in the same soil, and treat fifty of them. On the other hand replication can be almost impossible if, for instance, one is observing a phenomenon associated with a total eclipse of the sun or one which human behavior is a major factor. A psychologist studying the reaction of the masses to national disaster would find are difficulty in repeating his observations.

After the scientist has satisfied himself that the observation which he has made are valid, he seeks an explanation, relating cause and effect (***deduction***). In this he draws upon his basic knowledge of hi subject and upon his powers of deduction and reasoning which has developed as an essential part of his training. When the scientist thinks that he has found a possible explanation, he sets out to prove or disprove the validity of this, his hypothesis.

He might, for the sake of argument, propound the theory that the quantity of Mangos ripening in Rani is in direct proportion to the severity of the subsequent Kaka. In this case, unless accurate records were available from the past — not only on the weather but also on the number of Mangos — he would need to make his own recordings over a large number of years in the future. He would eventually be in a position to calculate the correlation between the numbers of berries and mean temperatures. Even if he succeeded in establishing a high correlation between these two factors, he would not be so rash as to state that the one was the cause of the other; he would merely say that such a correlation existed and that this was probably due to a third, and as yet unknown, factor which was the common cause of the other two.

Only when he has satisfactorily proved the validity of his hypothesis will the scientist think of ***publishing*** the results of his research but, when he does so, it is not just because he wants to show the world how clever he is; it is because he has an almost sacred duty to make available to all future researchers the results of his work, in the same way as all his predecessors' findings were available to him when he was beginning. The accessibility of published experimental results has always been of vital importance to all scientists and for this reason it has usually been an essential part of a scientist's training to become fluent in at least one foreign language.

These attributes reflect "big" laboratory-intensive science, and provide a conceptual framework against which judgments about "science" are made in any discussion on science education, whether for boys or girls.

Girl-Child Science Education in Context

Women in Nigeria face the same sociological problems as women elsewhere: gender disparity and discrimination. To this effect, Lewis (1980) claims that "today, many African women are calling for a radical break with the sexism of the past. They are calling upon their governments to establish departments that address the concerns of women. They feel that they, and their countries, would benefit directly from a policy aimed at upgrading the basic knowledge of the thousands of women who toil in the rural area and live in the urban areas but because of illiteracy and lack of skills never reach their full potentials. These women assert that the integration of women into national development should not be based on former myths, for it can, they realize, mean that co-option may still become part of the established order and, therefore, controlled by it…The critical point here is whether the new developmental thrust in Africa and the integration of women into the economy will restrict instead of enhance or harm instead of benefit, women" (Lewis 1980 p.45)

Such points were brought out forcefully in a survey by Adisa and Nwankwo (1984) who conclude that the austere times in the country compels some housewives to search for jobs (one area where women are wanting). Women formerly left at home to cope with their motherly roles and ensure proper upbringing of children now troop out of their homes for employments "to make ends meet."

Equality of opportunities of course begin with the educational system the society operates, and as far as the western form of education is concerned, this is also likely to remain a big problem in Northern Nigeria — especially as the problem has deep roots. For instance as far back as late 1950s, Congleton (1958) claimed in an interview that "people in Northern Nigeria attach great importance to the discipline which children learn in the home, and many of the men feel that if girls stay away from home at a boarding school too long they will never be able to control them when they are their wives. They know that once a girl is beyond the age of 14, she has more ideas and a will of her own, and she may not be submissive to her husband in the way they would wish her to be" (Congleton 1958, p.73).

The fee of independence from the men by women who are educated is seen as a stumbling block by the women themselves — as reflected in a survey by Hackett and O'Connell (1976). The respondents in their sample indicated that the main obstacle to girls education in their home area was the fear that education will spoil girls. The researchers claim that "other research has singled out this factor as being most important among Hausa communities where *yar bako* or "schoolgirl" has often been made synonymous with a girl who will deteriorate morally" (Beckett and O'Connell 1976, p. 251).

Science Education of Girls

It would be naive to create the impression that sex differences in aptitude, ability and performances do not exist between boys and girls in any culture. But as has been pointed out, "it should not be assumed that these are innate or necessarily biologically rather than culturally influenced, especially since it has already been suggested that it is in the interest of a capitalist society to select different skills, values and ideas to transmit to different social groups" (Deem 1978, p. 29).

Thus the growing concern about the quality of education offered to girls reflected in the equal opportunities debates sweeping Europe and America has lead to demands for equality for both sexes in schools. It could be argued that both sexes can study what each wants to study; but when it comes to optional subjects, some form of stratification occurs – with girls opting for those subjects traditionally thought suitable for women such as Domestic Science (or Home Economics/Management), and in many cases, Biology. During introductory science stage, "young children in schools are usually introduced to the elements of physics, chemistry and biology at least within the broad science area. However, when pupils being to choose between science subjects in preparation for external examinations, we find that more boys than girls opt for physics and chemistry, while the reverse is true for biology. Physics with its machines and Mathematics reverts to being a boys' subject while biology with its animals and flowers becomes defined as more suitable for girls." (Walford 1980, p. 220).

This view tends to support the impression that girls are generally not suited for sciences; an idea, it is claimed, that "may have a grain — but only a grain — of truth in it. Sex differences occur in many cognitive functions, girls performing better than boys in some tests (such as verbal ability, memory and manual dexterity). The intellectual factor which has been found to be most closely related to attainment in science is spatial ability — the ability to manipulate objects mentally and visualize them in different configurations — and boys are, on average, better at this than girls." (Kelly 1974, p. 539).

The factors influencing a child's spatial ability and achievement, especially in Science and Mathematics, have been vehemently debated. These factors are mostly speculation on the basis of the researcher's experience with the research participants (Clements, 1981; Bishop, 1980). There is consensus among mathematics educators that education and the child's environment are important influences in the development of children's spatial ability (Bishop, 1979, 1980; Jahoda, 1979; Battista, 1990; Presmeg, 1986b). The role of general education in the development of spatial visualization remains undetermined (Ben-Chaim, Lappan and Houng, 1988). It is however clear from studies of ethnic differences that education does positively influence visual communication through the learning of conventions of representation (Bishop, 1979; Mitchelmore, 1983). In Western society is difficult to separate the influence of education and the environment.

The living environment of the child is a second factor in the development of spatial ability (Bishop, 1986). Deregowski (1980) suggests that in the "Carpentered World", where orthogonal constructions are prevalent, visual-pictorial development is superior. However it is the child's experience with and not presence of orthogonal constructions that is of benefit in visual-pictorial development (Jahoda, 1980). The influence of the environment includes the exposure to art and the characteristics of the art (Deregowski, 1976). Therefore the child's visual-pictorial experience is influenced by the social experience and not only the physical environment (Battista, 1990; McGee, 1979; Mitchelmore, 1980; Presmeg, 1986b). Jahoda (1980) illustrates how British children are more accustomed to pencil and paper activities and therefore more adept at drawing than Zambian children. In contrast Zambian children make functional model vehicles that require a great degree of mechanical and spatial understanding. This contrast can not be ascribed to the physical environment but rather differences in social expectations of the two societies.

Generally speaking, however, the problem of girls in science education is not so much lack of educational opportunities to study science, but, it could be argued, because of the social and cultural attitudes of most cultures to "smart" girls. Science is essentially a male-oriented activity and while it is easy to see that see a change of this image is necessary, it is far from easy to see how to go about changing it. Ultimately, says Walford, "such changes will only come about at the same time as changes at the societal level with regard to the role of women and increased occupational opportunities" (Walford 1980, p. 221).

It is rather a bit difficult to envisage such societal change in the Northern Nigerian Islamic Culture in the near future. Society in general does not consider a career as forming an important part of a women's life. "By and large" claims Kelly, "women who wish a career in science…often have to choose, if not between marriage and career, then between children and career." (Kelly 1974, p. 538)

This analysis extends to the way in which children are brought up leading to role stratification early in life. Girls are brought up to accept that their as mothers and wives, and since science is associated with high intellectual ability, with a non-verbal (spatial) bias — qualities girls are not allowed to develop early in life in most cultures, then the access of many girls to science is blocked already. Within this context, boys may have much greater scientific experiences before they reach secondary school: they have often played with mechanical toys, probably help mend the family car and are generally more adventurous than girls. So they begin studying science with greater interest and understanding than girls, and the normally maintain this. And since most science teachers are often men, there is a tendency on their part to encourage boys more. The problem of girls is more acute in mixed schools (e.g. Federal Government Colleges) where teachers may openly encourage boys at the expense of girls.

This gives an idea of the sort of problems girls are likely to face when venturing into a male dominated territory.[1] The cultural image of the girl-child places her in the home. Even her biological structure does not seem to favor career orientation up to a certain stage of her life: for instance, if she is married, children may hinder her scientific career. "In this way marriage, even without the extra responsibility of children, is a severe constraint on (their) progress." (Perry and Moore 1982 p. 29)

Further, "it is probably not unfair to suggest that parental attitudes, along with teachers and pupils attitudes, are a significant factor in shaping a girl's attitude to her future" (Hearn 1979 in Walford 1983, p. 566). Walford generalized this statement by suggesting that low aspirations among girls and women in physical

[1] Interestingly enough, males moving into female-dominated territory face the same problems of turf control and territoriality. Home Economics is normally associated with girls and women; male students who wish to study it are often considered too effeminate.

sciences are probably caused by sexual stereotyping in schools as well as negative parental attitudes to women in physical sciences. In a survey reported by Walford, the vast majority of boys and girls aspired to occupations which were congruent with commonly accepted gender stereotypes. Girls, in the main, opted for nursing, teaching, typists, secretaries and working in shops; while boys chose work in engineering or metal processing, vehicle mechanics or TV repair. Walford concludes by suggesting that

> "if we wish to encourage girls into science it is necessary to have at least a two pronged attack. At the beginning, girls need to be encouraged to take science subjects through school-based strategies which make the subject more attractive to girls in itself rather than as a pre-requisite for a science-related career. Developments in curriculum design and materials may well be important here. In addition parents need to be told of job opportunities for girls in sciences so that they, along with teachers, are prepared to question the traditional gender role stereotype of job available for these mid and low ability pupils so that eventually more girls may be encouraged to consider science related occupations" (Walford 1983, p. 567).

What makes the situation worse for girls is the image of scientists held by both boys and girls. Data from European studies reveal that both see the scientist as a "disheveled and wildly excited man, dancing around and waving a test tube and talking to himself" or "a drab bespectacled figure bending over a Bunsen burner in a back room" (Kelly 1974 p. 540). Certainly this is not an attractive individual for a girl to model her life on. Thus another problem is lack of female scientists in the North who would act as role models for many girls and thus encourage them to study science.

These images of the role of women are particularly strong in Northern Nigeria. The basic problem in the area, however, is the generally negative attitude to female as a whole, rather than specific career orientations. As Bray (1981) observes, "parents (in Northern Nigeria) send their children to school not so much because they think hey will find knowledge intrinsically useful but because possession of education will enable the child to later obtain a better job. Since men rather than women are more likely to earn their family's income, it is logical for parents with limited resources to spend them first on boys and only second on girls." (Bray 1981, p. 19).

Further work by Yeld (1964) indicates the difficulty girls who want to make a career out of science are likely to face in Northern Nigeria. This is because, according to Yeld, the only socially respectable form of employment outside the home for girls (especially those married) is teaching. My connection of this statement to career in science is locked up in the fundamental observation that most Northern Nigerian girls are married during or immediately after their teenage years and in some cases, before (see, for instance Adams, 1973 and Kaita 1969).

If this can be accepted as the general practice, then it may not be possible to produce women scientists from Northern Nigeria in great quantities because most men would not simply allow their wives to work due to the purdah status of most Muslim marriages in Northern Nigeria. So girls with strong scientific inclinations fall effectively in the earlier indicated Catch 22: if they insist on following their personal aspirations of becoming scientists they may be castigated with charge of neglecting the husband and the children as well as introducing elements of feminine irrationalism (their femininity) into a purely rational process.

If they remain single and become devoted to a career in science they are even more likely to be considered abnormal (even without career orientation, unmarried Muslim girls in Northern Nigeria, i.e. up to about 20 years old are considered by many as a bit “freakish”).[2] Again even if they do ever actually graduate in pure sciences, the most likely job for them (putting aside the fact that most industries in Northern Nigeria may feel more comfortable with male scientists) is teaching as indicated by Yeld above. Thus held down by this rigid cultural role straight jacket, any scientific interest in Northern Nigerian women is likely to be snuffed than fanned.

Interventionist Strategies

Thus interventionist strategies take into account the need to make special provisions for girls in science education, and this is a strategy increasingly adopted by government as a well as pressure groups all over the world. For instance, in England, Alison Kelly and her colleagues came up with Girls into Science and Technology scheme (GIST). The purpose of the project was to help secondary schools to develop ways of encouraging more girls to study the physical sciences and crafts. It was an action research project concerned with schoolgirl under-achievement. The project was based at Manchester Polytechnic and jointly funded by the Equal Opportunities Commission and the Social Science Research Council with additional grants from the Department of Industry and Schools Council. Its purpose was to initiate and support school-based efforts to improve girls' attitudes to physical science and craft subjects, and to encourage more girls to study these subjects when they become optional. As noted by Smail et al,

> At present technical subjects, physics and to a lesser extent chemistry are dominated by boys from fourth year onwards. This means that girls are cut off from most technical jobs by their lack of qualifications, with deleterious consequences both for themselves and for the country as a whole. It also means that many women are technologically illiterate and therefore at a distinct disadvantage in modern society. Schools will be failing girls if they allow this situation to continue. The GIST project is encouraging schools to take practical action to remedy the situation (Smail et al, 1986, p. 353).

In Kano, the most effective interventionist strategy devised was through the Science Secondary Schools project started by the Kano State Government in 1977. Initially the project was developed only for boys; as revealed by the government,

> “The Science Secondary School Management Board has plans to open a Science Secondary School for Girls...due to financial constraints and the inability of the Ministry of Education to hand over one of its schools (this was not possible)” (Kano State 1979 p. 161)

[2] However, these were attitudes that seemed to have been mellowed drastically in the early 1990s. There are now many unmarried Muslim women strongly attached to their careers and without any social stigma being attached to them.

But during the civilian administration (1979-1984) the Board was allowed to start Science School for girls which was initially planned in Bunkure, but later changed to Taura. The Board had wanted to take over Girls Secondary School Kura for conversion to the Science School for Girls, but this was resisted successfully by the Ministry of Education. The eventual acquisition of a site at Taura to build the new Science School, indeed reflected a further example of the fellowship network that ensured the survival of the Science Schools project. This is because when the Ministry of Education refused to allow Kura to be converted to a Science School, the then Commissioner for Education (1982/83), Dr. A T Abdullahi, a first generation member of the Science Board intervened and made the establishment of the Girls Science School possible. As the Technical Adviser of the Science Board recalled,

> "We felt all along that we should have started a girls and two boys Science Schools. But we had trouble with the Ministry of Education. We wanted to take Kura girls secondary school; they refused. So we had a lot of problems. In fact it is through the Commissioner for Education, Dr A T Abdullahi that we acquired the site at Taura for the girls Science School, otherwise it would have been impossible." (Interview 29/9/1986)[3]

The Girls Science Secondary School was officially started in September 1981. It was, like the overall concept of the Science Schools, the first of its kind in Nigeria. The science school for girls appears to be unique because it was the first time the Kano State government (or any other arm of the Nigerian government) has made such explicit statement about the science education of girls. The school therefore appeared revolutionary arising out of social context where general modern schooling for girls was not openly encouraged.

But the most surprising development about the girls Science School was some Principals of some girls schools were *against* it; and registered their feelings, like their male counterparts, by first of all not allowing their own students to take the selection examination of the Science Board, and secondly, in cases where the students were allowed to take the selection examination, by not releasing the girls to attend the Science School. Matters reached a head when the Science Board complained to the Permanent Secretary, Ministry of Education Kano on 4th February 1985 in a communication where the Board stated

> "....three weeks after the opening of science Secondary School, Taura, some principals of girls institutions are yet to release their students to report to the school. This shows that some principals are not co-operating with the Board on science schools programme. (The Principal of…(withheld)...) is particularly noted for this, for she even refused to allow her students to sit for the science secondary schools entrance examinations. It has come to the Board's notice that the Principals of...(5 schools)....are yet to release the students who were selected for Government Girls (Science) Secondary School, Taura. The Principals of......(3 other schools)... are yet to release one or two of their students to report to Taura." [4]

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[3] Taken from Adamu, A. U. , *Science, Schooling And Manpower Production in Nigeria: A Study of Kano State Science Secondary Schools, 1977-1987*, an unpublished D.Phil dissertation, University of Sussex, Brighton, England, 1988).

[4] Quotes based on personal interviews I held with key policy initiators of the project during a field work for a larger study on the evolution of the Science Schools as manpower development strategies. See Adamu (1988).

What is surprising about this is the Principals' unwillingness to participate in the scheme, the argument being they should be the first to demand equal opportunities for girls in science — especially in a place such as Kano where very few girls are encouraged to attend modern schools. It should have been expected those few who do show inclinations towards science (certainly an unusual occurrence for girls from Kano) would be encouraged by their own Principals. The fundamental principle behind the science schools is the belief that the Science Schools, being specialist, may cater for the needs of the students in science more than in normal schools. Consequently, the chances of those students in pursuing scientific careers are thought to be higher in the Science Schools.

A further observation is women such as the Principals of the schools who refused to allow their students to go to the Science School, being educated in the modern sense, are expected to be more liberal in their attitudes to female schooling. Thus their opposition, as in the case of their male counterparts, underscored their uncertainties about how the girls Science School will affect them personally, rather than a reflection of their professional concern about the quality of education in their schools.

But not all Principals opposed the girls Science School. As a female Principal in a (prestigious girls) nonscience school rationalized,

> "I know quite a number of Principals do not like the idea of the Science Board selecting their best students. But as far as I am concerned it boils down to the same thing. You are educating these students for the state and the country at large. So it doesn't matter whether they are here (in a nonscience school) or at Taura. It is the same thing. Moreover, I feel with the Science Board, the girls have a better chance at science education." (Interview 15/10/1986)

Right from the time the science school for girls was established, the Board made it clear that provision in the school would be along the same line as in the boys schools. The only discrimination — it may be labeled that in another perspective — was in the range of subjects offered to the girls. They have all the subjects offered to the boys except Further Mathematics, Agricultural Science and Technical Drawing; although Food and Nutrition is compulsory for the girls, and it is not taught to the boys.

Again the combined effects of economic factors as well as inadequate planning for expansion has greater affects on the newer schools in terms of their basic equipment and materials supplies. In Taura, for instance, there was no functional Biology laboratory for well over two years since the school was opened on 14th January 1985; all Biology practicals during this period were conducted in the Chemistry laboratory. This problem was acknowledged by the school authorities in an address to the Science Board Members during their familiarization tour to the school on 26th February 1985 where the Principal pleaded,

> "The provision of well equipped laboratories in a Science institution cannot be over emphasized though it is costly. At present we have two laboratory buildings finished (Chemistry and Physics), and two others at standstill (including Biology). We put our request to the Board to accelerate equipping our labs to enable us start practical lessons. Over the

> last six weeks, we concentrated effort in giving the students theoretical knowledge. It is therefore high time to start some practical lessons to go along." (Interview in Adamu, 1988).

It is thus surprising a new Science School was started without all the facilities necessary to provide its basic needs. Therefore the level of attention afforded by the Kano State government to the older Science Schools must be seen as their legacy as political strategies of the Kano State government in 1977. Since the newer science schools, and especially the girls Science School, have evolved in a radically different political and economic climates (1981—1985), they were not similarly catered for.

Outcomes of the Project

The most visible outcome of the project is the results of the first set of students of the school. The credit level passes, which qualifies them for admission into university level courses is given in Table 1 below:

Table 1: Taura Girls Science Secondary School Credit Level GCE Ordinary Level Examination Passes, 1980—1986

Subject	No.	Crd	% Credit
Chemistry	127	28	22.0
Maths	129	8	6.2
Biology	129	35	45.0
Physics	129	15	3.0
English	128	12	9.3
Average	**128**	**20**	**15.6**

Thus from Table 1, an average of 15.6 students passed their science examinations at Taura to enable them proceed to higher schooling. Mathematics and Physics, two highly complex subject requiring high degree of spatial ability recorded the least favorable results, although more students passed Mathematics than Physics. Biology, traditionally considered "soft science" and mainly the preserve of girls has the highest rate of passes, followed by Chemistry. While the sampling frame is too small to enable an effective generalization, nevertheless it provides an indication of the state of affairs in a school dedicated to studying science.

In a closer survey of the results of a questionnaire administered for the purposes of the original study (Adamu 1988), the only careers chosen by female students were Human Medicine, Pharmacy, Nursing and Engineering. These were given the same value as alternatives and respondents listed them as their real expected occupations, with the inclusion of marriage. However, none of the female respondents could provide what is adjudicated as good explanation of her career choices. For example, a respondent's view of medicine is

> "I think the job involves studying some part of the body like a dentist. It involves doing theatre and other things."

Another female respondent suggest medicine

> "As we know, involves treatment, health"

Yet still another medical aspirant explains that medicine

> "Involves the study of chemistry, biology and physics. It qualifies you to become a doctor."

The variable asking students list their expected "real life" occupations seeks a distinction between occupational expectations and aspirations and raises some analytical problems which are not peculiar to this research alone. In making such distinctions as part of a research design, Takei et al (1973) proposed

> "socio-economic aspirations should be treated as constituting circumstance-free wishes that can be freed theoretically from the constraints of perceived reality...Socio-economic expectations, on the other hand, should be viewed as circumstance-bound responses which are subject to being strongly influenced by perceptions of reality." (Takei et al 1973 p.218)

Similarly, Little (1978) in a discussion of the distinction between aspirations and expectations in educational research argues,

> "A number of studies confirmed the hunch that students in secondary schools in many developing countries were "unrealistic" about their futures. Indeed, many of the questionnaires request students to look at their futures 'realistically' when answering questions..." (Little 1978 p.18)

Little calls for a consideration of the reasons behind career expectations of students in developing countries instead of dismissing such expectations as unrealistic by stating

> "Realism versus unrealism is one way of explaining away the difference between student in developed countries and students in developing countries. But is it sufficient? Indeed, is it a fair explanation at all? The problem with a word like 'unrealism' is the other ideas associated with it — there is the implication that the root of the problem lies within the person himself, that the person is being somewhat irrational and is either ignorant of or fails to understand the 'facts of the case' (the scarcity of school places and non—manual jobs)." (Little 1978 p.19)

Concluding Remarks

It is therefore clear that although concern for women in general education, and especially their participation in science and technology disciplines has become an international issue, few long lasting strategies were suggested to solve the problem. Most of the initiatives centre around enlightenment services with interest groups - mainly in developed countries - drawing attention to the problem.

In the light of this, the Kano State Girls' Science Schools, arising out of a traditional culture where modern women education has not made significant impact on the society is a bold attempt at providing a long term solution to the problem of encouraging girls to study science and technology disciplines. There are many barriers - mainly to do with predominant cultural attitudes - to be overcome. However, a government backed project would seem to indicate a significant step towards overcoming these barriers.

By 1987, the total population of the Girls' Science Schools was 560 (Science and Technical Schools Board, 1988). It is in this figure that the Kano State policy initiators of the project see the Girls' Science Schools as something of an achievement: creating a learning context where over five hundred girls from a predominantly conservative Muslim State such as Kano State learn the main core science subjects on a non-option basis necessary for scientific and technological career advancement.

However, the importance of participation of women in science and technology has become recognized by the Nigerian government, especially after the establishment of the Girls Science Secondary Schools. As *The Triumph* newspaper of Monday 29th May 1989 (p.2) reported,

> Over N300,000 has so far been spent this year by the women education unit of the federal Ministry of Education to promote the education of girls in the fields of science, technology and mathematics. The ministry has also launched a women education Science Technology Mathematics (STM) scholarship scheme to cover tuition, boarding, transportation and books for senior secondary school girls in the federal and states secondary schools.

In a more radical move, the Federal Ministry of Education intended establishing new Federal Technical Colleges at Akwa Ibom and Sokoto States for girls only. The literature on Science Education in Africa reveals this is one of the first strategies of its kind in any class of manpower development initiatives (see, for instance, Duncan 1989).

Perhaps not surprisingly, even in this move to provide more opportunities for girls to study science education within a legislative framework, especially in a traditional society such as Kano, elements of stereotyped stratification from officials about the students' eventual careers was somehow inevitable. For instance, in most official statements, it was made clear a major objective of the Girls' education in Kano is to produce women doctors and nurses. Not much emphasis was given to the need for the production of women engineers, geologists, aeronautic engineers, computer scientists, veterinary doctors, or agricultural engineers. As an official rationalized,

> "…If you go to the Hospital today, you will find that up till now the ratio of medical personnel is more men to few women attending to females; you see more men attending to female patients than females attending to female patients. By the establishment of the Girls' Science School, this problem should be reduced. (Interview 29/9/1986)…" (Interview in Adamu, 1988).

The Girls' Science Schools project is just a step towards a New Social Order that includes every member of the society, regardless of sex or ability. Other strategies can be taken to refine this process to make it possible for more girls, especially those not within the Science Schools system to participate in science and technology for development.

These strategies may be been either as areas where improvements are needed to encourage girls to study science, or where more empirical investigations needed to be carried out to determine how to utilize such opportunities to favor girls.

For instance, to make science education more functional for girls in Kano, and to make the Girls' Science Schools live up to their expectations of being science schools, wider and more scientific curricular offerings must be made available to the students. For starters, Agricultural Science should be given a serious consideration in the curriculum of the girls science schools. At least if the stereotype of the role of women in the society must be maintained by the Science and Technical Schools Board, then this subject might make it possible for the students to apply knowledge of agricultural practices at home and thus enrich the quality of life of their families.

Generally, if the policy initiators of the project are convinced of the value of science education for girls, then there is no reason why the girls should not be given the same curricular offering as the boys. After all, the Girls' Science Schools were established on the same equal intellectual footing as the boys' schools.

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