PROGRAMME OF TRAINING AND SUPERVISION FOR THE EFFICIENT USE OF EQUIPMENT; AND THE DISSEMINATION OF INFORMATION RELATING TO THEIR USE

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With the acknowledged new methodology and efforts in science teaching, the use of apparatus and materials for instruction assumes a very important role. However, in a non-technological developing country, manufactured school science equipment is hard to obtain. Imported materials are expensive; it takes a long time for them to arrive; and it is not unusual for those ordered from abroad to arrive so late that the topic has been taught without them or the teaher requiring them has left the school. Besides, imported materials are often inappropriate and do not meet the needs of local curricula. Thus when educational materials are required, more attention should be given to the need to utilize local resources which are familiar and readily available to the teacher and learner alike.

In providing school science equipment, the specific requirements of individual teachers should be borne in mind. Mass produced materials are not always appropriate. In addition, teachers and allied workers may have to be provided with training and supervision for the efficient use of equipment.

Types of School Equipment and Construction Tools required

School equipment required to teach the various branches of science are classified for the purpose of this paper under the following categories:

(a)	mechanical	-	balances, pendulums
(b)	electrical	-	meters, electrical circuits, machines
(c)	wooden	-	trolleys, cages, racks
(d)	metal	-	stands, dissecting instruments
(e)	glassware	-	receptacles, thermometers
(f)	plastics	-	containers, models

Tools required to construct the above types of materials include heavy machinery, such as drills, saws, lathes for wood and metal; simple hand tools including drills, saws and a hammer; welding and soldering equipment; glass and plastic moulds, and blowing equipment.

Since teachers rarely possess the skills needed for using construction tools, and since schools in most developing countries are hardly ever

provided with qualified laboratory technicians, it is necessary to provide facilities for training teachers and technicians in constructing school equipment.

This paper therefore deals, from the viewpoint of a curriculum developer, with training and supervision for the efficient use of construction and science teaching equipment made from local or foreign material.

The kinds of construction tools required to construct the categories of apparatus listed earlier are:

(a)	tools for wood working	-	cutting, drilling, turning equipment
(b)	tools for working with glass	-	melting, moulding, blowing
(c)	tools for working with plastics	-	melting, moulding

Because heavy equipment is expensive and therefore not widely available, it is best provided as part of a national equipment construction centre which also serves as a training centre.

The Science Curriculum Development Centre, Njala University College as a National Training Centre

The Science Curriculum Development Centre (SCDC) at Njala has for long been the national centre for science curriculum development in Sierra Leone. The Centre has been involved in producing primary science units based upon materials and phenomena in the local environment. The tools and equipment used in their construction are made from readily available materials in the environment.

SCDC has also been working at the in-service level with primary school teachers and school administrators, such as headteachers, inspectors and supervisors of schools, to train them in curriculum development and the efficient use and construction of simple locally-constructed scientific equipment.

Simple equipment which has been constructed include items dealing with:

(a)	measuring	-	balances of various types, measuring wheels, water-clocks, thermometers, pendulums and gears
(b)	electricity	-	bulb and battery holders, switches, galvanometers, electric motors and electrolytic cells
(c)	heat	-	condensers, oil burners, solar furnace, water turbine, oven for drying plant materials and chemicals, hatchery
(d)	construction	-	wooden pedal-operated lathe, saws, hammers, chisels, screw-drivers and knives

Others include such items as cages, traps, dissecting sets, water-drop and bead microscope, periscope, test-tube racks, holders and tongs.

The imported construction equipment available at the Centre includes two heavy saws, one floor-mounted drill, three table drills, soldering equipment, and hand tools like saws, chisels, hammers, pincers and pliers.

The construction workshop is manned by a laboratory assistant who is untrained in the area of school equipment production but has been in the carpentry trade for about twenty years. As a technician, the laboratory assistant does simple construction work with metals and electrical components. He works very closely with the Director of the Centre, and although he has no formal training or qualification his productions are always of high quality. Attempts have been made for him to be given a bursary to gain further training and experience in school equipment construction, but because of his weak academic background he has always been rejected despite the high regard in which he is held by the staff of the Centre. Attempts to secure a more qualified technician in this area have been unsuccessful because the few technicians available in the country either do not find the work exciting enough or prefer to find employment in the basic or applied science sectors of the university and by industry.

Though the human and material resources at the Centre are very limited, SCDC has made some contribution in sensitizing teachers, students and pupils to the use of local materials for teaching and learning science. When SCDC was set up as a national training centre, it brought together primary school teachers, headmasters and school inspectors for the purpose of introducing them to the instructional methodology of discovery science. This was achieved by getting the teachers interested in local materials and encouraging them to try to discover things about these materials. To carry out these studies, equipment and other items had to be constructed. Most of the teachers, however, were found to lack the skills required to use the tools at the Centre. The technician successfully eliminated this handicap by means of instruction and demonstration exercises. At national workshops that have followed this initial effort, the Centre has always made use of the additional services of the chief technician of the physics department in the University College. Also, the workshop participants who want to use heavy construction equipment are encouraged to do so under the supervision of the construction workshop technician.

With the teachers becoming increasingly aware of what they can learn about things in their environment, and the fact that they recognize the possibility of using low-cost science equipment for this purpose, participants would like to be able to construct many items to take back to their schools. This, of course, is usually not possible due to the very poor financial resource of the Centre.

A possible outcome of a teacher's experience at the National Centre would be in recognizing the potential that exists within the local (and possibly rural) environment for teaching science. Efforts have been made to establish teacher centres which would serve to bring teachers together to exchange ideas and to discuss with the view to solving their problems.

Between 1970-72, teacher centres were set up at Bo, Bonthe, and Freetown. These were expected to co-ordinate with the National Centre so that advice and materials could be passed on and so that staff could exchange visits. However, due to shortage of staff, inadequate transport facilities, and lack of funds at SCDC, it was not possible to effect a reliable working

relationship between SCDC and these teacher centres.

Again as a national centre, SCDC was to have provided regular training opportunities for workshop organizers who would be placed in charge of the teacher centres. It was envisaged that in this role SCDC would allow three to five teacher-demonstrators to be attached to the Centre for a period of up to three months after which they would return to their local centres. Apart from the fact that this arrangement would have increased the professional competence of these local organizers, these trainees with field experience would have augmented the SCDC staff, thus making the Centre a more viable National Centre providing in-service training for teachers. Unfortunately this proposal, to date, has not materialized.

At the national workshops, ideas on equipment required for science teaching are introduced by the teachers. Prototypes arising out of such ideas are constructed and tested and, if found suitable, become part of the items of equipment for use by teachers.

Most useful ideas on school science equipment are born when particular problems are being studies. For example, a teacher engaged in experiments to study the passage of electric current through a coil of wire soon realizes the need to hold two or more batteries together. He may then decide to solve the problem by constructing a battery holder of a certain size and shape using readily obtainable materials such as plywood or wood from old packing cases. So he takes a hammer, nails, and a saw and produces the required device.

The SCDC has not as yet beeen developed into a centre for mass production of school equipment. To embark on this venture, the Centre would have to be provided with more technical staff and a building with adequate workshop space and more heavy machinery and technical personnel. Plans, however, have been suggested for the Centre to embark on mass production of certain materials. The Centre could also act as a maintenance unit for servicing school science equipment around the country. This service can be provided if a roving technician is available to visit schools and help with repairing equipment on site. Those items of equipment requiring major repairs would be taken back to the Centre where better facilities might be available. This proposal was made a few years ago when the Centre was in contact with a CUSO volunteer who was willing to undertake such service, but up till now the proposal has not been implemented.

In-Service Training at Local Level for Teachers

The Science Curriculum Development Centre has been involved in in-service training for teachers at the local level for a number of years. In 1970-72, SCDC staff travelled extensively across the country contributing professional service towards the training of primary and secondary school science teachers.

The in-service administrative set-up for primary teachers was tried at district level and then at town and village levels.

The district administration for these programmes usually included the Senior Inspector of Schools for the district; representatives of non-Government school authorities; headmasters of schools in the district; teacher training college tutors within the district; and the United States Peace Corps Associate Director for the area. The Director of the Science Curriculum Development Centre was usually invited to attend these organizational meetings at which schedules of in-service programmes were arranged, and brief explanation of the Centre's role in and facilities for the programme were usually discussed.

At scheduled dates, the staff of SCDC, loaded with hand tools and essential materials, would be present at the in-service course which might run for a period of 1-3 days.

These workshops were sometimes organized for the purpose of working with primary school teachers in subject areas like English, mathematics, social studies and science. Invariably, the SCDC had responsibility for the science aspects of such in-service programme.

From October 1970 to June 1971, the SCDC was involved in 54 off-campus in-service workshops; an average of six workshops a month. This field operation was made possible because the Centre had departmental transport donated by UNICEF and had an additional staff member appointed through the Education Development Centre with aid from the United States Agency for International Development. During these in-service workshops, instructors and participants, working with simple materials like discarded tins, cooking oil, razor blades, packing cases, knives, hammers and saws, examined the physical, chemical and biological properties of various substances. These practical exercises included investigations on the cultural, medicinal and other uses of plants. Though teachers found these courses professionally refreshing and useful, shortage of staff and lack of adequate funds have made it impossible for SCDC to maintain the high 1970/71 level of field operation.

In-Service Training of Technicians

In 1969, the qualified laboratory technicians of Njala University College initiated a training course for their colleagues who had not received previous training as laboratory technicians. Though the SCDC science educators were not directly involved with this course, they had informal discussions with the course organizers.

The classes were held in the evening and were arranged in the following hierachy:

(a)	Laboratory Apprentice Course	- for promotion to Laboratory Assistants
(b)	Laboratory Assistant Course	- for promotion to Senior Laboratory Assistants
(c)	Senior Laboratory Assistant Course	- for promotion to Laboratory Technicians

The syllabus for the Senior Laboratory Assistant Course was that of the City and Guilds Science Laboratory Technician Ordinary Certificate First Year.

The course structure was made up of an introduction to basic concepts of science, laboratory preparations and instrumentation. Concepts including organization of the laboratory for physics, chemistry, biology, first-aid, care of equipment, and advanced laboratory techniques. Courses were given in mathematics, biology, chemistry, physics and workshop technology. Workshop technology included the use of different machines and tools, including precision bench tools, micrometers and verniers among other things.

A major problem which the organizers had to contend with was that of funding; the funds required to provide extra materials for the course and the instructors' salaries were unavailable. Thus, even though the idea for the

programme was well conceived, the course could not be run on a regular basis. Regrettably, it was abandoned in 1975. With adequate facilities, a centre such as SCDC which is engaged in production of equipment could organize and run a technicians' training programme not only for the home institutions at the national level. Such a programme could be run at the pre-service and in-service levels.

In a technological society, laboratory technicians are expected to have the skills to repair and maintain sophisticated equipment. Only occasionally will they have to produce designs for improvised equipment. In a developing country, technicians are needed who can not only maintain and repair existing equipment, but are also able to improvise, convert old and out-dated equipment into other uses and use local resources and techniques to produce useful items of equipment.

A school or college laboratory technician in a developing country should be a workshop technician. He should be skilful with construction tools and not merely be available to prepare solutions, collect standard materials and wash up receptacles. The technician should be trained to recognize potential resources within the local environment and also to translate the ideas of the science teacher into workable school science apparatus.

With the necessary pool of laboratory or workshop technicians available to assist in science teaching, more effective teaching and utilization of local resource materials would be achieved. The science teacher would have the technical assistance to develop the equipment he needs, while at the same time he would have additional free time to develop effective teaching strategies.

Networks for Dissemination of Information on Successful Utilization of Local Materials

Various means could be used for the dissemination of information on successful utilization of local materials. These could be summarized as follows:

(a)	Printed materials	- pamphlets, handbooks, adverts, and newsletters
(b)	Audio sources	- cassette tapes and phonograph records
(c)	Video sources	- filmstrips, slides, and photographs
(d)	Mass media	- radio, television, and newspaper reporting
(e)	Network of teacher centres	

For these to be utilized, the informational materials should be available. The printed, audio-recorded and video materials have to be provided to portray the effective utilization of local materials. Such facilities as are required to record local experiences are usually hard to come by in a developing country. Even at the Njala University Campus where there is an Educational Service Centre (ESC) that develops printed and photographic materials, a film unit has not yet been set up.

The ESC records experiences in the use of local materials and produces these by lithographic reproduction. These materials, in the form of hand-outs, mini-units and unit booklets have been widely circulated and used in the development of the primary science programme.

Experience at Njala University College shows, however, that although these materials can be recorded and reproduced within a short time, it is usually difficult to collate the materials because the ESC is without a collator. This means that printed materials amounting to a thousand or more copies have to be manually collated. This procedure, of course, wastes much time and prevents useful materials from reaching recipients in good time. It would seem, therefore, that a well-equipped printing and reprographic unit centrally located and associated with the National Training and Development Centre would serve the purpose of producing materials showing the effective utilization of local materials.

When the informational materials have been prepared, they must be made available to teachers, teacher trainers and policy makers. This dissemination is best done through the national and local teacher centres. Apart from in-service courses at which teachers would be made familiar with the potential and use of low-cost equipment, information could also be disseminated through showrooms where both hardware and software materials can be exhibited. Such showrooms could be located at teacher centres and other sites around the country. This visual presentation at places within reach of schools would be a an incentive to teachers to use as well as innovate in low-cost school equipment production.

Although television could be very useful for the dissemination of such information, many developing countries do not yet possess a nationwide television system. Broadcasting on the radio lacks the visual presentation of television and is therefore not so effective.