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Science Teacher Training in Tanzania: A Study of Junior Secondary and Primary School Teacher Training Programs

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SCIENCE TEACHER TRAINING IN TANZANIA: A STUDY OF JUNIOR SECONDARY AND PRIMARY SCHOOL TEACHER TRAINING PROGRAMS

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ABSTRACT

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Purpose: The purpose of this project was twofold: to examine the curricula of science teacher training for junior secondary and primary schools in Tanzania and their relationship to policies stipulated by the Party and government, and secondly, to compare and contrast these programs with those in selected African countries in order to offer recommendations to strengthen our own programs.

Procedure: A field study was conducted in Tanzania involving tutors of the three colleges that train science teachers in biology, chemistry and physics at the diploma level: Dar-es-Salaam, Mkwawa and Klerruu and three among those which train general science teachers for primary

schools. Specifically the study investigated the syllabus contents, teaching methods and evaluation systems and how relevant these practices are to official procedures.

The instruments used in collecting data in the first part of the study included teachers' questionnaires, interviews, classroom observations, documents such as inspectors, reports, and local and national examination results. At the same time, literature on the national educational policy and teacher education were reviewed. The second part of the study was done at University of Massachusetts/Amherst library by reviewing literature about the experience of several African countries in training teachers, especially science teachers. The countries included Kenya, Uganda, Zambia and Nigeria.

Findings: The study revealed that despite the efforts made and successes so far realized, there is a general divergence of practice from the general policy of teacher training when the latter is defined in terms of broad national goals and syllabus objectives. The syllabi are not explicitly designed to train teachers to be both academically and professionally competent. These syllabi need to be re-examined in terms of appropriateness, composition and duration of study. Entry qualifications for teacher training need to be revised. The lecture and

other passive activities are predominantly used mostly because of pressure of external examinations. National examinations test more the academic rather than the pedagogical domain. Attitude training seems to be much more successful than knowledge and skill training.

There are a number of things we can learn from the other countries including how to involve Universities in one way or another in the training of low cadre teachers.

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TEACHER EDUCATION IN SELECTED AFRICAN COUNTRIES: A SUMMARY

This section contains a brief survey of teacher education systems in four African countries. Kenya, Uganda and Tanzania had a lot in common in the field of education before and immediately after independence in early 1960s. Do they still have common policies and practices in education and especially in teacher education? What does each country emphasize in teacher education and science teacher training? Nigeria was selected because it is one of the most successful countries in Africa in education. Zambia was included in the survey because of some similarities in the two political philosophies; Tanzanian "Ujamaa" and Zambian Humanism.

KENYA

The lowest cadre of primary school teachers, called P3 have two years of secondary education and two years of training. They can also be form four leavers with division III in the final examinations. The highest cadre (P2) are those who have passed their Ordinary level examinations (form four) with division II and have had two years of teacher training. Junior secondary teachers, called P1, normally have passed either Ordinary level with division I

which is the highest pass also known as distinction, or Advanced level (form six) and have completed a diploma course at one of the secondary teachers colleges or at the university. Higher forms are taught by university graduates.

The Kenya Institute of Education (KIE) is responsible for preparing the curricula for all levels of education except the university.

Although the objectives of teacher education include the need to teach the child how to learn and to develop the child's creative learning experience (Mwendwa, 1970), instructional methods are reported not to have changed much. They still emphasize the "telling" approach at the expense of the "dialogical" approach. This is largely because of overcrowded classrooms, unqualified teachers and the pressure of external examinations (Eshiwani, 1985). Kenya's emphasis in the next decade will be on technical education. One of the concerns of the government is that the curricula in primary, secondary and teacher education is not relevant to the needs and aspirations of the Kenyan people. In this case it is contemplating the complete revision of the curricula.

For science teacher training, a special college, the Kenya Science Teachers College, has been established to offer a diploma course. Plans are underway to expand it so it can offer a bachelor's degree for science teachers.

At present there are too many subjects at teachers' colleges especially in primary school teachers training. It is against this background that the government, through the K.I.E., is thinking of grouping similar subjects. For instance, all languages could be treated as communication skills. Arts and crafts, domestic science, music, physical education and cultural education could be classified as creative skills. Geography, history, religious knowledge are combined as social science, while physics, chemistry, biology, agriculture and health education are treated as natural sciences. The idea here is to confine the teaching of methodology to fewer groups, saving in tuition, time and effort.

UGANDA

There are three categories of teacher training: Grade two training is defined as a course of four years following seven years of primary education. Grade three is two years training after secondary Ordinary level education. Grade five is either two year course of training after completing Advanced level or three year training following Ordinary level.

Grade two and three are primary school teachers while grade five are secondary school teachers. The latter are trained at the National Teachers College at Kyombogo. The Faculty of Education, Makerere University, is responsible

for training of the secondary teachers at the diploma level. College tutors are trained mainly by the National Institute of Education.

The curriculum for primary, secondary and teachers' colleges are prepared by the National Curriculum Development Center (N.C.D.C.) through subject panels which include the inspectorate, teachers colleges and university staff. Teachers' guides produced by N.C.D.C. include recommended methods of teaching, but teachers select the methods or a combination of methods they will personally use. The curricula emphasize functional education for development and education for self-reliance. For this purpose, all secondary schools teach agriculture as a compulsory subject (Odeat, 1985).

NIGERIA

There are two categories of teachers in Nigeria: trained and untrained. The untrained ones have just formal education without any pedagogical training.

The lowest grade for the trained is Grade III. These have a two year post primary training. Grade II teachers are upgraded Grade III after having had a two year course (in-service). However first class school certificate (primary) are also trained for five years and receive a Grade II certificate. Secondary school learners (O'level) undergo a three year training to qualify as Grade II

teachers. The majority of primary school teaching staff in Nigeria are Grade II teachers.

Science teachers for primary schools are trained separately and these are called Grade I teachers. Selected Grade II teachers undergo a two year rural science teacher training program to specialize in the teaching of science in rural schools.

Some universities offer a one year Associateship diploma in education for Grade II teachers. The diploma is equivalent to Grade I status. Bachelor of Education (BEd) degrees are offered by universities for secondary school teachers in science and arts subjects (Ogundimu, 1985).

ZAMBIA

The University of Zambia offers diplomas for teachers in several fields including science subjects, and provides correspondence courses and in-service training for primary school teachers. The School of Education conducts a four year program for students preparing to be senior secondary school teachers in arts and science subjects. In addition, there are two teachers' colleges offering a two year course for junior secondary teachers.

The Natural Resources College conducts a three year program in agricultural education for secondary school teachers (Senyangwe, 1985). This is pertinent to the Zambian educational ideal of Development Education which is

aimed at breaking down the barrier between the different social and economic groups in that country. The majority of Zambians are peasants; thus, through the teachers trained in agriculture, students will learn better farming methods.

C H A P T E R I I

SCIENCE TEACHER TRAINING IN TANZANIA: POLICY AND PRACTICE

This section is entirely devoted to the current experience of Tanzania in the training of science teachers for junior secondary and primary schools. First, the chapter looks at the policy in terms of broad national goals of education, of teacher education and finally of science teacher education. The latter is presented as curriculum contents, entry qualifications of teacher trainees and certification. After that the practice is presented as a product of the study conducted in September to December 1986 to verify the extent to which the policy is being implemented. Specifically three areas of the curriculum were surveyed: the syllabi, their content and how the tutors feel about them, the teaching methods predominantly used and finally the evaluation systems of the programs.

A total of 16 tutors out of 29 (57 percent) who teach chemistry, biology and physics participated. They were from Dar-es-Salaam, Mkwawa and Klerruu teachers colleges. Only seven grade III A general science tutors in three colleges took part. This is a very small percentage because there are 18 such colleges which train science

teachers for primary schools. Perhaps this is one of the major limitations of this part of the study.

Data were collected by using questionnaires, interviews and class observations.

Background: The Evolution of the National Policy of Education

Tanzania Mainland became an independent nation in 1961. Since then it has made several significant changes in the education system both as a means of exercising its identity and to do away with the inherited systems of British colonialism which were not intended to educate the masses to serve their own people.

The 1961-66 period saw the integration of schools, introduction of uniform curricula and the development of education for manpower requirements. Before 1961 there were separate schools for Africans, Asians and Europeans. "Soon after independence it became illegal to keep anyone out of formal school on the grounds of sex, race, color or religious faith" (Mmari, 1975, p. 10). In 1967 the "Arusha Declaration" was proclaimed by the ruling political party, TANU (Tanganyika African National Union). The contents of the declaration were intended to direct the masses towards building socialism and self-reliance. Along with this declaration, President Nyerere, then the Party and the United Republic President, issued a paper on Education for

Self-Reliance (ESR). This paper became the basis of all major educational changes in the country. ESR outlines all the aims and objectives of education in Tanzania commensurate to a country which is aspiring to build Socialism and Self-Reliance. The paper recommended alternative curriculum contents and methods of instruction and evaluation aimed at producing egalitarian, self-reliant citizens.

In a nutshell, the objectives of ESR are of two categories as summarized by Ligate (1975, p. 58).

1. Egalitarian: To adjust the educational system to the social goals as defined in the Arusha Declaration and "Socialism and Rural Development," the latter being another policy paper by Mwalimu Nyerere following the Arusha Declaration. Thus the school should no longer be an elite establishment aloof and detached from the community; rather it should be an integral part of the community. Intellectual arrogance is discouraged and the idea of human equality is fostered.

2. Economic: To prepare pupils for a life of service to the community bearing in mind that their standard of living will depend mainly on the level of productivity they attain in farming since the majority of people are peasants.

To achieve these two goals, schools were integrated into the community in many ways; parents committees were

formed and teachers and pupils started teaching Adult Education classes in the communities. In villages they helped to construct village feeder roads and in towns they participated in cleaning the streets. Economically, schools started vegetable gardens and even large cereal farms; they raised cows, chickens and pigs, and established carpentry units in order to meet part of the schools' expenses.

However, implementation of the policy faced several problems. Chief among them was the lack of enough trained teachers in the trades: agriculture, carpentry, commerce, home-economics and the like.

Perhaps it was for this reason that the Ministry of Education established vocational secondary schools beginning in the mid 1970s specializing in agriculture, technical subjects, commerce and home-economics. Along with these schools, similar specialized diploma teachers colleges were established and the existing ones strengthened. It is interesting to note that all the colleges that offered specialized courses were for secondary school teachers only. Primary schools were not a priority for a long time. This was a great mistake, especially because ESR policy stated that primary education should be terminal and complete. Maybe the error could be explained partly by the fact that in 1972, the "Decentralization" policy led to decentralization of

schools, vesting primary and adult education in local authorities, leaving the Ministry of Education to look after secondary, teacher training and higher education (Ministry of Education, 1980, p. 2). The local governments, by nature of their financial capabilities, could not have established such big projects. The Decentralization policy was later abolished.

In November of 1984 the TANU National Executive Committee sitting at Musoma passed the popular "Musoma Resolution," a directive to the government to ensure that education is integrated with work so that it produces self-reliant people. This was a reminder to ESR, to try to correct some of the hitches of the earlier policy. The contents of the directive relevant to this paper were that primary education should be universal, compulsory and terminal, in the sense that the curriculum should aim at giving skills to the youths necessary for rural life. Secondary education should also be terminal by imparting skills which would enable the recipients to enter directly into the various middle level sectors of the national economy. The implementation of this is vocationalization of schools, which is discussed above.

In summary, all these changes and modifications by the Party and Government were an attempt to effect not only the policy on access to formal education, but also the policy on what type of education should be given in formal

educational institutions and for what ends (Mmari, 1975, p. 10).

Science Curriculum at Teachers' College: The Situation Today

National Goals of Education

The national policy on teacher education rests on the general policy of education in Tanzania. The policy of education of any country can be seen from the written goals and objectives of such education. Let us look at the general aims of education in this country before we consider those of teacher education and science teacher education in particular.

1. To provide Tanzanians with a proper education, that is, knowledge and understanding, important skills and attitudes appropriate and relevant to the national policies of socialism and self-reliance; that is, science, technology and vocational training.

2. To develop in our people self confidence and an inquiring mind in order to enable every citizen to make a material and moral contribution to the development of society; to search for, accept and respect truth; to carry out scientific investigations, and research; to promote discoveries and inventions; to try out new things and learn, adopt and adapt acceptable theories and practices from others without prejudice.

3. To enable the student to understand a variety of world social systems.

4. To enable Tanzanians to understand, accept, respect and value their customs and traditions, practices and ethics and to apply these principles.

5. To prepare young people for work with emphasis on cooperative work (Ministry of Education, 1980 , Ministry of Education, 1984).

In short, we can see that the policy is aimed at developing Tanzanians academically and professionally (and semiprofessionally) but at the same time it offers a great provision for the majority who would not get professional qualifications on account of the meager resources obtainable in the country. This policy is both inward and outward-looking in the sense that it provides for understanding national and international issues. One of the most significant points in the policy is the deliberate emphasis on developing a socialist attitude with its accompanying principles of equality, morality and cooperative work.

National Goals of Teacher Education

Teacher education aims at:

1. Providing the student teachers with adequate knowledge of the principles of education and selected specialized subjects in order to enable them:

a. To develop the highest possible competence in the subjects they will teach.

b. To acquire, apply and pass on to others the techniques of scientific investigations and research.

c. To acquire, assimilate and pass on to others the national cultural practices, including their moral, ethical and aesthetic principles.

2. Providing the student teachers with a knowledge of philosophy of development to enable them:

a. To teach with competence and so develop and expand the general level of education and scope of pupils in their care.

b. To instill in the children the principles of good citizenship and a sense of self-sacrifice for the good of society.

c. To develop in the children an appreciation and acceptance of the national policy of socialism and self-reliance.

3. To provide the serving teachers with further training in order to improve their academic and professional abilities and efficiency.

The Science Teacher Education Programs

Both the diploma and Grade III A course require the completion of two academic years. Three colleges in Mainland Tanzania offer diplomas in Education-Science

courses. These are Chang'ombe (Dar-es-Salaam), Klerruu and Mkwawa teachers colleges. In these institutions there are three different approaches (Kessi, 1985) based on the entry qualifications of the candidates.

1. The "Ordinary" Pre-service Approach: Candidates are those who have completed the "A" levels, that is, six years of secondary education. Their program includes general education courses such as Psychology, Philosophy of education, Research methods, Curriculum Development and School Administration. Additionally, they specialize in two secondary school teaching subjects together with Political Education. This approach is found in Dar-es-Salaam and Klerruu colleges.

2. The In-service Approach: This is also known as "Upgrading A to Diploma." Candidates are Grade III A teachers who must have been teaching in primary schools for at least three years. Prior to teaching they underwent a teacher training course for two years after having completed "O" level, that is, four years of secondary education. The course is a crash program in the sense that candidates study two subjects (from 1983 until now, biology and geography) plus political education and sit for National "A" level examinations after only one academic year instead of two. They are considered private candidates and therefore their continuous assessment is not taken into consideration in their final evaluation. In the

second and final year, successful candidates continue with the same subjects, but this time they study the diploma syllabus. In other words, the amount of work that is normally done in four years is in this case done in only two years. This approach is offered at Dar-es-Salaam college, although under similar conditions other arts and languages subjects are offered at Dar-es-Salaam and Mpwapwa teachers colleges.

3. The "High School" Pre-service Approach: Candidates enter teachers college directly after the "O" level to pursue a diploma program. The program takes three years. They study for their high school certificate and sit for "A" level examination after two years of study. In the third year they study the diploma syllabus. The program includes two science subjects and education plus political education. Only Mkwawa teachers college offers this program.

Graduates from all the three approaches teach form one through three or sometimes form four. Some of them are posted to teach in teachers colleges with Grade III A and III C in their subjects of specialization.

Grade III A Certificate Course

All teachers colleges which offer Grade III A have science in their programs. The course is a general, non-specialized subject including topics in biology,

chemistry, physics and earth science. There are 18 such colleges. Just as in the diploma course they study education and political education. But in addition to these they are taught: geography, history, English, Kiswahili, mathematics, physical education, home economics, music, arts and crafts. As pointed out earlier in passing, candidates enter the program after the O'level. Upon successful completion of the course, they teach in primary schools.

At Mkwawa teachers college the science course is more intensive than in other colleges. The course curriculum is divided into three sections: chemistry, biology and physics, which are taught as separate subjects. The aim is to train better science teachers for primary schools.

Subject Area Combinations

At form five and six ("A" level) all students have to specialize in three subjects, be it in science, arts or languages. When they join the diploma course of study they are allowed to choose the best or most favorite two out of the three. The choice is based on "A" level passes. The following combinations are currently offered, irrespective of the approach followed:

1. Biology/Chemistry
2. Physics/Chemistry
3. Maths/Physics

4. Maths/Chemistry
5. Biology/Geography
6. Geography/Maths

It should be understood that not all these combinations are obtainable in all the three colleges: Mkwawa, Klerruu and Dar-es-Salaam. The number and type of subject combinations offered in a college is contingent upon facilities and teaching staff availability.

Out-of-Class Activities

In implementing the national policy of Education for Self-Reliance, out-of-class activities are integrated with classroom work. Students "learn by doing" and at the same time contribute to their own upkeep by using the products of their work (Mmari, 1979).

Some of the work activities include care of livestock, farming/gardening, carpentry, simple crafts, teaching adult education classes, nursery school, etc. Every student is required to take part in at least one of these "Self-Reliance Projects" as they are popularly known (College Prospectus, Dar-es-Salaam Teachers College, 1983/84, p. 35). It is interesting to note that although tutors are assigned to take part in these projects as directors and active participants, students assume full responsibilities in leading their own groups through their democratically elected leaders.

Block Teaching Practice (B.T.P.)

The ordinary pre-service approach offers two sessions of six weeks each of supervised teaching practice and 48 weeks of college instruction. On the other hand, the high school pre-service program offers only one session of six weeks of BTP and about 74 weeks of in-college instruction (Kessi, 1985). The in-service program offers one session of the same duration in the second year. This is because the "high school" and in-service models reserve the first part of their programs for intensive "A" level academic work as it was pointed out earlier.

Candidates Entry Qualifications

"Ordinary" Pre-service Approach (Dar and Klerruu). Prospective candidates must have written the National Form Six examinations and passed with at least three subsidiary passes (S) in three of the following:" physics, chemistry, biology, maths or geography. All "A" level students specialize in three principal subjects; e.g., PCB, PCM and CBG. Basic mathematics, otherwise known as Basic Applied Mathematics, is compulsory for all science students regardless of combinations they choose.

"High School" Pre-service Approach (Mkwawa). Candidates must have passed National Form Four examinations in at least three subjects in science. They must have earned an A, B or C in two of these subjects. After two

years of study they must have at least three subsidiary passes at form six in order that they can proceed to the third year of the diploma in education (Ministry of Education, 1982).

In-service Approach (Dar-es-Salaam). Prospective candidates are Grade III A teachers with passes A, B or C in their National Form Four examinations in at least three science subjects (College Prospectus, Dar Teachers College, 1983/84, p. 7).

Grade III A Course. The prospective candidate must have passed at least four subjects at the "O" level, two of which must be at grade C or above. Alternatively, they could pass at least five subjects, one of which must be at grade C or above.

Additional Qualifications. The applicants must have indicated in their career application forms that they prefer to join the teaching profession. The prospective candidate must have been recommended by their secondary school teachers (normally the Headmaster/Headmistress) for their eligibility of being teachers with at least a grade of C; that is, satisfactory. (A is "very good" and B is "good".)

Tutors (College Teachers). All the tutors of diploma science subjects have Bachelors degrees. A few of them have Masters degrees either in their subjects of specialization or in Education. Most of them have, in

addition, secondary school teaching experience of at least three years.

Conditions of Certification

Diploma. A successful candidate is one who at the end of the course scores an A, B, C or D grade in each of his/her two subjects, education and political education. One must also pass the Block Teaching Practice.

In case a candidate fails in one of the subjects he/she must resit it within two years after the first attempt. Meanwhile they are allowed to teach without a certificate. Candidates are allowed to resit only once and if they fail again they are discontinued from the profession. Except in mathematics the failure rate is generally very small indeed. In Dar-es-Salaam college for instance, only one or two may fail in one year and sometimes there are no failures at all in a group of about 200 candidates.

Grade III A. A candidate is regarded as a failure if he/she gets less than a D in more than four of the eight examination subjects.

Features of the Syllabuses

Physics

Objectives: At the end of the course, students are expected to be able to:

a. Acquire a useful command of physics concepts and principles.

b. Explain the physical realities within their immediate environment.

c. Achieve professional competence in imparting these relevant knowledge and skills to Form I to IV pupils.

d. Use effective techniques of teaching physics.

e. Recognize and appreciate that physics knowledge is a tool for technological development (Diploma Physics Syllabus, Ministry of Education, 1980).

Structure and Content: The syllabus is divided into two sections:

a. Academic Section: This includes Measurements, Introduction to vector analysis, Forces, Energy, Motion, Wave theory, Quantum theory, Electromagnetic induction, A.C. Circuits, Structure of Matter, the earth (structure and origin).

b. Principles and Methods of Teaching Physics: Aims of teaching physics, physics curriculum development, various teaching methods, physics teaching preparation (lesson plans and schemes of work). Physics teaching aids, projects and field trips, Assessment methods and techniques, Laboratory management, and finally, Microteaching and analysis of the secondary school syllabus.

It is further directed that under syllabus analysis the tutor should demonstrate, discuss, and arrange microclasses in all the topics in the "O" level syllabus -- including Mechanics, Wave motion, Optics, Electricity and Magnetism, etc.

For every topic there is a list of several behavioral objectives that should be achieved. There is also a list of suggested activities, experiments, projects and field trips for each topic.

Chemistry

Objectives: Generally, the objectives of this syllabus are to enable a student teacher to:

a. Know the fundamentals of chemistry teaching.

b. Employ appropriate methods in the teaching of the subject.

c. Acquire basic principles of chemistry taught in secondary schools ("O" level -- emphasis mine).

d. Relate chemistry with everyday life.

e. Manage a school laboratory.

f. Manipulate and use with skill the chemicals and apparatus in the laboratory (Diploma chemistry syllabus, Ministry of Education, 1980).

Structure and Content: The syllabus is not physically divided into sections of methods and academics.

However, the first four topics are pedagogical or skill oriented -- including:

a. The laboratory -- preparation of standard solutions and the like.

b. Application of psychological principles to the teaching of chemistry.

c. Chemistry projects.

d. Laboratory techniques -- including laboratory equipment and how to use it.

The rest of the topics are academics -- although not labeled as such. They include: Matter, Oxygen, Oxides, Atomic structure, Chemical bonding, Hybridization of atomic orbitals, Resonance, Isomerism, The Benzene chemistry, chemistry of Transition metals, Nonmetals, Metals, Kinetics and Energetics, Electrochemistry, Soil chemistry and finally Organic Chemistry.

As in the physics objectives (which are actually goals in the correct meaning of the word), class activities and references are also provided for each topic.

It is directed that more time should be spent on HOW to teach than WHAT to teach in the ratio 3:2, respectively. Thus the coverage each year should be as follows:

Methodology -- 162 periods

Academic -- 108 periods

Teaching practice, six weeks (i.e., 60 periods).

Additionally, there should be three weeks for revision at the end of each term.

A critical discussion of this plan is found later in this Chapter .

Biology

Objectives:

a. To prepare biology teachers for secondary form I to IV and teach with confidence and efficiency.

b. To enable teacher trainees to analyze and interpret the biology syllabus -- for form I to IV.

c. To provide teacher trainees with every opportunity to investigate problems by performing individual experiments to develop their efficiency in laboratory techniques and practices.

d. To expose the teacher trainees to the current methods in the teaching of biology.

e. To raise the academic standard of the teacher trainees by teaching them topics which were difficult during their secondary school time or new changing topics which are currently under research.

f. To enable teacher trainees to apply their biological skills in solving environmental problems.

g. To enable teacher trainees to impart the biological skills to their pupils so that these pupils can solve the biological problems of their environment.

Structure and Content: This syllabus is more elaborate than the previous two. It is divided into four sections.

Section A -- Selected Academic Topics: Principles of classification, Plant-water relations, Photosynthesis, Respiration, Responses in animals and plants, Excretion in Plants, Genetics, Organic evolution, Interdependence of organisms (Ecology).

The topics are selected from a longer list of "A" level syllabus. Those left out from the high school syllabus include Cytology, Histology, Basic biochemistry and Reproduction. Details of the selected topics are similar to "A" levels and are sometimes above them.

Section B -- Methodology: The nature of Science Approach to the teaching of biology, Measurements (Test construction, etc.), curriculum development in biology.

Section C -- Laboratory Skills and Management: Biological skills such as preparation of chemical reagents, collection and preservation of specimens, etc. Laboratory management and maintenance.

Section D -- Analysis of "O" Level Biology Syllabus: This includes cell structure and function, Parasites and diseases of man, soil and plant growth, Nutrition (of both plants and animals), genetics, reproduction, etc.

The syllabus is arranged in columns (like physics and chemistry) of Topics, Objectives, Activities and

References. Section D carries two additional columns of concepts and skills to be emphasized and methods to be used.

Generally speaking, the biology syllabus is much more systematic and explicit than physics which is better than chemistry. Perhaps the advantage is that it minimizes diverse interpretations by different physics tutors and by other related institutions like the National examination council.

In this observation on clarity of curriculum (policy) not another factor yet to explain why a number of students claim that biology is easier than chemistry or physics?

Grade A General Science

Objectives: At the end of the course, students are expected to be able to:

a. Have acquired necessary techniques in teaching primary school science.

b. Relate classroom teaching and everyday activities.

c. Think scientifically.

d. Have a sense of Self-Reliance and advance themselves in science.

e. Relate science to other subjects.

f. Recognize the importance of science in human development (Grade A Science Syllabus, Ministry of Education, 1985).

Structure and Content: The syllabus is divided into academic and methodology sections.

The following topics are listed under the academic sections -- Matter -- including structure of atoms, Bonding, Compounds, Elements, Acids, Bases, Salts and Chemical Kinetics.

Mechanics -- including Newton Laws, Pressure, Work, Energy and Power Machines, Electricity, Heat, Light, Sound, Living things, Photosynthesis, Respiration, Sensory organs, Reproduction and Growth, Soil, Ecology, Astronomy, Weather, Rocks and Minerals.

Under methods are the following: What and why science, Principles of teaching science. Methods suggested include the discovery method, deductive and inductive, heuristic and experimentation. Cognitive, affective and psychomotor domains. Projects in science, Lesson planning, Measurements and Evaluation, Making teaching aids, Analysis of Primary school science syllabus.

Grade III A Science at Mkwawa Teachers College

As pointed out earlier in this chapter Mkwawa College offers a more intensive science course for the Grade A teacher trainees. More advanced topics are added onto the

normal program. These include Genetics, Radioactivity, Electronics, Cathode rays, Valves and transistors, Organic Chemistry topics, namely Hydrocarbons, Alcohols, Organic acids, Amines and Amides, Aldehydes and Ketones, Diethyl ether and Polymers.

Policy on Teaching Methods

All the four syllabuses presented above suggest the following teaching strategies: Discussion, Experimentation, Demonstration Projects, Field trips, Heuristic, Inductive-Deductive and Lectures. Lectures are to be used the least. Generally, methods that involve inquiry are highly recommended. The application of teaching aids (audio and visual) is emphasized. Micro teaching is also emphasized in all the pedagogical sections of each syllabus.

The integration of theory and practice is absolutely essential.

Unfortunately, science process skills, i.e., observation, investigation, prediction, inference, and the like are not particularly emphasized although they form the basis of any science education.

Policy on Evaluation of the Curriculum

All teacher education curricula including the science programs irrespective of the level (certificate or diploma)

are evaluated in four areas. Before we briefly look at them it is interesting to note that these areas together take care of the three basic faculties a teacher must be trained for; that is Knowledge, Skills and Attitudes or Values (UNESCO, 1973, p. 27).

The four areas are:

1. Continuous Academic Assessment: This includes weekly or monthly exercises or tests, terminal (semester) examinations and projects. This coursework component carries 50 percent of the whole evaluation in the final analysis. Special forms are available in which the cumulative progress is recorded.

2. Teaching Practice: As explained earlier in this paper, blocks of time in the academic year are spent for field experience. Student teachers are sent to schools where they work under the assistantship of experienced teachers. Their tutors sit in their classes at least four periods in the entire six week course. Standard prepared forms are used in the assessment. Items on the forms include: Use or appropriate teaching aids, mastery of subject matter, handling students questions, motivating pupils, etc.

3. Character Assessment (Social Attitudes and National Spirit): This is a cumulative assessment of students towards society and the national ethic as

expressed by the things they do during their two years at the college.

4. National Examinations: Written examinations at the end of the course. These carry 50 percent of the entire evaluation.

If a student scores very low in continuous academic assessment he/she may be discontinued before the end of the course if efforts to help fail. But this normally does not happen. If, on the other hand, a diploma student fails in one of the four subjects (political education, education, or the two teaching subjects) in the National Examinations he/she can resit within two years after the first attempt.

Findings and Their Implications

In the previous section an attempt has been made to describe and explain in detail the policy of science teacher training in Mainland Tanzania at the diploma and the certificate level. This section presents a discussion of the findings or practices obtainable in colleges today. How do teachers perceive the syllabi and examination processes? How appropriate are these? What teaching methods do they use and why? What do the final examination results look like? What do such results mean to us? These are but some of the issues appearing in this section. Actual statistics obtained from the field study have been omitted but they can be found in the original paper of this

study on Tanzania titled "Science Teacher Training in Tanzania: Policy and Practice" by the same author.

The Diploma Program

The Syllabuses: We have found that the syllabi of Diploma and Grade A Certificate are (1) Too long for a period of two years; (2) Too advanced; (3) Not tailored to provide a realistic opportunity for learning the professional and academic components of the vocation.

It is clear that teachers colleges are in origin and intention vocational institutions. But they have both "vocational" and "educative" objectives. It has been observed (Golby et al. 1975) that all sides of a student's course should and can contribute to his/her personal academic education and that as a student's professional understanding grows, it will affect his/her personal development. What is advocated here is the concurrent course program whereby methods and contents are taught in a way that they support each other.

Renshow (1971), in proposing objectives and structure of the college curriculum had similar observations; a college of education has twin functions: - Personal (academic) development and professional (vocational) development. The tendency, in many areas the paper notes, is that academic study is not necessarily connected with the teaching work. "All academic study ought to be

conceived within a professional frame of reference; it ought not to be pursued for intrinsic reasons alone. A balance between theory and practice needs to be maintained in any professional study, and much of the theoretical knowledge must be acquired through academic study."

The proposed model of the integral program and the argument that the teaching profession should be a "knowledge-based profession" has four interrelated elements, namely:

(a) Nature of the discipline.

(b) The place of the subject in education.

(c) The psychological aspect of learning the subject.

(d) The subject matter for schools and teaching methods.

From this model it can be seen that the "professional relevance connotes a wider sense than the immediate practical needs of the classroom.

In the same vein and deriving from findings of this particular study, this paper attempts to formulate an integral model for teacher education programs in Tanzania, at the Diploma and Certificate levels which are its main concern.

Proposed Teacher Education Programs

FIGURE 1

Certification Level	Present Qualification	To Teach	I Scope of Syllabus
Grade C	Std. 7	Up to Std. 3	Std. 1-5
Grade A	Form 4	Up to Std. 7	4-7
Diploma	Form 6	Form 1-2 or 3	Form 1-4

Certification Level	II Only Selected Topics in the following syllabuses
Grade C	Std. 6,7, Form 1 and 2
Grade A	"O" level and Form 5
Diploma	"A" level and University level Year 1.

I. Intensive and extensive academic and professional (methodology) training is required. Since candidates will have successfully completed their respective levels, they will not find the academic part too difficult. Consequently, claims of time not being adequate for the program will be allocated for methodology, as policy directs. Remember that it has been shown earlier that the situation today is the opposite of what the new model and the policy are advocating.

II. Selected topics are included in order to serve as a "bridge" between the maximum level of education a candidate reached and the next level of education. For

example, diploma student teachers should learn in addition to form 1-4 materials, Advanced level and at least year 1 University in their respective subjects of specialization. The rationale here is first, that we want them to know more of their subject matter than their clients (in this case, junior secondary school pupils). But equally important is the second point, which is to equip the student teacher with knowledge which will help them advance to the next level of education without much difficulty. For instance, diploma students, after working for a couple of years or so may wish to undertake undergraduate courses.

Although I don't intend to interfere with the freedom of individual departments or tutors in arranging their schemes, the practice of having a whole month or two for academics, and the following month for methods seems to dichotomize the two objectives of teacher education. It is desirable to program such that academic and pedagogy are mixed throughout the week, month, semester, and year.

It was pointed out earlier that the present diploma syllabuses are in most cases, repetitions of "A" level ones. Let's look at a comparison of some of them:

Diploma Physics (Academic	"A" Level Physics
1. Measurements	1. Errors and observation
2. Units and dimensions	2. Dimensions of physical quantities
3. Error Analysis	3. Mechanics
4. Vector Analysis	4. Force
5. Force	5. Properties of Matter
6. Energy	6. Heat and thermodynamics
7. Motion	7. Waves
8. Wave Theory	8. Electricity and Magnetism
9. Quantum Theory	9. Electronics
10. Structure of Matter	10. Modern Physics
11. Electricity and Magnetism	
12. The Atom	
13. The Earth	

These two syllabi are very similar, not only in terms of names of topics, but also in their details. Apart from this, the diploma candidates have to undergo training in the second component of the course - that is the methodology part - which is another repetition of all "O" level syllabus in just two years.

The diploma biology syllabus is also quite similar to the "A" level one except that topics like cytology and basic biochemistry are left out in the teacher training program. The chemistry syllabi have a more or less similar relationship.

Such programs have so far brought about the problems we are dealing with today such as lack of time, consciously avoiding "hands on activities", etc. Consequently it is not possible to produce professionally and academically competent teachers at the same time.

Because the syllabi are so advanced, three major problems arise with consequent low passes at diploma and Grade "A" final examinations.

1. They are more of preparatory for further education, e.g. University studies than for teaching form I, II, and III.

2. Because of lack of essential materials and equipment for the courses, the teaching is not effective. The laboratories for instance, were not built to cater for "A" level courses, but for "O" level (save Mkwawa teachers college).

3. Entry points of students now appear to be low, that is, some of them "failed" in form 6 and therefore cannot cope with the advanced material now being taught.

In order to substantiate the third problem, we can compare entry qualifications (Form 6) and grades attained after the diploma course for a randomly selected sample of candidates, 1985 and 1986. In this presentation only a summary of the comparison is given. By comparing the two scores, the author could decide if a candidate (a) deteriorated, (b) showed no improvement, (c) showed slight

improvement, (d) had good improvement, and (e) had very good improvement.

TABLE 1

Comparison of Scores in Form 6 and Diploma Examination for 53 Diploma in Education Finalists, 1985

	CH	BL	PH	MT	GE	TOTAL	PERCENTAGE
Deteriorated	5	4	10	1	1	21	19.8
No improvement	16	16	14	6	3	55	51.9
Slight improvement	8	2	3	9	3	25	23.6
A good improvement	1	2	1	1	-	5	4.7
A very good improve.	-	-	-	-	-	-	0.0

Source: National Examination Results and students personal files, Mkwawa and Dar-es-Salaam Teachers College.

TABLE 2

1986 Data (38 Candidates)

	CH	BL	PH	MT	GE	TOTAL	PERCENTAGE
Deteriorated	1	-	1	1	-	3	3.9
No improvement	13	12	9	6	1	41	54.0
Slight improvement	6	4	4	1	3	18	23.7
A good improvement	3	4	-	1	1	9	11.8
A very good improve.	2	1	-	1	1	5	6.6

Source: National Exam Results and Students personal files, Mkwawa, Dar-es-Salaam and Klerruu Teachers College.

KEY	FORM 6	DIPLOMA
Deteriorated	Subsidiary (S)	F or any such α trend
	Principal E, D	
No improvement	Subsidiary (S)	D grade
	Principal E, D	
Slight improvement	Principal E, D	C grade
A good improvement	F (fail)	C grade
	Subsidiary (S)	
Very good improve.	Principal D or lower	B
	Principal C or lower	A

It is important to note that the total indicated in this sample is the total number of papers attempted. Each candidate writes two science papers, e.g. Physics and Chemistry, Chemistry and Biology, etc. Thus the number of candidates is half this total.

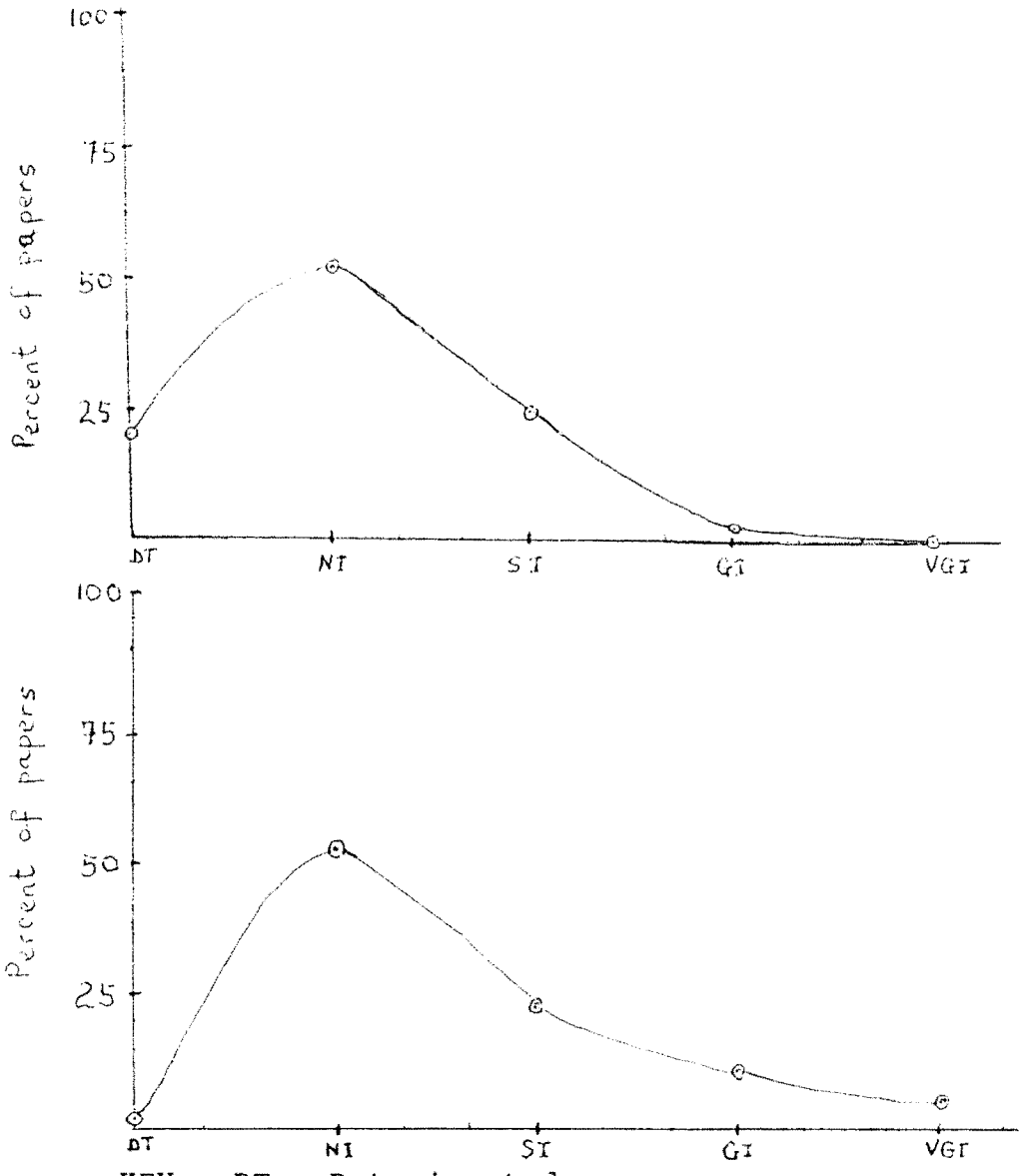
Geography and Mathematics are included here because some of the candidates study Geography and Biology or Physics and Mathematics.

Perhaps graphs will simplify the argument (refer to Figure 2 on next page).

The tables and graphs show that both in 1985 and 1986 in more than fifty percent of papers written in science subjects for the sample of candidates randomly selected there was no improvement (in significant terms) when passes of Form 6 are compared with diploma results.

FIGURE 2

Comparison of Scores in Form 6 and Diploma Examinations for 1985 and 1986



KEY: DT = Deteriorated

NI = No Improvement

SI = Slight Improvement

GI = Good Improvement

VGI = Very Good Improvement

In fact, in some subjects there were a regression in pass levels: 19.8% and 3.3% in 1985 and 1986 respectively. Only in a small minority, there was good or very good improvement. Less than a quarter showed slight improvement (23.6 and 23.7) percent in 1985 and 1986 respectively). In view of these findings, academic standards have not been improved as much as anticipated by the policy. This calls for a recommendation that a review of the syllabus and/or of entry qualifications for science teacher trainees is essential.

It is true that the teacher education programs include a professional component (methodology) whereas those in "A" level do not. But this particular study has found that student teachers have no problem with the methodology part of the syllabus. Kessi (1985) reported a similar response that students find methods much easier than academic section. These two studies indicate that methods components would not affect performance of the examinations to that extent.

Further, data from this same sample indicate that candidates who enter college with low passes are most likely to perform poorly in the final examinations. This may sound as a matter of common sense, but with the following objective evidence one can see more than that.

The 1985 results show that there were a total of twenty-eight "C" graduates scored by a sample of the

fifty-three candidates - from Mkwawa and Dar es Salaam Teachers' College. Twenty-three of these (i.e. eighty-two percent) were scored by candidates who had had principal passes E and D at Form 6. Only five "C" grades (eighteen percent) were scored by those who had just subsidiary passes. In the same year and same sample there were twenty-three "Fs" (complete failure); fourteen of these (about sixty-one percent) belonged to those who had subsidiary passes. Five Fs (seventeen percent) to those who had "Fs" as they entered college. Only four "Fs" (seventeen percent) belonged to those who had a principal E or D.

This observation verifies in a way that we can predict with a substantial degree of accuracy, scores at diploma examinations from Form 6 results. Statisticians would call this "a high predictive validity of Form 6 examinations" with respect to diploma examination results.

Thus, if we agree that a very good (A), good (B), and satisfactory (C) pass is an indicator of an academically (and possibly professionally) well prepared teacher, then we have to consider raising the entry qualifications of diploma in education program. Two principal level passes, at least "E" in any two subjects of specialization - instead of three subsidiary level passes required now.

It is high time we looked for quality instead of quantity.

If this may prove difficult, we might allow them to specialize in only one subject. this, taken with political education and education, will provide enough load and challenge to the candidates. Alternatively, we can introduce a major/minor system whereby a candidate will major in that subject which he/she had a higher principal pass and minor in the other. In the minor subject they can only do the methodology section while in the major subject, details of academic and methodology could be taken.

Examination

There is not much to comment on the continuous academic assessment as the findings show that it is done almost according to the policy/directive of the National Examinations Council of Tanzania.

The final examinations have been reported to be too academic just like the syllabi are. Consequently, as discussed in the previous section, the performance leaves much to be desired due to the reasons cited, including level of entry qualification and teaching and learning facilities. Let's take a brief look at a sample of 1986 diploma science finalists.

Generally speaking, the results are characterized by "D" grade which is the minimum pass one can obtain in this examination. Will these really make professionally and academically competent teachers? On the other hand,

TABLE 3

Results of 25 Science Diploma in Education Final Examinations, 1986, Klerruu, Dar-es-Salaam and Mkwawa

Candidate	Physics	Chemistry	Biology	Maths
1	D	D		
2		D	D	
3		D	D	
4	D			D
5		D	C	
6		D	D	
7	F			F
8	D			F
9		C	D	
10	C			F
11		D	C	
12		D	D	
13		D	C	
14		D	D	
15		C	D	
16		D	D	
17		C	C	
18		C	D	
19		F		D
20		D		C
21	D	D		
22	D	C		
23	C	B		
24	D			D
25		D	D	

candidates studying languages, history, or home economics usually score "C" as an average grade. Obviously something must be wrong with the science programs. In the previous section we saw how these results compared with entry qualifications. Maybe this is just one of the contributing sources of the problem.

The National Examination Council and Ministry of Education through the Institute for Curriculum Development should work together to find out more about the problems of this program which has not been seriously evaluated since it was instituted six years ago.

Concerning "crash" programs like the upgrading Grade "A" to diploma, results for the single science combination biology/geography at Dar es Salaam Teachers' College have not been encouraging so far particularly in biology. As a matter of fact, the situation is worsening. Since 1984 when the first group wrote the Form 6 examinations after only one year of study, results show that most of the candidates cannot qualify for entry into second year as demonstrated in table 4 below.

Both the number of candidates who opt to pursue this course and their scores are decreasing tremendously year after year. This year (1986/87), there are only two candidates who will sit for the "A" level biology exams in May, 1987. Already the trend depicts that it is too tricky for one to choose that combination.

TABLE 4

National Form Six Examination Results for Biology

Upgrading Course: Grade A to Diploma

For the First Three Years

	Number of candidates who scored the grade each year		
Grade	1984	1985	1986
A	-	-	-
B	-	-	-
C	-	-	-
D	3	-	-
E	4	1	-
S	4	2	-
F	11	12	7
Total	22	15	7

Source: Abstracted from The National Examination Council of Tanzania, Advanced Certificate of Secondary Education Examination Results Booklet, May 1984, 85 and 86.

Several factors contribute to this pathetic situation, chief among them the unsatisfactory entry qualifications arising from their poor background, and the length of the "A" level syllabus which is compounded by the fact that they have to cover it in half the time normally prescribed, that is one academic year instead of two. In addition, it has been pointed out elsewhere that the

college laboratory was not meant for "A" level teaching. I am quite sure that the tutor' competence is not doubtful at all. The biology department at Dar es Salaam Teachers' College is one of the most and best staffed in the College. There are almost constantly four tutors, all University graduates and adequately experienced. One of them holds a Masters degree in biology and another Master of Education.

If the same course is offered in schools and at Mkwawa Teachers' College for two years and yet their results are not very good, how do we expect long-serving primary school teachers to cover the course effectively in one year with all the problems we have highlighted here? After three years of experimentation, it is high time the Ministry of Education, particularly the Teacher Education section looked at the program afresh. One of the recommendations is to extend the duration of the course. The first two years would be used for "A" level studies and the third year for the proper diploma course. This will be similar to the Mkwawa system.

Finally, teacher education science exams should include practicals. This should automatically stimulate hands-on experience now very seldom included in the colleges. Inspectors reports in all the colleges in which this study was done continue to blame tutors for not teaching by the experiment method. There has not been any

change at all because tutors are very much aware that practicals do not form part of the final examinations. I am quite sure if they (the National Examination Council) removed practical exams from National Form Four and Six for whatever reason, teachers in secondary schools would also revert to teaching without experimentation.

Teaching Methods

From class observations, interviews and Inspectors' reports, we have seen that the lecture method characterizes science classes at the diploma and Certificate levels. All the syllabi suggest methods of student involvement. Even the broad national policy directs a mixture of student and society approach (Ligate, 1975). Yet educational institutions and teachers colleges have not been able to adopt it fully.

Ketta (1986), studying the adoption of discovery methods in teacher education, found out that only the theory of the discovery method was taught with the expectation that they (the student teachers) would apply it in their schools. The author found the following reasons for non-adoption of discovery methods:

1. Inadequate training of tutors in the discovery method.

2. The curriculum for teacher education is not problem solving oriented despite the policy.

3. Time required to cover the syllabus is not equivalent to contents. Discovery methods require more time than lecture method.

4. In some cases, the teaching load is too heavy.

To reduce the latter, some tutors combine two or three classes (about 50 or 75 students). Consequently this means a high tutor/student ratio definitely unfit for any effective discovery approach. The lecture method remains the answer. If any other activity is incorporated, it is either some discussion in the crowded classroom, or a demonstration.

While this paper still recommends that discovery methods should be emphasized despite these hitches, the education course at University of Dar should also be reviewed. It should be more practically oriented, training in the actual skills of teaching. This is particularly essential for the Bachelor of Education Course program for would-be teacher trainers.

Microteaching is suggested in all the syllabi. But I suspect that the term is loosely used both in the syllabus (policy) and by many tutors (practice) to include situations in which a student teacher teaches a whole class in a whole period of 40 minutes or even 80 minutes. Feedback is given but this is often too general. As a result the trainee cannot concentrate and learn any particular skills. In "modern" microteaching founded by a

group of educational researchers at Stanford University, United States of America in 1963 a student teacher can effectively learn specific teaching skills like introduction, reinforcement, questioning techniques and so forth. This is made possible because the teaching is scaled down in terms of time, class size and teaching complexity.

Ideally a student teacher would teach a small group of pupils (or even peers) for a short time, say 10 to 15 minutes, practicing just a single skill. After that the tutor and students, aided by a video or audio recorder, give feedback (also called a critique) to the training teacher. If necessary, the trainee re-teaches, focusing on the same skill until all the participating parties are satisfied that the skill has been mastered.

My own experience as a student in the U.S.A. and recently as a researcher at Dar-es-Salaam Teachers' College indicate that the method works, even without sophisticated equipment like video or audio machines (refer to my report on "Introduction to Microteaching at Dar-es-Salaam Teachers' College, Fall, 1986).

Equally important for both the two levels (diploma and Grade A) is the inclusion of "Science Process Skills" in the training program. In this case, teacher trainees learn how to teach science by investigation, observation, graphing, inference, prediction and so on. Again these

skills are not thoroughly understood by the tutors. In-service workshops and seminars should be arranged for tutors who train both secondary and primary school teachers.

Grade III A Science Program

From the findings of the Grade A program it seems that due to the small size of the population sample, the outcomes are illuminating rather than generalizable, exploratory rather than definitive. But that fact notwithstanding a brief discussion and some recommendations must be included here. In the previous discussion some points were mentioned concerning Grade III A findings as well.

As far as the syllabus is concerned tutors' worries about its length are genuine. There are just a lot of things to be covered in the time available (two hours per week). The tendency is often times to rush through and complete the content for the purpose of the examinations. The obvious consequences of this kind of teaching are, among others: Low level of passes at final examinations, and low level of scientific knowledge and skill transmitted to primary school pupils. Taking only one year, 1985, and only one representative college, the results were as follows:

A	-
B	-
C	22
D	115
F	32
Total	169

Source: National Examinations Council of Tanzania: Teacher Education Examination, Grade III A, May 1985.

It is worrisome to note that the 1978 certificate science syllabus was intended for both Grade A and C. The latter are standard seven leavers who are trained to teach standard one through three or four at most -- while the former are form four leavers -- training to teach up to standard seven. How do we make the same program for two groups with different levels of education? It is unrealistic for grade C candidates to learn and understand topics like chemical kinetics, Newton's Laws of motion and the like -- which form part of that syllabus. Fortunately the new syllabus edition (1985) is for Grade A only. I hope the new edition for Grade C is appropriate to their level.

At the beginning of this discussion, this paper attempted to propose a model for Grades A and C and diploma science teachers. I recommend that this should be the beginning of the dialogue among interested and concerned

parties towards the formulation of viable and realistic programs.

It was found that students who never took science subjects at secondary schools (or who did not go beyond form two science) have to study it at teachers' college. The paper recommends that there should be some sort of specialization. Non-science majors should not be allowed (or not forced) to study it as a teaching subject. If we could afford to let them specialize at secondary school, why not at college?

The Mkwawa program, i.e., science specializing college: The science examination should be in three papers separately, namely, physics, chemistry and biology -- A candidate should have to pass the individual papers in order to get the Grade A Certificate. This would perhaps motivate them, as they would know that their conditions of admission and certification are tougher than and superior to the rest of other candidates in other colleges. Right now, only the admissions conditions are different. Equally important in this same line of thinking is that they should be exempted from studying subjects like geography and history which are quite different from the pure sciences. This modification might motivate them because they will graduate as science teachers only. Currently they teach all the subjects as may be assigned by the head of the school.

C H A P T E R I I I

TANZANIA AND THE OTHER COUNTRIES COMPARED

KENYA

The study and findings of Tanzanian science teacher training curriculum is similar to great extent to the one done in Kenya by Koech (1982). While the study in Tanzania dealt with all science subjects, the one in Kenya investigated the internal consistency of the School Science Project (S.S.P.) Biology course objectives at the secondary school level and compared them with national examination objectives.

S.S.P. Biology is an inquiry-oriented course. Because it involves students in "doing" things, that is because of its teaching methods, both students and teachers were found to have positive attitudes towards the course. However, just as in the Tanzanian study, there were a number of impediments that include:

1. Inadequate teacher in-service training in the heuristic method.

2. Inadequate supervision and follow up of teachers by the inspectorate.

3. Pressure on teachers to teach only examination material.

4. Lack of consistent involvement of teachers in the development and revision of the course.

One of the objectives of teacher education, including science teacher education in Kenya, is that teachers should be taught by the same methods which they will be expected to use in teaching children (Mwendwa, 1970). The fact that there was inadequate teacher in-service training in the heuristic method, which apparently was new to the teachers, was probably the principal cause of the widespread inappropriate teaching methods in schools as reported by Koech (1982): "Evidently the majority of classroom teachers relied principally on the S.S.P. Biology texts and teacher notes as sources of biological knowledge" (p. 151).

Although the programs in the Tanzania study are not explicitly heuristic by design there was a parallel observation that teaching is more lecture dominated and demonstrations and inquiry oriented methods are down-played. Apart from this problem, both the two systems are examination dominated. Mayer, in 1977 rightfully stated that "The examination cannot be changed because it measures mastery of the curriculum and the curriculum cannot be changed because it prepares for examination" (Mayer, 1977, p. 87). Obviously it becomes a vicious circle.

Both Kenya and Tanzania have tried to alleviate the teacher shortage in a similar way. In both cases the governments have reduced the duration of pre-service

training. Of course there has been a trade-off between quantity and quality as demonstrated in the data of diploma science (biology) crash program in the Tanzania study. This will definitely have tremendous effects on school teaching. Realizing this dilemma, the Tanzania government has increased the training of primary teachers of Grade B level from three to four years starting from this year.

The innovation mentioned in the previous section concerning grouping similar subjects to be taught as a unit in Kenya (Eshiwani, 1985) is a plausible one. Since one of the problems found in teachers colleges in Tanzania is the inadequacy of time required to cover the syllabus, this innovation would help in reducing the amount of time required for methodology teaching. For instance, some aspects of laboratory management need not be taught separately in chemistry and biology for those candidates majoring in the two subjects. Several things need to be done if we decide to adopt the innovation. There should be in-service training for the instructors already in the colleges and the current syllabi should be modified to reflect the integrated method.

Perhaps another valuable innovation would be to have only special colleges for training science teachers. In Kenya, as it was pointed out earlier, there is the Science Teachers College. The advantage of this system is that we can pool together the scarce resources we have, such as

instructors, laboratory facilities, books, etc., in only one or two colleges in the country instead of scattering them in three or more colleges. Just to cite a related example; teachers of commerce and accounting are trained at Dar-es-Salaam and Sinyanga Colleges. At Dar, there is an adequate teaching staff -- at least two teachers and an average of only five students. At Shinyanga, however, there is a substantial number of students and occasionally a shortage of teachers. It would be more economic to train them in one college.

Autonomy and Decentralization. Kenyan teachers colleges have a great deal of freedom to prepare their own syllabi and systems of assessments. Although the Kenya Institute of Education works out a common syllabus for the subjects, colleges prepare their own details of work, set their own exams and establish their own criteria of assessment (Mwendwa, 1968). In Tanzania we have national syllabi and instructors prepare their own "schemes of work" but final exams are national. The K.I.E. moderates these exams and sends a panel of examiners to assess teaching practice. Teaching practice in Tanzanian colleges is locally assessed, although a team of moderators can be invited to observe a few candidates in the field. These are normally instructors from nearby colleges. In Kenya, each college is required to send their schemes of work once

every two years to K.I.E. and to show how the teaching of one subject fits into the teaching of another.

UGANDA

Like Kenya, Nigeria and Zambia, Uganda's University shoulders the obligation of training junior secondary school teachers at the diploma level. As pointed out earlier, in Tanzania, the training of diploma teachers is done by three colleges: Mkwawa, Changaimbe (Dar-es-Salaam) and Klerruu.

Unlike Tanzania, Uganda's teachers college tutors are trained by the Institute of Education.

Although the curricula are prepared by N.C.D.C., the syllabus material must be reviewed by the National Conference on Education or by policy review commissions on education. This is primarily to ensure the economic, social and political relevance of the curriculum. In Tanzania, once the subject panels of the Institute of Education have prepared the material, they are ready to be used in schools and teachers colleges.

NIGERIA

The system of upgrading teachers in Nigeria is of utmost interest and worth comparing and contrasting with the Tanzanian practice. As explained in the preceding sections both Nigeria and Tanzania have elaborate programs

of upgrading teachers who have had fewer years of formal and professional education.

The rural science teachers program of training and upgrading Grade II teachers is similar to the one currently at Dar teachers college which upgrades long serving elementary school teachers to science teachers. The difference here is that while in Nigeria the candidates come to the college with A'level qualifications -- obtained through private examinations, in Tanzania the college prepared them to sit for National A'level examinations and then continue with teacher training in their subject areas. Whereas the graduates of this program in Nigeria become rural primary school science teachers in Tanzania they teach in rural and urban secondary schools.

Nigeria and Tanzania are phasing out primary school teachers who have only a primary (elementary) education. In Nigeria for instance, the lowest status teachers, Grade III (primary education plus two years of teacher training), are upgraded to Grade II by an extra two year in-service training period. In Tanzania, Grade III C (primary education plus three years) are upgraded to III B by similar in-service training. By 1993, all primary school teacher trainees will have gone through secondary school (four years) before they undertake a two year teacher training course (Ministry of Education, 1984). The III B (formally Grade III C) course has been extended to four

years instead of three beginning this year, 1987. It is believed that by the time they complete the four year course they will have gotten an education equivalent to form IV leavers. They will therefore be in a position to be upgraded to III A if they attempt the National Form IV examinations. Ultimately those who are really academically oriented can upgrade to diploma and degree status. Of course not everybody is capable, but the opportunity is open.

The success of this important reform will depend on several factors, including appropriate syllabi. It was previously pointed out that the Grade III C science syllabus was inappropriate in that it was too advanced for the learners' level. The same syllabus, 1978 edition was used for both Grade III A and C. Thus together with extending the course duration, the Institute of Curriculum Development should take a fresh, critical look at the syllabi.

ZAMBIA

Mukoboto (1982) wrote extensively on the need to incorporate other parties, namely teachers, the learners and the community, into the curriculum development process. In Zambia as in Tanzania, Kenya, Uganda, Nigeria, and other countries, these parties are either minimally involved or ignored completely. In almost all countries,

there is a centralized curriculum decision. Generally the study showed that (1) the Government's suggested roles of curriculum development were not in agreement with the roles currently performed by the various groups. There is therefore a mismatch between policy and practice as found in the Tanzania study in several aspects.

(2) Most groups of people agreed that the teachers and educational leaders should assume the major responsibility in curriculum decision-making whereas the community, people and the students could provide the data for decision making.

Lewis (1970) stated that:

> At present time there is a tendency to force new tools upon the teacher and the teacher trainer before the necessary conditions which justify adoption has been proven. As a result, the persons involved find themselves in the role of the sorcerer's apprentice unable to control the magic broom and bucket (p. 405).

Zambian and Tanzanian educational ideals are much the same in that both of them aim at egalitarian education. In Zambia, Development Education helps in developing societal relationships. It is an education that promotes change and helps in transforming society (Mukoboto, 1982). This is a translation of Zambian Humanism a political philosophy into educational terms just as Tanzanian Education for Self-Reliance is a translation of "Ujamaa". We would therefore expect that these two countries would involve the

community in the process of curriculum development more than what they are doing now.

Oliver (1977) has an interesting rationale for a cooperative approach in curriculum decision making. Shared responsibility is necessary because the teachers' views of learners are different from those of other groups in the community. For example, the teacher concentrates on the academic side of the learner while parents or local community members will have other expectations. The learners will also have their own interest and if all this pool of interest and knowledge is put together then there will be a better chance of having a comprehensive curriculum.

Looking back at the publication of the Education for Self-Reliance document we remember that it was met with surprise by both the Ministry of Education officials and teachers who had not been consulted during its preparation. The government was just directed to implement this policy (Mmari, 1975). ESR was complex and generalized, and was not congruent with teachers' existing practices and expectations. In addition, teacher education programs were not ready to produce the kind of personnel to carry out the policy in schools. Perhaps research in the form of pilot experimental schools and teachers colleges should have been done before the whole thing was institutionalized. The apparent success of S.S.C.E.P.

(Secondary School Community Extension Project) in Papua New Guinea is attributed to the fact that it was tested in only five pilot schools (Saunders, 1983).

Indeed in early 1960s when the U.S.A. was contemplating revamping its science curricula, the Biological Sciences Curriculum Study (BSCS) brought together a group of 70 contributors including research biologists, high school teachers and educators to prepare the initial version of basic curriculum (Koech, 1982). As a result, the curriculum was so thoroughly thought out that it eventually permeated to many other countries including Africa, Asia and Latin America.

Sinclair (1976) summarizing on cooperative curriculum design in the curriculum process said, "The role of the teacher does not include only teaching but also the transmission of values and attitudes that should be reflected in the created intellectual, moral and physical environment" (p. 55). This in a way implies that if teachers are given a major role in curriculum decision making better learning environments would be created since teachers have more data about the learner. The study conducted by Kessi (1985) in several teachers colleges in Tanzania on students' and teachers perspectives on the physics curriculum more than prove this fact.

Certainly one is made to believe that some of the problems encountered in implementing curricula in Tanzania,

Kenya and Zambia as has been shown in this paper so far would have been avoided had there been a cooperative curriculum design process.

Training of Secondary School Teachers for Agriculture. Tanzania and Zambia have separate colleges for agriculture. In Tanzania there is the Monduli Teachers College where student teachers specialize in Nutrition Science and Agricultural Science. This is similar to the program offered in the Natural Resources College in Lusaka. Both these courses take three years. Agriculture teachers for primary schools in Tanzania are trained in another college, MANTEP (Management Training for Educational Personnel). This is an in-service training of only one year. The program is a new one just founded several years ago.

C H A P T E R I V

RECOMMENDATIONS

The recommendations are presented in two categories, those derived from the comparative study of other countries (A) and those derived from the original study in Tanzania (B).

A.

1. Unlike in Nigeria, Tanzanian primary school teachers are upgraded by long courses are automatically transferred to teach in junior secondary schools or primary teachers colleges while others become inspector of schools. This applies to science as well as non-science majors, e.g., Changombe in-service programs. It is high time we seriously rethink this practice if we are to realize a high standard of education in the primary schools. Wilson (1972) in Developments in Teacher Education for the Teaching of Science argued that "science is a way of thinking ... unless a start is made in the primary school, it may be too late to be able to introduce a scientific way of thinking at all" (p. 65). We need qualified teachers at both primary and secondary levels.

Thus some of the diploma graduates especially from in-service programs should go back to the primary schools in order to strengthen teaching at that level.

2. The integrated teaching method discussed in the previous chapter is an innovation worth adopting especially in the pedagogical sections of the curricula. I see it as having two important advantages. (1) The trainees would see the relatedness of knowledge and subsequently learn how it can be taught as an entity rather than as discrete, disconnected portions. (2) It would serve a lot of time. However the caution I raised previously about need to train college instructors on how best it can be applied is extremely valid.

3. There is some degree of specialization of colleges in Tanzania in terms of the courses offered, for example sciences -- Mkwawa, Dar and Klerruu; English -- Marangu; Arts -- Morogoro and Dar; Agriculture -- Monduli (these are for diploma courses only). More specialization such as having Dar and Klerruu intake together would be more economic.

4. This comparative study has revealed that out of the five countries selected, it is only Tanzanian University that does not take part in training teachers at the diploma level for junior secondary schools. Actually the University of Zambia goes further to provide correspondence courses and in-service training for primary school teachers.

This paper, therefore, recommends that a study be done to investigate the pros and cons of collaborating the

university of Dar-es-Salaam in the training of junior secondary and primary schools teachers. It may not be necessary to have the colleges administration completely under the University like the Kyombogo College in Uganda, for that may mean too many responsibilities which may result in inefficiency. However from the programs suggested in Figure 1 the University would be required to cooperate in designing part of the diploma courses for "selected topics". It can also participate in designing the integrated program in which a group of subjects could be taught as a unit as suggested in (2) above.

In the U.S.A., for example, elementary and secondary school teachers are trained at Universities. Two major advantages are likely to be gotten out of this practice: (1) The teaching staff at University is more qualified than at the present teachers colleges; and (2) Research funds are more available than at the Ministry of Education. Thus the programs would be continually monitored and modified accordingly.

B. Although these recommendations were mentioned in Chapter II, the following is a summary of them.

<u>The Syllabuses</u>

1. Due to several problems found in the science syllabi, a new module of teacher training programs has been

recommended. It caters for both professional competence and academic potentialities for further studies. Since it was found that the entry qualifications for diploma candidates are too low for some of the course requirements it has been recommended that they be raised a bit. Instead of three subsidiary level passes at the A'level there should be two principal level passes, at least principal E which is a minimum. This will ultimately help produce quality teachers.

Alternatively, a major/minor system could be introduced whereby candidates could be allowed to major in one subject and minor in another. This is to make sure that they graduate as real masters of at least one subject.

2. For the in-service course for diploma biology teachers to be more productive, the Ministry of Education should consider extending the course from two to three years. The first two years would be used for A'level studies and the third year for the proper diploma. We need not even do further research before we decide because evidence shows that candidates enrolled at Mkwawa with the same entry qualifications (at least three credits at O'level) are doing better in the same subject in A'level examinations. At Mkwawa the course takes three academic areas. Of course extending the course duration itself might not be enough if laboratory facilities are not improved. It was pointed out that the laboratory

conditions at Dar-es-Salaam teachers college were not originally meant for A'level instructions.

3. This study has indicated that since there is no specialization at the Certificate level of teacher training, a substantial number of student teachers who had not majored in science in secondary schools do not perform well. In Tanzania, students can choose to major in science (chemistry, biology, physics) or arts after Form II (9th grade). But there is no choice in teachers colleges if one is training for primary school teaching. This paper recommends some sort of specialization. Non-science majors should not study science as a teaching subject.

Examinations

4. Examinations have been reported to be too academic just like the syllabi. Consequently the results of the final examinations have not been encouraging. One is tempted to conclude that the poor performance in diploma and certificate courses replicate themselves into the performance in secondary and primary schools seen these days in sciences and mathematics. It is hereby recommended that the instructions as well as the examinations should include more methodology questions than they do now. Maybe two separate papers should be given in order to give legitimate respect to the professional paradigm of the course. Presently, the single paper given for each of the

science examination in diploma and even certificate programs asks more questions on academics than methodology. As a consequence instructors and students prepare more for content than pedagogy.

5. In order to stimulate hands-on experience during instruction as is directed in the policy, teacher education science examinations should include practical sections.

6. The examination for the Mkwawa science program should be split into three separate papers; i.e., chemistry, biology and physics in the same way the course itself is taught. After all, one has to have sufficient passes from form four examinations (O'level) for each of these subjects as a prerequisite to get an admission in this course.

In order to increase their performance, they should be exempted from taking such subjects as geography and history. After graduation they should be assigned to teach science only.

Teaching Methods

7. The teaching should be more discovery oriented. The University of Dar-es-Salaam teacher education program, which prepares teachers college instructors and secondary school teachers, should set an example. Currently it is too theoretical and therefore teachers tend to teach the way they were taught. This is natural. Recommended is a

microteaching component in the syllabi as a skill for learning the various instructional skills.

8. "Science Process Skills" should also be part of the science teacher training programs. Here the trainees would learn how to teach techniques of investigation, observation, graphing, prediction, etc. In-service workshops and seminars should incorporate these important domains because they are the basis of inquiry which we all cherish.

BIBLIOGRAPHY FOR TANZANIA STUDY

Dar-es-Salaam Teachers' College, Inspectors Report, August 1986.

Dar-es-Salaam Teachers' College, Prospectus 1983/84 Unpublished.

Kessi, V.J. (1985), Students Perception of a Physics Curriculum. Unpublished Master of Education Thesis, University of Alberta, Edmonton.

Klerruu Teachers' College, Inspectors Report, September 1986.

Kotta, M.N. (1986), Tutors and Student - Teachers' Reactions to Discovery Methods in Diploma Colleges of Education: A Case Study of Morogoro and Dar-es-Salaam College. Unpublished M.A. Education Dissertation. University of Dar-es-Salaam.

Ligate, N.E. (1975), Teachers - A Powerful Force for Nation Building: 1961-1971. Unpublished M.A. Educational Planning and Development in Low Income countries. University of London Institute of Education.

Ministry of Education (1980), A Biology Syllabus for a Diploma in Education Course. Institute of Education, Dar-es-Salaam, Tanzania.

Ministry of Education (1980), Chemistry Syllabus ...

Ministry of Education (1980), Physics Syllabus ...

Ministry of Education (1985), Science for Grade III A Science ...

Ministry of Education (1980), Basic Facts About Education in Tanzania. Ministry of Education, Dar-es-Salaam, Tanzania.

Ministry of Education (1984), Educational Systems in Tanzania Towards the Year 2000. Recommendations of the 1982 Presidential Commission on Education as Approved by the Party and Government.

Mmari, G.R.V. (1979), A School for Work: The Tanzanian experience (cited in Kessi, 1985).

Mmari, G.R.V. (1975), Papers in Education and Development No. 1. Policy and Practice in Tanzanian Education. The Role of Formal Education in Developing Countries: The Tanzania Case. University of Dar-es-Salaam, Department of Education.

Renshaw, P., appearing in Gelby, M. et al., 1975 (Education), Curriculum Design. The Objectives and Structure of the College Curriculum. Croom Helm in Association with the Open University Press, London and Sydney.

UNESCO (1973), Report on International Conference on Education of Teachers for Integrated Science held at University of Maryland, U.S.A. (April 3-13, 1973).

BIBLIOGRAPHY FOR COMPARATIVE STUDY

Eshiwani, G.S. (1985), Education System in Kenya. The International Encyclopedia of Education, Vol. 5, pp. 2807-2809. Pergamon Press, New York.

Koech, M.K. (1982), Life Science Curriculum in Kenya: A Study of a Secondary School Science Project Biology. Ed.D Dissertation, Univ. of Massachusetts, Amherst.

Lewis, L.J. (1970), Good Teachers for Developing Countries. International Review of Education, Vol. XVI, No. 4, p. 405.

Mukoboto, S. (1982), Curriculum Planning for Secondary Schools in Zambia. Ed.D Dissertation, Univ. of Massachusetts, Amherst.

Mwendwa, K. (1970). New Directions in Teacher Education: Report on a Conference held in Kenya, May 1968. Teacher Education in New Countries, Vol. 11, No. 1

Odeat, C.F. (1985), Education System in Uganda. The International Encyclopedia of Education, Vol. 9, pp. 5333-4. Pergamon Press, New York.

Ogundimu, B.A. (1985), Education System in Nigeria. The International Encyclopedia of Education, Vol. 6, pp. 3534-3536. Pergamon Press, New York.

Oliver, A.I. (1977), Curriculum Improvement: A Guide to Problems, Principles and Processes (2nd edition). New York: Harper and Row.

Saunders, M. (1983), Implementation of Curriculum Reforms in Tanzania and Papua New Guinea. Comparative Education Review, Vol. 27, No. 3, p. 351.

Sinclair, R.L. (1976), The School and You: Critical Awareness for Improvement. The National Elementary Principal, Vol. 55, pp. 55-58.

Sinyangwe, W. (1985), Education System in Tanzania. The International Encyclopedia of Education, Vol. 9, pp. 4989-4990. Pergamon Press, New York.

Sinyangwe, W. (1985). Education System in Zambia. The International Encyclopedia of Education, Vol. 9, pp. 5640-5642. Pergamon Press, New York.

Wilson, J.M. (1972), Developments in Teacher Education for the Teaching of Science. Teacher Education in New Countries, Vol. 12, No. 3.