A CRITICAL AND COMPARATIVE STUDY OF THE PREPARATION OF SCIENCE TEACHERS AT INSTITUTIONS FOR THE EDUCATION OF INDIAN TEACHERS IN NATAL

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by

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The Problem:

The problem investigated is the preparation of science teachers at institutions for the education of Indians in Natal. In this study a brief comparison of the preparation of science teachers is also made with some institutions in Great Britain and parts of the United States of America.

Motivation:

In 1968 the writer participated in a Summer Institute in Pennsylvania in the United States. It was there that he was exposed to modern science curriculum projects and new trends in the teaching of science. Being a lecturer in science at a college of education, he was motivated to examine current trends in science education and more parti= cularly the preparation of science teachers amongst Indians.

Methods and materials used in the investigation:

The following methods were used:

1. For background information books, journals, periodicals, reports, etc. were consulted.
2. To examine the position of science teaching at high schools and to find out some of the problems with which science teachers are confronted, questionnaires were used. Questionnaires were also administered to first year students at a college of education in order to get some idea of the teaching of science and its problems from the students' point of view.
3. Visits were made to various institutions in Britain and America to examine science education programmes.
4. Personal interviews were held with the lecturing staff at institutions overseas and at the Springfield College of Education and University of Durban Westville.

CHAPTER I

THE ROLE OF SCIENCE AND SCIENCE EDUCATION IN THE SPACE AGE:

1. Definition of Science:

The word "Science" is defined as systematic and formulated knowledge. Such knowledge relates to moral, political, natural and other fields.[1]

Fitzpatrick[2] emphasises the dual nature of science when he states that "science is a cumulative and endless series of empirical observations which result in the formulation of concepts and theories, with both concepts and theories being subject to modification in the light of further empirical observations. Science is both a body of knowledge and the process of acquiring and refining knowledge." This definition is supported by Conant[3]. He defines science as "an interconnected series of concepts and conceptual schemes that have developed as a result of experimentation and observation and are fruitful of further experimentation and observation."

Billeh and Pella[4] also think of science in terms of sets of conceptual schemes which can be analysed into different levels of complexity and abstractness; whereas Loeb and Adams[5] speak of science as "controlled quantative investigation".

In this thesis, however, science will be considered from the point of view of natural and physical phenomena, involving hypothesising, experimenting, inductive and deductive reasoning which may culminate in the formulation of theories and laws

2. The Scientific Method:

Knowledge applied to the physical and natural sciences is dependent on the scientific method.

Gray and Coutts[6] state that the scientific method involves a series of systematic steps viz.

1. Recognition of a problem
2. Collection of experimental facts
3. Analysis of these facts to see if there is an overall pattern

4. Adoption/....

4. Adoption of a working hypothesis
5. Testing of the hypothesis
6. Substantiation, modification or abandonment of the hypothesis in the light of experimental results
7. Conclusion - formulation of theories
8. If the theory holds good and cannot be disproved then a law is formulated.

The scientific method cannot be effectively applied without the adoption of scientific attitudes. The chief characteristics of scientific attitudes are:-

1. A curious mind which seeks cause-and-effect relationships.
2. Respect for opinions and views of others.
3. The making of honest and objective observations.
4. Rejection of superstitions, prejudices or magic to explain natural phenomena.
5. Being prepared to change one's ideas in the light of new evidence.
6. Withholding judgement until careful analysis of all evidence.[7]

3. Scientific Literacy:

A scientifically literate person is one who has objectivity; rejects myths and superstitions and thinks logically; is critical and draws conclusions only after weighing evidence. He perceives science as a product, a process and a human enterprise.[8]

Recent research carried out on scientific literacy at the University of Wisconsin resulted in characteristics being attributed to a scientifically literate person - viz. one who had an understanding of the -

(a) "interrelationships of science and society,
(b) ethics that control the scientist in his work,
(c) the nature of science,
(d) basic concepts in science,
(e) differences between science and technology, and
(f) interrelationship of science and the humanities."[9]

Stated/....

Stated more simply, scientific literacy implies an understanding of the "what and how" of science, i.e. the fundamental laws and theories which operate in nature; and the processes of investigation and interpretations of scientific phenomena.[10]
Scientific literacy is of vital importance in an age when man is trying to understand the nature of the planet on which he lives and its relationship to the rest of the universe by probing the mysteries of outer space and the secrets of the deep sea, establishing facts about the origin of life and the mechanism of genetics, and challenging the scourge of disease.[11]

4. Science and Technology:

While science has to do with understanding of natural and physical phenomena, technology deals with the application of such knowledge and scientific principles in man's environment.

The Schools Council Working Committee[12] defines tech= nology as "the purposeful use of man's knowledge of materials, sources of energy and natural phenomena." They also state that the ultimate purpose of technology is to exploit scientific knowledge for productive ends, and that it also involves an understanding of man's needs as an individual and as part of society. Thus man employs technology to a great extent to make his environment more comfortable and pleasant to live in. Science, however, has influenced technology to a great extent resulting in profound changes in social organi= sation. Weisz[13] points out that there is a complementary relationship between science and technology.

While scientific concepts have stimulated technological growth, technology itself has made many scientific advances possible.[14]

5. Science/....

5. Science and Society:

Science originated through the activities of the so called witch doctors and medicine men of antiquity who explained the phenomena of nature in terms of magic. Superstitious beliefs dominated the lives of early man. But later when man realised the weakness of magic it was a momentous break through for science. For the first time the rituals of magic were found to have scientific principles underlying them.[15]

From the Middle Ages scientific discoveries such as the mariner's compass lead to the exploration and colonization of the new world.[16]

In the seventeen hundreds man depended on animals to a large extent for his work. The sources of power available to him were water, wind and to some extent heat. But since then the production of heat from coal was a great step forward.[17]

In the eighteenth century the mechanistic outlook gained momentum. There were three chief characteristics viz. facts were based on observation rather than unsupported authority; the earth was no longer regarded as being the centre of the universe. Traditional beliefs were dispelled and natural laws were thought to control the inanimate world.[18] In the nineteenth century man's knowledge and development of electricity created a new potential power supply. This was a tremendous break-through for industry. These discoveries also brought about changes in society such as the class structure in industrialised countries. There was now created a large working class and a small new class of industrialists. A further consequence of these discoveries was the reduction of work hours, and a corresponding increase of leisure time. This was a profound change and one that had to be reckoned with in social reconstruction.[19]

Lord Balfour[20] states that -

"Science is the great instrument of social change, and its silent appropriation of this dominant function ... is the most vital of all the revolutions which have marked the development of modern civilisation."

The two/....

The two world wars provided the stimulus for innovation in further scientific invention and discovery. With the invention of sonar for spotting submarines near the surface; radar for locating aircraft and missiles and the atomic bomb, a further world war has been stemmed. Discoveries in medicine, organ transplants, antibiotics and drugs have influenced society. While these dis= coveries aim at increasing man's life span somewhat, other problems such as population explosion and pollution have been created. In order to check population explosion birth control clinics were set up all over the world - the first of which was in New York in 1923. This was mainly as a result of the western movement towards the emancipation of women. These relied on physical barriers to conception but in the 1950's the contraceptive pill was discovered. It is thought that this may be man's greatest weapon in the struggle towards an adequate world-wide standard of living.[21]

Society today is dependent to a great extent on science in some form or another. Every major problem - be it environmental, educational, social or political has important ramifications which involve scientific and technological judgements, knowledge and data obtained through scientific investigation.[22]

The scientific enterprise is a human enterprise with high values common to men everywhere. It is through science and technology that man can be released from ignorance and insecurity that are responsible for human conflict and misery. The 'scientific society' in which we live is no mere cliché but a fact to be recognised and a system to be reckoned with. Science is central to all man's aspirations and is dedicated to his service and advancement.[23]

At the opening of the first National Convention of Science and Mathematics teachers for Indians in July, 1969 the Chairman of the South African Indian Council,

Mr Joosub/....

Mr Joosub commented as follows on the importance of science in our society - "A society enjoys prosperity if it shares in the industrial and commercial life of the country and the world. And if that society does not have its full quota of people skilled in science and mathematics, in technology and inventiveness, such a society cannot have its own industries. It can only follow others."[24]

6. The importance of Science and its place in the Curriculum:

In primitive societies as well as today man shows interest in science in his attempts to control his environment. Therefore science should have a significant place in education not only because of its content but because it arouses some degree of interest which leads to some effort. Science is also part of the culture pattern of the modern world and therefore scientific attitudes are essential.[25]

The report of the Harvard Committee[26] states that science can make a lasting contribution to general education if there were interrelationships with other disciplines, with human history and with problems of human society.

Education in Science is of great value to the child. Not only does it provide him with scientific knowledge but it awakens in the child a sense of joy and excitement. He begins to appreciate the world around him and man's control over nature.

Saunders[27] feels that science should not only be included in the curriculum because of the tremendous influence it has on civilization but it is worthy of a place in its own right - because of its methods it can draw order out of chaos within its limits.

The launching of the first Russian earth satellite in 1957 marked the beginning of a new era in the space age.

This/....

This made a tremendous impact on society and had a ripple effect in modern countries such as the United States of America and Great Britain. It resulted in these countries re-examining their research programmes in science and technology and also science education.[28] The British Science Masters Association, now - the Association for Science Education, drew attention to the defects in science teaching in Britain and set out certain requirements for improved and modernised science teaching in British Schools. This lead to new science curricula and materials being produced. The projects were sponsored financially by the Nuffield Foundation.[29] (These are dealt with later).

Similar projects were developed in the United States of America. (dealt with later)

7. The modern era of Science Education in South Africa:

The development of science and science education abroad also made a tremendous impact on South Africa. The following events indicate efforts to modernise science education-

7.1 On the 18 March 1959 the Cape Association of science teachers was formed at Worcester and their first publication viz. 'Die Wetenskaponderwyser' (Science teacher) appeared in January 1960.

7.2 On the 14 October 1960 the Orange Free State Asso= ciation for Science teachers was formed at Bloemfontein.

7.3 On the 4 April 1961 a meeting was held in Bloemfontein to consider a closer liaison between methematics and science teachers of the various Education Departments. Representatives of the Association of Science teachers of the Cape, Orange Free State and Natal attended. Observers from the Transvaal Association of Mathematics and Science Teachers and the Manpower Development Foundation were also present.

Two very important recommendations were made at this meeting, viz. -

(a) The formation/....

(a) The formation of a Federation of South African Associations of Science teachers by the provincial associations, and

(b) The publication of a national journal for mathematics and science teachers. A draft constitution was also drawn up at this meeting which was to form a basis for future liaison between the Federation and the Manpower Development Foundation.

7.4 On the 28 April 1962 the draft constitution was accepted and an executive committee was elected. The aims of the Federation are:

(a) The promotion of the teaching of mathematics and the pure and applied sciences at schools and colleges;

(b) The promotion of the exchange of knowledge between teachers and other scientists by suitable means;

(c) The maintenance of the status of teachers of mathematics and the pure and applied sciences; and

(d) The execution of all the necessary steps to realise these aims.[30]

At the same meeting it was also decided to hold the first National Convention of science teachers during the winter vacation at Pretoria in 1963.

7.5 The Manpower Development Foundation was established in 1961 to give prominence to the importance of human material in the promotion of science.[31] It is now known as the Foundation for Education, Science and Technology.

The board of the Foundation was made up of leading scientists in South Africa. It grew out of the Association for the Advancement of Knowledge and Culture and is registered as a non-profit organisation. Its chief aim is to co-operate with teachers of mathematics, science and technology in order to strengthen the teaching of these subjects and to interest youth in science and technology.

The publication/....

The publication of quarterly journals such as "Lantern" and "Archimedes" was also a means of promoting science education. The Foundation was also entrusted with the administration of "Spectrum" in 1963. Two types of articles appear in it viz. background articles which have a bearing on latest developments in science and technology in relation to the school syllabus; and didactics articles which consist of methods of teaching, effective classroom experiments, stimulating class projects, useful apparatus and practical hints.[32] The appearance of "Spectrum" was of great signi= ficance and value to science teachers. Its publication was given every encouragement and support by the Directors of Education of the various provinces and the then science adviser to the Prime Minister Dr H.O. Mönnig.[33] The then Minister of Education, Arts and Science, - The Honourable J. de Klerk clearly points out in this message to "Spectrum" the need for capable and well-informed teachers of science and mathematics especially in the light of phenomenal strides made in science and technology over the last two decades. A teacher needs to be up-to-date in method and content in order to inspire and stimulate his pupils.[34]

As a further means of encouraging science education in the schools, the Foundation for Education, Science and Tech= nology sent outstanding and gifted pupils to the International Youth Science Fortnight in London; established science clubs in schools; staged local science fairs culminating in a National Science Fair and participated in the annual International Science Fair in the United States of America. It also organised the first National Youth Science Week in Pretoria and Johannesburg in October, 1965 at which there were sixty pupils from all over South Africa.[35]

Outstanding teachers of science were given awards and grants to study overseas. Teachers of science and mathematics are also sent to the United States of America to attend Summer Institutes to up-date their knowledge in content and approaches to science teaching under the auspices of the United States - South Africa Leadership Exchange Programme.

Overseas/....

Overseas lecturers were also invited to South Africa by the Foundation in consultation with the Federation of South African Science Teachers Association. The First National Convention for White Teachers of Science and Mathematics was held at the University of Pretoria in 1963.[36]

As a result of these opportunities teachers in South Africa began to gain some insight into the latest trends and curriculum development projects abroad. Consequently Colleges of Education in conjunction with Universities in the Transvaal[37] and Natal[38] held vacation and in-service-courses for the benefit of science teachers.

While these developments were taking place in the White Sector there was pari passu development in the Non-White Sector. The First National Convention for Indian Teachers of Science and Mathematics was held in Durban in July, 1969 under the auspices of the Foundation for Education, Science and Technology, and in collaboration with the division of Education of the Department of Indian Affairs. One hundred and fifty teachers from all over the country attended. The purpose was to orientate teachers to the new thinking and developments in science and mathematics by bringing them into contact with overseas and local experts.[39]

The programme for the week consisted of lectures, demonstrations of equipment, discussion groups, practical work and excursions to places of scientific interest. The Secretary for Indian Affairs, Mr J.H.H. van der Merwe stressed the need for trained Indian scientists and technologists when he formally opened the Convention. He said that it was evident that South Africa was not providing sufficient men of the required calibre to meet the ever-increasing demands made on trained scientists although the brainpower and potentials were not lacking. He went on to say that "Unless those in our schools, Colleges and Universities who are endowed with the necessary intellect and aptitude are guided to acquire an interest for these subjects, and to qualify in one or more of them, the position will undoubtedly deteriorate."[40]

Further/....

Further conventions of this nature were held in July 1971[41] and 1973 respectively. Previous to these Conventions a senior Physical Science and Biology refresher course was held at the Springfield College of Education in April 1967. An orientation course in General Science for Junior Secondary Science teachers was held at the University College for Indians in Durban in February 1969; and a course for primary school General Science teachers in Natal and the Transvaal was organised in February 1970.[42]

Arising out of the refresher course held in April 1967 a resolution was passed to form a national body for science teachers. A draft constitution was drawn up and ultimately on the 2 July 1969 a Science Subject Society was formed under the auspices of the South African Indian Teachers Association[43] to foster the teaching of science in Indian schools.

From the foregoing it will be realised that the teaching of science is undergoing considerable change in all modern countries including South Africa.

The purpose of this study is therefore to investigate the extent to which the training of teachers of science in Indian Schools in Natal is keeping abreast of modern trends, and also to make a comparison with the teaching of science in Britain and the United States of America.

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CHAPTER 2

NEW DEVELOPMENTS IN SCIENCE EDUCATION IN BRITAIN AND THE UNITED STATES OF AMERICA

1. Problems of Curriculum Planning and Development

1.1 What is meant by a Curriculum:

According to Behr, the term curriculum has two meanings. In the narrow sense it means the courses or subjects offered by a particular institution or department of education. For example in South Africa, the primary school curriculum is made up of a definite number of subjects viz. - the mother tongue, the second official language, arithmetic (mathematics), science, history, geography, health education, arts and crafts, music, physical education and scripture.[1]

Kerr[2] states that the term curriculum is often loosely used as being synonymous with "syllabus", "courses of study", "subjects", or even the "time table."

Maccia[3] who worked at Ohio State University, defines curriculum as "presented instructional content."

In the broader sense, curriculum means the sum total of learning experiences that a school gives its pupils within the classroom as well as extra mural activities.[4]

Other writers also think of curriculum in a broad sense viz. - Beaucamp's[5] working definition is "a design of a social group for the educational experiences of their children in school". Kerr's[6] definition of curriculum is "all the learning which is planned and guided by the school, whether it is carried on in groups or individually, inside or outside the school", while Hooper's[7] view is that the curriculum is closely inter=woven with the social fabric that sustains it, and that it does not develop in a vacuum. Smith, Stanley and Shores[8] also support this view. They say that the curriculum in every society is a reflection of what the people think, feel, believe and do.

In an/....

In an even broader sense curriculum could be taken to include everything within the school environment which may affect the efficiency of the pupil's learning.[9] In this sense the term curriculum embraces not only the content of the syllabus, teaching methods and materials, but also the organisation of the school which may include streaming, setting, team-teaching, as well as the architectural design of the school buildings as all these may influence learning. Oliver's[10] definition of curriculum is - "the educational programme of a school," the elements of programme being (a) programme of studies, (b) programme of activities, and (c) programme of guidance.

It is this broader meaning that is given to curriculum by developers of science projects in Britain and the United States of America. This is evident from the objectives of the Nuffield Foundation Science Projects which state that science education should provide a foundation for adult life and work in an increasingly scientific and technological age, and should provide an essential ingredient in a humane education.[11]

The California State Advisory Committee on science instruction in High Schools also states that science courses must provide information of cultural value, skills and understanding that are fundamental to living more effectively in a science-oriented and science-dependent society, and knowledge that is directly or indirectly vocational in nature.[12]

In the British and American systems of education where local authorities are responsible for curriculum planning and development, knowledge and experience of the layman is also needed so that a careful study can be made of the relations of the school to other agencies of society.[13]

1.2 Curriculum Development:

Curriculum development has to do with "the conscious selecting and directing of educational change through group processes".[14] It is a complex undertaking and involves making decisions regarding general aims and specific objectives, the major

areas/....

areas and content to be covered in each. Decisions have also to be made about learning experiences and how to evaluate them in terms of the aims.[15]

Stanley, Smith and Shores[16], however, point out that curriculum development has at least four significant aspects, viz. -

1.2.1 the determination of educational directions;

1.2.2 the choice of principles and procedures for ordering the instructional programme;

1.2.3 selection of a pattern of curriculum organisation; and

1.2.4 principles and procedures for changes and evaluation.

Similar models have been devised by Kerr,[17] Taba, Taylor, Mervit and Hirst - with four components viz. curriculum objectives, knowledge or content, learning experiences and curriculum evaluation. Taba[18] in her model, however, begins with **'diagnosis of needs'**. She feels that this is essential as in any given population there are gaps and deficiencies, and variations in the back= ground of students. In some instances according to Taba[19] the selection of learning experiences has been based on tradition, legislative pressure, as well as on the needs of children. Curriculum development should therefore be seen against the cultural background of the society as different cultures require different kinds of knowledge, capacities and skills, for example - reading will be of little or no importance in a non- literate society, whereas a highly technological society will require a greater development in scientific knowledge and skills.[20]

Krug[21] states that learning depends on the total environment, and this in turn depends on the "how" as well as the "what" of teaching. Hence a curriculum development programme should emphasise teaching pro= cedures, classroom environment, and the nature of pupil- teacher relationships.

1.3 Educational/....

1.3 Educational Objectives:

The specifying of objectives is a debatable issue. There are authorities who favour the specifying of objectives. For example the work of Bloom, Tyler, Wood and Gagnê support this.

Eisner (1967) believes that there are four main weaknesses in specifying objectives, viz.

1.3.1 Educational objectives cannot be predicted with accuracy;

1.3.2 The predicting of objectives does not lend itself to all subjects;

1.3.3 In some cases objectives can only be used as criteria for judgement; but they are also used as standards of measurement;

1.3.4 There can be confusion in relating means to ends in curriculum construction.[22]

Eisner does, however, advance the following three reasons for specifying objectives, viz.

(a) They provide goals towards which the curriculum is aimed;

(b) They facilitate the selection and organisation of content;

(c) When objectives are specified in behavioural terms they make it possible to evaluate the outcomes of the curriculum.[23] Stenhouse (1969)[24] is of the opinion that objectives tend to stress convergent rather than divergent thinking, thus somewhat restricting the scope of the teacher. This view is also shared by Atkin (1968)[25] who, to some extent feels that the curriculum may regress towards objectives reflected in test items with the result that some worthwhile learning activities may disappear.

Stones and Popham[26] however, feel that although it is not possible to specify precise objectives for all subjects, for example, fine arts, there is merit in stating clear objectives. De Cecco is of

the same/....

the same opinion but states that if objectives are over explicit, they could inhibit critical judgement, creative innovation and adaptative individual behaviour.

Gagnê states that the fundamental reason for defining objectives is that they distinguish clearly between content and method. While content is derived from objectives, method is not.[27] Tyler and Krawthwohl feel that although objectives should be specific, there can be different levels of specificity.

Furst (1957) suggests the following characteristics for objectives, viz. -

(a) They should be clearly stated in terms of pupil behaviour;
(b) They must not overlap;
(c) They should include all the important aspects of behaviour related to the problem;
(d) They should specify the kinds of response that may be accepted;
(e) They should specify the limiting conditions under which the learning is likely to take place.[28]

Objectives which are unrelated could produce problems at the planning, teaching and evaluative stages. Bloom and Krathwohl divide their objectives into three domains, viz. -

(a) Cognitive domain. This deals with objectives related to thinking, knowing and problem-solving.
(b) Affective domain - includes objectives dealing with attitudes, values, interests, appreciation and social-emotional adjustment.
(c) Psychomotor domain - includes objectives dealing with manual and motor skills.

1.4 The planning and development of a curriculum project: The following considerations are taken into account in planning a project, viz. -

1.4.1 the/....

1.4.1 the educational purposes or objectives that should be attained;

1.4.2 the learning experiences that should be provided for the attainment of the objectives;

1.4.3 logical organisation of the learning experiences for meaningful and effective learning to occur; and

1.4.4 effective evaluation by use of appropriate assessment procedures.[29]

1.5 Thereafter the following steps may be taken in developing a project, viz.

1.5.1 Innovation

There has to be a need for some change in a curriculum, and it is usually a teacher or teachers who feel that there is something wrong with the existing curriculum or have some new ideas. Thus schools 'invent' their own innovations or adopt innovations developed elsewhere.[30] The ideas are then discussed with other teachers, educationists, local advisers (in Britain) etc. resulting in a 'feasibility trial'.

1.5.2 Feasibility Study

A director of a project is then appointed and he plays a crucial rolē in development. He carries out a feasibility study after which a report is presented to a central committee in charge of education or sponsoring body, for example, the Nuffield Foundation or Schools Council (in Britain); and National Science Foundation (in the United States of America) for careful scrutiny. A Decision has to be made regarding sponsorship. Criteria taken into account include - cost, ability to plan; whether the project can be communicated to teachers to whom it is directed and whether there is any possibility and hope of achieving educational patterns within a span of three to five years.[31]

1.5.3 Selection of writing team

The director then selects a team of teachers who have

the necessary/....

the necessary expertise in particular subject areas to form a writing team. They are seconded for specific periods and are offered a small honorarium as an inducement.

1.5.4 Selection of trial schools - particular schools are selected for trying out project materials in their entirety. Suitable publishers are also chosen at this stage.

1.5.5 Briefing conferences - purpose-designed courses for explaining the philosophy behind the materials[32] and appropriate training for teachers to use the new materials are organised at teachers' centres. New centres are set up if they do not already exist. Project materials are also sent to Colleges of Education and University Departments of Education for perusal and comments.

1.5.6 Evaluation - Systematic planning of materials at each stage is done. This is achieved through tests, questionnaires, recordings and feedback from teachers from pilot schools.[33]

1.5.7 Diffusion - Materials are then sent to schools not selected for trial before publication. After materials are published diffusion to other areas and countries takes place.

Fig. 2,1/.....

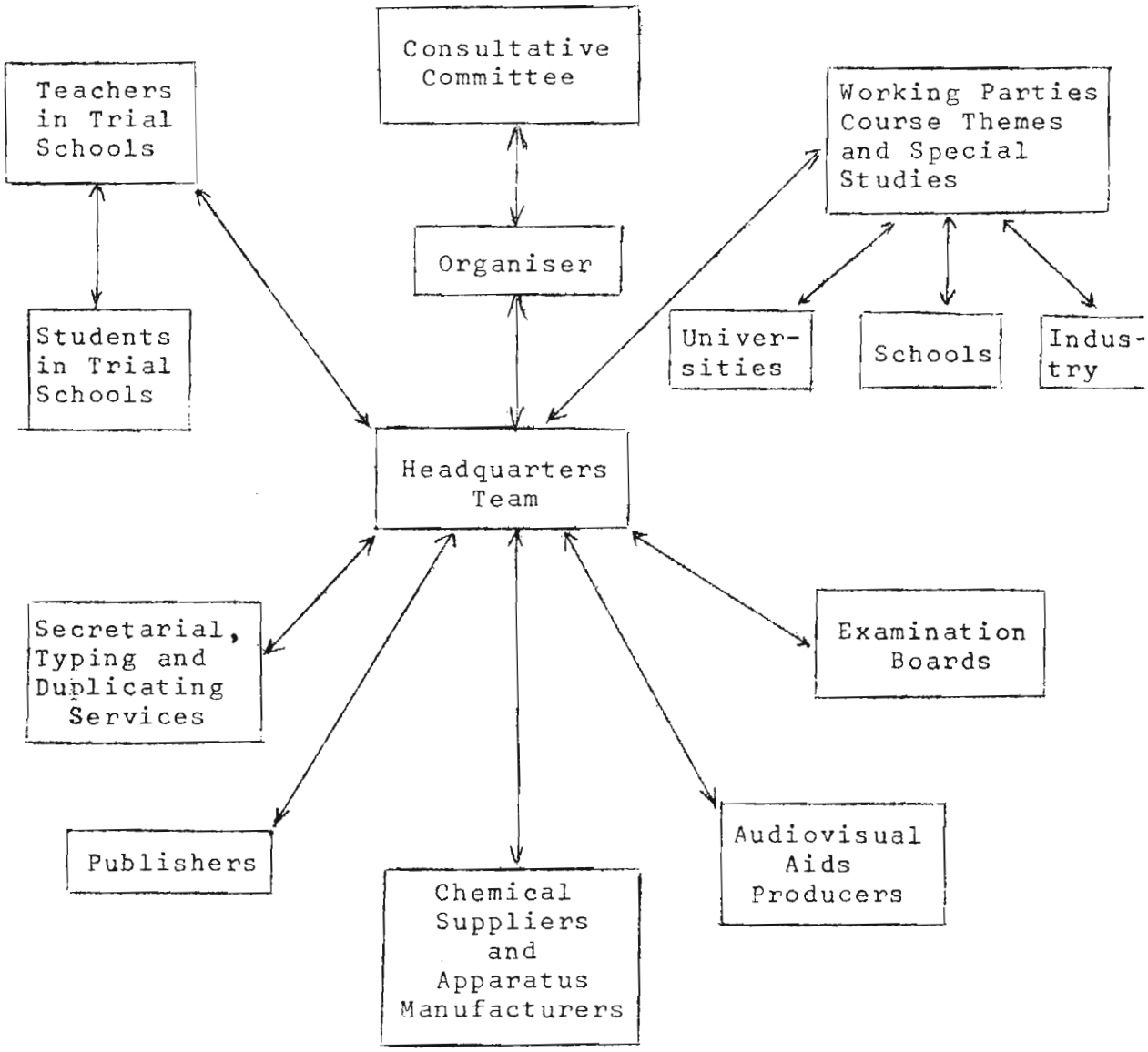

FIGURE 2.1[34]

The Organisational structure and planning involved in the development of a typical curriculum project.

3. Some/....

2. SOME SCIENCE CURRICULUM PROJECTS OVERSEAS

2.1 BRITAIN:

2.1.1 THE NUFFIELD SCIENCE PROJECTS:

2.1.1.1 Origin of projects:

As early as 1900 science teachers in Britain felt the need to improve science teaching methods. This resulted in the formation of the Public Schools Science Masters' Associations which later became the Association for Science Education (ASE). This association laid the foundations for science curriculum development projects by a series of reports which dealt with the place of science subjects in the school curriculum and outlined the possible content of new courses. Because of a lack of finance, implementation of the recommendations in the ASE reports was not possible.

In 1962 the Nuffield Foundation made available the sum of two hundred and fifty thousand pounds for this purpose. It was intended to sponsor mainly projects in Biology, Chemistry and Physics for the top twenty five per cent of the ability range in students aged between eleven and sixteen years. The number of projects was soon increased and the total expenditure was between one and a half to two million pounds.[35]

Although the Nuffield Foundation's curriculum projects differ in points of detail they share fundamental objectives and a common organisational pattern. Each arises from a growing concern among teachers that the whole teaching approach in the classroom and laboratory be reviewed in the light of recent research, current views on the nature of learning, and a new emphasis on the active part that the pupil should play in the learning process.

The Nuffield science projects being developed include the following -

(a) Nuffield/....

(a) Nuffield Junior Science.
(b) Nuffield Combined Science
(c) Nuffield Secondary Science
(d) Nuffield Physical Science
(e) Nuffield Biology - Ordinary level
(f) " " - Advanced level
(g) " Chemistry - Ordinary level
(h) " " - Advanced level
(i) " Physics - Ordinary level
(j) " " - Advanced level[36]

2.1.1.2 Objectives of Nuffield Science projects in general:

The 1964 progress report of the Nuffield Science Foundation states that science education should provide -

(a) an essential ingredient in a humane education;
(b) an indispensable foundation for adult life and work in an increasingly scientific and technological age;
(c) a well-grounded understanding of science (or a branch of science), not a knowledge of disconnected facts;
(d) encouragement of children to think freely and courageously about science in the way that practising scientists do;
(e) experimental and practical enquiry for children as a means of awakening original thought.[37]

Two major divisions of Bloom's taxonomy of educational objectives have been taken into account in formulating aims in the Nuffield Projects. These are knowledge and intellectual abilities which are expanded in the following framework:-

A. Knowledge/.....

A. Knowledge:

Knowledge of specifics - though material may be of a low level of abstraction it results in more complex forms of knowledge; knowledge of terminology - includes knowledge to define technical terms by giving their attributes, properties or relations; knowledge of specific facts - such as specific data or exact magnitude of a phenomenon; knowledge of conventions - characteristic ways of dealing with ideas and phenomena. This is essential for communication and consistency; knowledge of trends and sequences - includes knowledge of processes, directions, and movements of phenomena with respect to time; knowledge of classifications and categories - classes, sets, divisions are fundamental for a given subject, field or problem; knowledge of criteria - criteria for judgement and testing of facts, principles and opinions; knowledge of methodology - methods of inquiry, techniques and procedures in particular fields, as well as investigating particular problems and phenomena; knowledge of principles and generalisations essential for observations of phenomena; knowledge of theories and structures - can be used to show interrelation and organisation of a great range of specifics.

B. Intellectual Abilities and Skills:

Comprehension, for example, translation; preserving of original material though communication is altered; interpretation - involves reordering, rearrangement or new view of material; application - ability to predict effects of change; analysis, for example, analysis of relationships and skills in distinguishing facts from hypothesis; synthesis - involves putting together elements and parts to form a whole; evaluation, for example, judgements in terms of internal evidence and external criteria.[38]

The objectives have also been arranged in stages so that they are compatible with Piaget's[39] views of children's development from intuitive or early animistic, through concrete or magical and artificialist to abstract

or rational/....

or rational thought. The materials are drawn from children's own environment and tackled largely by practical investigations.

It is observed that on the whole the projects have much the same purpose though stated differently.

Learning by inquiry and the discovery methods are emphasised in the Nuffield Projects. Though these methods are stressed today, they date back to the previous century. The discovery method was advocated by Rousseau[40] and Herbert Spencer who stated that children "should be told as little as possible, and induced to discover as much as possible." This viewpoint was also shared by Professor H.E. Armstrong (1848-1937). In a paper published in 1898 he makes reference to the "heuristic method", or "the art of making children discover things for themselves."[41] Problem-solving and discovery methods are of great value to children in the learning process. Gagne[42] states that they result in establishing of high-order principles. The learner discovers the high-order principle without any guidance by way of specific verbal help. He found in an experimental group which had no verbal cues high-order principles were discovered and retained for a considerable period of time. A prerequisite, however, is the recall of principles, i.e. previous knowledge from which the learner con= structs a solution of "his own." This leads to generalising to many situations.

There is an "inductive leap", a combining of ideas that comes from widely separated knowledge systems and a bold use of analogy.

In problem-solving situations the learner instructs himself. He then makes use of particular kinds of strategies which guide his thinking.[43]

Bruner/....

Bruner[44] also states that children can benefit from learning through discovery, viz.

(a) Increase in intellectual potency i.e. it has the effect of leading the learner to be a constructionist, learning techniques of problem-solving and also of acquiring information which is more readily viable in problem-solving.

(b) There is a shift from extrinsic to intrinsic rewards. Discovering something rather than learning about it leads to self reward. The child comes to manipulate his environment more actively and derives pleasure from coping with problems.

(c) Learning the heuristics of discovery.
This can only be achieved through the exercise of problem-solving and the effort of discovery.

(d) An aid to memory processing.
Generally material that is organised in terms of a person's own interests and cognitive structure tends to be more easily remembered.

2.1.1.3 Aims of the specific Nuffield projects:

The O and A level projects designed for different age and ability groups also have very definite aims, for example, the O - level Biology aims for a comprehensive statement incorporating cultural objectives as well as activities to be developed and intellectual skills that have to be acquired; whereas the principal aims of the A - level Biology project which is taken three years later are more precise and state specifically that it aims at developing certain abilities in the students.

The general aim of Nuffield O - level Chemistry is - "Education through Chemistry" implying that education has priority and understanding is an 'umbrella word,' The A - level Chemistry course incorporates the aims of the O - level course and is based firmly on the establishment of three concepts of fundamental import= ance in the study of chemical systems - related to

energetics/....

energetics, structure and properties of substances and the unifying pattern of the periodic table. Other clearly defined aims are the integration of the various branches of Chemistry; and an understanding of the importance of its applied, social and economic aspects.[45]

The general aim of the O - level Physics is 'Physics for all'; and 'teaching Physics as a modern science, and to give pupils a lasting sense of understanding Physics as a structure of knowledge'. In A - level Physics real understanding of fundamental concepts and their interrelationships and the ability to apply these to new problems are the chief aims.

The Nuffield A - level Physical Science Project is intended as an integrated approach to Physics and Chemistry. Importance is given to investigating the 'real nature of the physical world'. Hence practical work is stressed and a large part of the time is given to project work.

The Combined Science Project designed for the 11 - 13 year age range is adapted for use with the whole range of ability. It is a basic course which could lead to any science course. The content is accordingly based largely on material of the first two years of the O - level projects. The material is arranged into nine topics and it is strongly recommended that they be taught by one teacher dealing with one class in one laboratory. The objectives are implied in the following statements -

(a) "the project provides a 'first look' at phenomena and their interpretation; the latter should be tentative and tempered by an awareness of some of the pitfalls of experimentation;

(b) children would:

i) be developing an appreciation that hypotheses could be formulated, tested and modified;

ii) be given sufficient time and data for the develop= ment of unspecified concepts;

(c) full/....

(c) full opportunity has been taken to use children's first-hand experiences as a starter to work in the laboratory;

(d) subject-matter as such is less important than the approach."[46]

The Nuffield Secondary Science Project is intended for pupils aged 13 - 16 who are not likely to take O - level in Science. Pupils are to have first-hand experience and must therefore do the experiments themselves as far as possible. Reasons for this are either apparent or have to be explained to them. The materials deal with aspects of science important in the present lives of pupils or will be in their adult lives.

The objectives of the Nuffield Junior Science are implied in the following:-

"learning through observation and experiment ('observing will mean doing every imaginable thing in a situation and then judging the response through all the appropriate senses'); planning experiments and being critical about the results; discussing with teacher and class= mates as a means of refining ideas which have been developed; communicating ideas by various means."[47]
The general aim is 'to help children develop concepts of science appropriate to their ages and to assist teachers to help children - through discovery methods - to gain experience and understanding of environment, and to develop their powers of thinking effectively about it'

2.1.2 The Schools' Council:

This is an independent body which is financed by contri= butions from local education authorities and the central government through the Department of Education and Science. The majority of its members are teachers.[48]

Its chief object is to undertake research and development work in curricula, teaching methods and examinations

in schools/....

in schools. It functions on the principle that each school should have the fullest measure of responsibility for its own work with its own curriculum and teaching methods based on the needs of its own pupils. Teachers with experience and interest in particular fields work together on projects in various subjects.[49] The Schools Council Integrated Science Project which is a typical example of a project undertaken will now be discussed.

2.1.2.1 Schools Council Integrated Science Project (SCISP):

This project is intended for the age range 13 - 16 and is of double General Certificate of Education (GCE) O - level value. Apart from being an integrated science course it has strong links with non-science areas - viz. - history, geography, economics, technology and sociology.

It was felt that pupils in secondary schools should have a course in science at least to sixteen years and that an integrated course in science will be of greater practical value to them than the separate sciences, and would also serve as a basis for A - level Chemistry, Physics or Biology. It is, however, offered as an alternative to Nuffield O - level Chemistry, Physics and Biology.

Certain aspects of this Project will be discussed:-

Aims:
In drawing up aims consideration was given to preparing pupils for a future job, for possible family commitments, for leisure activities, as well as forming a part of the cultural development of the student. The aims are divided into two categories, viz. -

Skills:
Pupils should be competent in -

"1. recalling/....

"1. recalling and understanding those facts and concepts which would enable them to pursue science (Courses in Physics, Chemistry, Biology or Physical Science) to a higher level or as a hobby.

2. understanding specific patterns which are of importance to the scientist;

3. identifying and using those patterns which are necessary for the solution of scientific problems;

4. making critical appraisal of available information (whether obtained from books, graphs or experimental work) as an aid to the formulation or extraction of patterns and the solution of scientific problems;

5. organising and formulating ideas in order to communicate to others;

6. understanding the significance, including the limitations of science in relation to technical, social and economic development;

7. being accurate in the reporting of scientific work;

8. designing and performing simple experiments (in the laboratory and elsewhere) to solve specific problems.

Attitudes:

Pupils should -

9. be willing to work individually and as part of a group;

10. be sceptical about suggested patterns yet willing to search for and to test for patterns;

11. be concerned for the application of scientific knowledge within the community."[50]

One of the major problems is that ideally the course should be taught by one teacher but generally science teachers specialise in one or two branches. It would be contrary to the philosophy of the project if it were to be divided and taught by individual specialist teachers. One possibility for overcoming this is "team teaching." However, each school adopts its own policy in this regard. This necessitates extensive co-operation between members of the science department and in-service training courses.

Evaluation/....

Evaluation of cognitive and non-cognitive objectives will form an important part of the assessment programme.

The content of the project is based on three useful ideas of science, viz.
building blocks - which range from electron to planets; interaction; and energy. Throughout the course there is a continuous search for "patterns". There are important generalisations which are used to solve problems both in and out of the laboratory. The project model may be summarised as a tetrahedron - thus

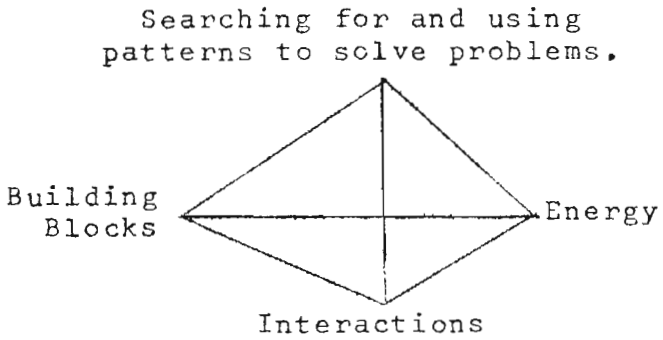

Fig. 2.2[51]

A Tetrahedron Project Model

2.2 Curriculum projects developed in America:
Discoveries and advancement in science over the last two decades had a profound influence on science education in America. The National Science Foundation was established to promote research in all branches of science education. Science teachers and educationists began to review science methods and text books in schools. These were found to be outdated, and as a result science curriculum study committees were set up for the purpose of producing project materials. The projects were funded by the National Science Foundation in conjunction with the federal government.

Summer institutes, in-service courses and conferences were organised throughout the United States of America for science teachers to up-date their knowledge both

in content/....

in content and approaches in science teaching.[52]

The following are some of the science curriculum projects developed in the United States -

Biological Sciences Curriculum Study (BSCS)
Chemical Education Materials Study (CHEMS)
Chemical Bond Approach (CBA)
Physical Science Study Committee (PSSC)
Harvard Project Physics (HPP)
Science Curriculum Improvement Study (SCIS)[53]

These projects have a dual purpose, viz. -

a) to provide general education for all students who take them, and
b) to serve as a sound introduction for future specialisation in particular fields of interest.[54]

Some of the above-mentioned projects will now be outlined.

2.2.1 The Chemical Education Materials Study (CHEMS):
"The Chemical Education Materials Study was formed to develop text books, laboratory equipment, and other instructional materials for the general student who takes high school Chemistry and to provide challenging problems and experiments for the gifted or upper part of the typical high school class. CHEM Study, then, is designed for about one-third of the students."[55]

Great emphasis is placed on experimentation as it provides a clear understanding of the advancement of science. This leads to discussion of basic principles and concepts in Chemistry. Extensive use is made of inquiry techniques. Through exploration of models for interpreting data students understand the ways in which chemists arrive at explanatory schemes.

Major concepts are developed as key ideas. These are arranged sequentially into seven topics, viz.

"Atomic/....

"Atomic theory
Conservation laws
Kinetic theory
The periodic table
Energetics
Equilibrium
Atomic and Molecular Structure."[56]

The materials may be divided for convenience into three sections. In the first section students get an over= view of Chemistry, becoming familiar with scientific methods, models and concepts such as chemical reactions, phase changes, energy, conservation of atoms, etc. In the second section the seven major concepts are examined more closely. In the third section descriptive chemistry is used as a means of applying and reinforcing the earlier developed concepts.

Laboratory work is of vital importance and poses quest= ions - the answers to which the student has to find after analysing his data. Most of the experiments are of a quantitative nature - the numerical data of which has to be manipulated and from which generalisations are to be made. The atmosphere is informal. Learning cycles are established and produce growth in understand= ing. It is hoped that the student at the end of the course will be able to interpret his own observations in terms of the concepts of structure and dynamics.

2.2.2 Biological Science Curriculum Study (BSCS):
As it was felt that most students in the United States take Biology at tenth grade and for many of these it will be the only science course at high school, the organisers designed the materials for all but the lower twenty per cent of the students taking Biology at tenth grade level. A sound knowledge of Biology is considered essential and the right of every child who, when adult, will need to cope -

"1. with/....

"1. with individual problems of health and nutrition;
2. with family problems of sex, reproduction, and parenthood;
3. with the citizen's problems of wise management of natural resources;
4. with the biological hazards of nuclear agents in peace and in war; and
5. with governmental support of science as the primary source of national strength and well-being in the scientific era."[57]

Because of the diversity of the life sciences and the nature of Biology as a science, nine themes were selected which tend to permeate all facets of the subject. They are:

"1. Change of living things through time - evolution
2. Diversity of type and unity of pattern of living things
3. Genetic continuity of life
4. Complementarity of organism and environment
5. Biological roots of behaviour
6. Complementarity of structure and function
7. Regulation and homeostasis - the maintenance of life in the face of change
8. Science as inquiry
9. The intellectual history of biological conceptions."[58]

These themes become key ideas and determine the approach, content and laboratory experiences. Three approaches have been developed - an ecological evolutionary approach - High School Biology (Green Version); a molecular-biochemical-evolutionary approach - Biological Science: Molecules to man (Blue Version); and a cellular-biochemical-evolutionary approach - Biological Science: An inquiry into life (Yellow Version). Within each of these the major themes form a framework.

Laboratory/...

Laboratory work also emphasises the investigative inquiry type of experiments and research. More time is spent on observation of living forms in controlled experimentation and on scientific communication such as collecting data, graphical interpretation and the relation of observation to theory.

In addition to textbook materials, twelve "laboratory block" programmes have been developed. Each of these consists of a series of laboratory experiments related to a major biological area such as plant growth and development; the growth, nutrition and interaction of microbes, etc.[59] The experiments are planned to give the student experience in depth.

The project has also developed materials for the gifted students, viz. Biological Investigations for secondary school students which includes one hundred research problems for individual investigation by the above average student. No solutions to these problems are available in the BSCS literature.

2.2.3 The Chemical Bond Approach (CBA):

The organisers felt that in order for the students to get a true picture of chemistry it should be presented through the exploration of three key points, viz.

"Chemists work in the laboratory to obtain data.
Chemists use imagination to develop ideas.
Chemists combine experimental data and imaginative ideas to further their understanding of chemical systems ....."[60]

"The basic themes of the CBA materials are developed around the idea or the central theme of chemical bonds; to a large extent, the properties of chemical substances are correlated or understood through consideration of the bonds between the atoms that compose each structure. The three thematic ideas involve structural models, kinetic - molecular theory, and energy."[61]

Theoretical/...

Theoretical models are also developed here to investigate and interpret new systems. Topics are not treated as individual entities but as interconnecting threads of the total fabric of chemistry.

The laboratory programmes are designed so that the purpose of experiments is not to verify a foreknown answer to a designated question but to provide data which will lead students to argue logically in support of their solutions to problems. Graphs are used extensively to interpret quantitative data.

"The emphasis in the laboratory programme is placed on the relationship between:

1. the structure of a substance and its properties;
2. the energies associated with chemical systems; and
3. the pathways of chemical reactions."[62]

2.2.4 Physical Science Study Committee (PSSC):

The PSSC course was designed for the academically superior, university-bound student. This caters for approximately the top quarter of the class.
The physics course is interconnected with biology and chemistry, with emphasis on the principles of physics that unify the subject, and on the development of theory in physical knowledge. Inquiry, significance, usefulness and reliability of physical measurements fit together into a total curriculum design.

General principles are woven into a sequential pattern with a thematic relationship - seen in the basic concepts of time, space and mass. Subplots are used to develop concepts of light, wave behaviour and particle mechanics. The experiments are open-ended. Laboratory work provides observations to generate ideas from which "models" may be developed. The laboratory programme is not designed to elicit inductive knowledge but is quantitative in nature.[63]

2.2.5 Science/....

2.2.5 Science Curriculum Improvement Study (SCIS):

This is a programme designed for the elementary school. It combines process, content and attitude. Children are introduced to scientific knowledge through their own experiences with the programme's materials.

The chief aim is scientific literacy which is defined by its directors as follows:

"The individual must have a conceptual structure and a means of communication that enables him to interpret the information as though he had obtained it himself."[64]

Scientific literacy permeates the whole programme and is pursued through concrete experiences whereby children acquire the concepts and communication skills essential to its development.

Another major objective is decision-making. This is achieved by making it possible for children to learn science in an intellectually free atmosphere where their own ideas are accepted and respected, where they learn to accept or reject ideas from their own observation and not from authority. This can be carried over to other areas of life and help children to make decisions on a more rational basis after weighing evidence more objectively.

Other objectives include general intellectual development, and to produce favourable pupil attitudes towards science.

2.2.5.1 Psychological basis of SCIS:

The learning potential of children and the importance of concrete manipulative experience as emphasised by educators such as Hunt, Piaget and Bruner were taken into consideration by the organisers of SCIS in developing an effective elementary science programme.

Their/....

Their belief was -

"1. The child's elementary school years are a period of transition as he continues to explore the world he began in infancy.
2. He develops confidence in his own ideas.
3. He builds abstractions with which he interprets the world."[65]

Using these factors as a rationale and in the light of the work of Piaget and others, it was felt that the elementary school years should provide:

"1. A diversified programme based heavily on concrete manipulative experiences.
2. Those experiences in a context that help to build a conceptual framework.
3. A conceptual framework that permits them to perceive phenomena in a more meaningful way (i.e. integrate their inferences into generalisations of greater value than the ones they would form if left to their own devices)."[66]

Although the key focus is on the cognitive domain which is of great importance the other domains of educational objectives, viz. affective and psychomotor have not been neglected. The materials provide for the child to develop in all three domains.

The chief concepts around which the SCIS materials are developed are:
organism; ecosystem; matter or energy; property; reference frame; system and model. The first four are major concepts while the latter are process-oriented concepts.

2.2.5.2 Evaluation of the SCIS programme:
The Science Education Centre, University of Oklahoma conducted a series of experiments with the programme in order to evaluate it and assess the impact it was making on children. Four aspects for evaluation were selected, viz. -

(a) Does/....

(a) Does the SCIS programme lead children to develop a functionality with science process skills which is superior to that which children can develop by using a science text book?

After a careful comparison with a control group, statis= tics showed that the SCIS programme is superior to a text book programme in aiding children to develop the process skills of science. The data indicated that children studying in the SCIS curriculum will be better observers, classifiers, measurers, experimenters, interpreters and predictors than children who have studied science through a textbook approach.[67]

(b) Do the experiences provided by the SCIS programme increase the intellectual development of children? After much experimenting and testing the children's intelli= gence quotients the overall results showed that the program enhances intellectual development of children, and it is one which they enjoy.[68]

(c) Does experience with the SCIS programme influence the achievement of children in mathematics, reading and social studies? Though there was no significant dif= ference in social studies content, mathematics skills and word meaning, the experimental group scored significantly better on paragraph meaning, mathematics application and Social Studies skills.

(d) Is the first grade programme of SCIS an effective reading readiness programme? The research which used material objects showed that they can develop reading readiness.

The overall evaluation of the programme is that it is not only a good science programme, but it is good education as it has potential for intellectual develop= ment, and contributes to academic growth in other subject areas as well.[69]

2.3 Summary/....

2.3 Summary of common characteristics of overseas Science projects:

Each project arises out of a growing concern among teachers that the traditional methods and approaches need to be reviewed in the light of recent advances in scientific knowledge, and the great emphasis laid on active participation by pupils in the learning process. Scientific knowledge of individual disciplines is interrelated by central concepts or themes.

The methods of science receive greater attention. The "inquiry" approach which aims at discovery through questioning rather than verifying of given information is emphasised.

Understanding of fundamental principles is given priority over memorising factual knowledge.

Science is recognised as an intellectual enterprise and as a cultural achievement of mankind.

The new approaches demand new methods of testing and evaluating of pupil achievement.

Experiments are open-ended and laboratory programmes flexible to allow students to choose long-range sustained experiments or individual studies and projects.[70]

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CHAPTER 3

THE PREPARATION OF SCIENCE TEACHERS IN BRITAIN AND AMERICA

1. Brief introduction to the Educational System of Britain:

Elementary education in England was first catered for by charitable and religious organisations such as the Society for Promoting Christian Knowledge. Later secondary education for boys was provided by Grammar and Public schools. These schools prepared pupils for entrance to university for professions. Before the establishment of universities they also undertook the teaching of rhetoric, dialectic and Latin grammar. Latin was the universal language of religion, law and government. It was therefore essential for any scholar who aimed at a career in the service of the church or state.[1]

University education dates from the late twelfth to the early thirteenth centuries with the establishment of Oxford and Cambridge.

The Education Act of 1870 empowered the government to provide educational facilities, and the Education Act of 1902 introduced a co-ordinated national system of education which emphasized local administration.

In 1926 the Hadow Commission proposed that eleven year old children be transferred to separate schools accord= ing to ability. It also recommended the raising of the school-leaving age from fourteen to fifteen years. In 1938 the Spens Commission proposed the continued development of secondary education in separate Grammar, Technical and Modern schools i.e. the 'tripartite' system.

The Education Act of 1944 superseded all the previous ones and through it the Minister was empowered to secure a national policy for education. The old div= ision into elementary and higher education was replaced by primary, secondary and further education.[2]

In 1959/....

In 1959 the Crowther Report recommended the raising of the school leaving age to sixteen years. This, however, only came into effect in the school year 1970-1971. In 1966 the structure of technical education was reorganised resulting in the establishment of a number of 'polytechnics'.

The public system of primary, secondary and further education is administered by the central government, local education authorities and voluntary organisations. The Secretary for State is responsible for education, assisted by two ministers of state and two parliamentary under-secretaries. Her Majesty's Inspectors liaise between the local education authorities and the state.

The Department of Education and Science is responsible for setting minimum standards; providing suitable accommodation; controlling teacher-training and supply; and supporting research at all levels in conjunction with the National Foundation for Educational Research, University Departments and other bodies.

Schooling is compulsory from age five. Primary education lasts until age eleven. Pupils are then transferred to the secondary school viz. 'Grammar', 'Technical' or 'Modern' according to their abilities and results of tests.

After the 1944 Act some local authorities such as London, Bristol and Coventry were against separate schools and consequently established Comprehensive Schools. These are non-selective and provide for all types of education in a district and cover the full secondary age range from eleven to eighteen years.[3]

Independent schools receive no grants from the Department of Education and Science, but are open to inspection. They must also register with the Department which has the right to close any of those schools if they do not conform to standards laid down. These schools

also/....

also include the preparatory schools which cater for boys from eight to thirteen years, and Public schools. They usually provide boarding and are amongst the most famous schools in England.[4]

Secondary School Examinations:

There is no national leaving examination. Secondary school pupils, however, take either the General Certificate of Education (GCE) or Certificate of Secondary Education (CSE). The GCE examinations are conducted by eight independent bodies usually connected with universities. They are set at two levels, viz. Ordinary ('O') level and Advanced ('A') level. The O level examinations are usually taken at the end of a five year course in a secondary school, while the A level examinations are taken after a further two years of study in the sixth form. Most universities require A levels for entrance. Oxford and Cambridge, however, set their own entrance examinations. At A level, passes are awarded in five grades, viz. A, B, C, D and E. A level candidates gaining a grade A, B or C may take special ('S') papers which are more searching.[5]

The GCE examinations cater for the upper ability group of students only. But about one third of the candi= dates come from educational backgrounds other than grammar schools. It was therefore felt that there should be examinations for candidates at a lower level than GCE, O level. In the mid fifties there were thus numerous examinations by various organisations. This, however, gave much cause for concern and a commission was set up to investigate whether examinations for candidates below GCE should be encouraged and intro= duced.

The Beloe Committee[6] after much consideration of the pros and cons felt that there was need for an

/examination ...

examination different from the GCE O level for pupils after the fifth year of secondary education. It was further recommended that a candidate should be able to take any number of subjects, and that teachers should play an important part in planning the syllabuses and setting the papers. The methods of examining were to be experimental and should meet the needs and interests of the pupils. This gave rise to the Certificate of Secondary Education (CSE) examinations, the first of which were held in 1965.[7] The teachers serving on panels were also responsible for marking of the papers. Each school could choose for each subject the kind of examination which best suited its needs.

There were three modes, viz.

"Mode 1 External examinations set on syllabuses which are published by Regional Boards.

Mode 2 External approved examinations on syllabuses devised by individual schools or groups of schools and approved by the Regional Boards.

Mode 3 Examinations set and marked internally by the individual schools or group of schools but moderated by the Regional Boards."[8]

Certain features are still being experimented with, viz. the overall assessment taking into account the work done by pupils during their course, objective testing, project work and the extension of oral examining. No candidate is said to have passed or failed. The results are in five grades.

Grade 1 represents a standard equal to that of GCE O level; Grade 4 could be achieved by pupils of average ability; Grades 2 and 3 lie in between these; and Grade 5 is below average. Pupils below Grade 5 are ungraded.[9]

3. A brief/.....

2. A brief overview of the Training of Teachers in the United Kingdom:

In view of the many ramifications involved in teacher-training in the United Kingdom and the United States of America, only the main principles will be discussed.

Prior to 1944 Training Colleges and University Departments of Education were responsible for the training of teachers. They functioned independently of each other. The Colleges offered mainly a two-year course except for specialised three-year courses in Art, Physical Education and Domestic Science in certain Colleges.

In 1944 the Mc Nair Commission was appointed to investigate and report on the supply, recruitment and training of teachers. Teacher training in the U.K. today is based to a large extent on the recommendations and implementation of the Mc Nair Report. An important outcome of the Report was the setting up of Institutes or Schools of Education.[10] The universities now play a leading role in the training of teachers. Though the university departments and colleges under this scheme retained their identity and individuality, the students and staff are members of the respective Institutes of Education.[11]

In order to illustrate the structure, organisation and functions of an Institute, the London Institute of Education will be discussed as an example.

The constituent Colleges in the London Institute are the colleges in the London Area, Kent, Surrey, part of Essex, the Inner London Education Authority (ILEA) and the outer London Boroughs. There are thirty one in number and include two departments of education in Polytechnics, a department in a College of Art and some specialist colleges; and departments of education of schools of the university which are

at present/.....

at present the faculty of Education of King's College, the centre for Science Education of Chelsea College of Science and Technology, and the depart= ment of Arts, Science and Education of Goldsmiths' College; and the Central Institute.

The activities of the Central Institute include the provision of Diploma courses for experienced teachers; courses for graduates from a wide range of disciplines leading to the Graduate Certificate in Education; and specialist courses for training Art and Music teachers. It also has a strong advanced studies department for higher degrees in Education. Consider= able organised research takes place at the Institute, and it also caters for overseas students through the department of education in Tropical Areas.[12]

The University of London also has its own faculty of Education which is concerned with awards in Education, for example Graduate Certificate in Education, B.Ed. degree and higher degrees such as M.Ed., M.Phil. and Ph.D. in Education, and academic diplomas in Education.[13]

The main functions of the Institute are:
To determine the structure and content of courses for the education and professional training of teachers in the area; to draw up regulations for the award of the Certificate of Education and other awards; to conduct examinations; to promote research in education; to organise in-service courses; to maintain co-operation with educational bodies such as the Department of Education and Science, Local Education Authorities, Teachers' Associations, the voluntary bodies and other institutions.[14]

Other recommendations of the Mc Nair Report included a three-year training period for students entering colleges at eighteen years; a one-year course for graduates and suitably qualified persons other than graduates;

teaching/....

teaching practice in schools for twelve weeks spread over the three-year period including a term of continuous teaching; and secondment of teachers from schools for in-service training.[15]

The James Commission which also reviewed the education of teachers presented its report in 1972. The report was being considered and discussed by various bodies in 1972. It recommended that teacher-training be divided into three cycles. The first cycle to consist of pre-service higher education occupying the first two years, and including a two-year diploma course and general studies.[16]

The second cycle which involves initial teacher-training is to be spread over a further two years. The first year to be spent at a college, university or polytechnic, and the second year to be school-based with concentration on preparation for work appropriate for a teacher. This second year to take the place of the probationary year during which the student is given a licence to teach. He is to be under the guidance of a professional tutor at the school and is to spend some time at a professional centre to continue with his studies.[17]

The third cycle stresses the need for in-service training for teachers as well as those holding promotion posts at all stages of their career. Every teacher should be entitled to in-service training for one term or its equivalent in seven years as an interim measure, and one in five years as soon as possible. Schools and colleges should have professional tutors to co-ordinate the second and third cycle work.[18]

Regional Councils for colleges and departments of education are recommended to replace the Area Training Organisations as it is felt that the colleges have now gained status and have grown up under the system of

institutes/....

institutes of education.[19]

If teachers are to be sufficiently qualified to meet the present-day demands, a four-year graduate course must become the minimum as considerable variations are necessary for emphasis in requirements of primary, middle-school and secondary phases.[20]

3. The preparation of Science Teachers at Colleges of Education in the U.K.:

3.1 Entrance Qualifications:

In general, to be admitted to a course of training at a college of education, a candidate must be not less than eighteen years of age in the year in which the course commences; and satisfy the autho= rities as to character, suitability for teaching, health and physical capacity. He must have passed an approved examination, at or above the required standard. For normal entry into a three-year course the minimum standard is five passes at O level, GCE; or three subjects at O level and two at A level; or two subjects at O level and two at A level; or three subjects at A level and evidence that other subjects have been studied beyond the age of sixteen; or similar success in comparable examinations.[21]

3.2 Courses offered at Colleges of Education:

3.2.1 Certificate in Education:

This is a three-year course in which students are trained to teach in one of the following age ranges:-

Nursery/Infant/Junior (3-9);
Infant/Junior (4-9);
Junior/Secondary (9-13);
Secondary (11-16);
Secondary/Further Education (13-16).

There is, however, at present a national restriction which inhibits students from taking secondary train= ing; but there are exceptions, and different institutions

may/....

may offer specific subjects as their main course subject, for example, Brighton College of Education offers only the following subjects for the main course - Mathematics, Physical Education, Physical Science or Religious Studies.[22] St. Paul's College, Cheltenham, offers - Constructional Design (Wood and Metal), English, Mathematics, Physical Education and Natural Science.[23]

Brighton College of Education also offers a course in Secondary/Further Education. This is an experimental course for training teachers for work with children of average and below average ability in secondary schools. The course aims at producing teachers with a special interest in, and knowledge of the nature of modern society and how to help adolescents to adapt successfully to it. Practical training is also given in Technical Colleges, Youth Clubs and Youth Employment Bureaux, and attachment to industry so that students can link their teaching to the needs of the secondary school leavers. Admission to this course is limited to only really suitable candidates.[24]

3.2.1.1 Outline of the Course:

3.2.1.2 Core Subjects:

1. Education - Theory and practice.
2. Main Subject.

These subjects form the core and are studied for three years. All other courses are related to Education or to the student's main subject, Education and the main subject occupy about two-thirds of the students' time over the three years.

3.2.1.3 Other Courses:

3.2.1.3.1 Subsidiary Course:

Students follow at least one of these courses.

They/....

They are professionally orientated and may be single subject or interdisciplinary. During the first two years secondary students follow a two-year, and if desired, a one-year subsidiary course. Junior/Secondary students take either a two-year and a one-year course or three separate one-year courses. Infant/Junior students pursue a one-year course in their second year.

Environmental Studies: (Infant/Junior)
This course is followed by all Infant/Junior students in the first or second year. It is an integrated course incorporating science, geography, history, art and craft, english and some simple mathematics.

Introductory Course for Junior/Secondary Students:

All Junior/Secondary students spend the first half-term of their course working at their main subject and Theory of Education, and the rest of their time is spent on a special Introductory Course which embraces learning processes and the organisation of curriculum material. After the first half-term work starts on the subsidiary and Junior/Secondary professional subjects.

Professional Courses:
These courses are designed to prepare students for teaching the various subjects in schools. Twelve to fourteen periods per week are spent on these in the first two years.

All students take a short course in Educational Technology which is designed to familiarise them with teaching aids before their teaching practice. Secondary and Secondary/Further Education students pursue three professional courses, one of which is English, and another of which is related to their main subject. The other one or two courses are taken from Mathematics, Science, Physical Education,

Religious/....

Religious Education, Modern Studies and Social Studies

Junior/Secondary students follow professional courses which run for one or two years. They are taken from english, mathematics, physical education and class= room presentation.

Infant/Junior and Nursery/Infant/Junior students follow a range of professional courses in the first two years from english, mathematics, art, music, phy= sical education and religious education. Work in these subjects and in Environmental Studies is phased so that they do not take all these subjects in any one half term. These subjects are also replaced during two separate half terms by 'theme work' such as 'mass media' or 'Community'.

General English and Mathematics:
The Department of Education and Science requires the college to certify to the University School of Educ= ation that each student is competent in written and spoken English, and for primary school teachers, in Mathematics teaching.[25]

3.2.1.3.2 Main Courses:

The main courses offered vary from one college to another.

In the first year students normally take two main subjects unless they do not wish to be considered for the B.Ed. degree and secondary course.

In the second and third year, students who wish to be considered for admission to the B.Ed., and who wish to train for full secondary work continue with both main subjects. The following is an example of the range of subjects a student can choose from: When two main subjects are studied, they must be chosen from different blocks as indicated. Mathe= matics appears in both blocks in order to provide a wider choice of combination with another subject.

Block A/.....

Block A	Block B	Block C
Art and Craft	English	Chemistry
Biology	Environmental Studies	Drama
French	Geography	German
Mathematics	Music	History
Modern Educational Dance	Physical Education	Religious Studies
	Physics	

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The following are the syllabuses and aims of Science Courses offered as main subjects at Brighton College of Education.

3.2.1.3.2.1 Biology and Physical Science:
The science courses, through an essentially experimental approach, aim at:-

(a) Providing an understanding of basic scientific concepts;
(b) Developing scientific attitudes and abilities in recognising and tackling scientific problems including open-ended investigations, and the use of resource material;
(c) Introducing students to recent curriculum developments in science and teaching methods appropriate for the students chosen age range;
(d) Equipping the student to organise and operate school laboratory and classroom work with due regard to the necessary safety precautions;
(e) Developing an awareness of the implications of science and its technological developments in a modern society.

3.2.1.3.2.1.1 Biological Science (for Infant/Junior and Junior/Secondary Students):

The following themes are studied:-

1. Marine or economic Biology.
2. Growth and development or Microbiology.

3. Freshwater/....

3. Freshwater Ecology.
4. Vertebrate Biology or Earth Science.
5. Professional work in primary or in secondary school.
6. Cell Biology.
7. Estuarine or woodland Ecology.
8. Genetics.

3.2.1.3.2.1.2 Physical Science (for Secondary Students)

The following topics are covered:-

Year 1
- Force and motion
- Particulate nature of matter
- Behaviour of gas
- Properties of elements and their place in the periodic table
- Stoichochemistry
- Heat and work
- Chemical reactions and heat
- Principles of chemical equilibria
- Electrostatics and electromagnetism
- Conduction of electricity in solids, liquids and gases
- Chemical reaction rates

Year 2
- Waves and vibrations
- Electrical oscillations
- The nature of light
- Electron beams
- The dual nature of matter
- Electron and proton transfer reactions
- Atomic structure and the electromagnetic spectrum
- Atomic structure and the periodic table
- Bonds between atoms
- Bonding between molecules
- Organic chemistry and mechanism

Year 3/.....

Year 3 Radioactivity
Particles and accelerators
Nuclear reactions
Solubility equilibria

All science students have to make a special study of a topic, commencing during the second year, for presentation toward the end of the third year. The study involves an investigation into a chosen aspect of science and includes experimental work.

Final assessment is by means of a written examination, a special study and course work. Each of the three components normally carries equal weighting.[27]

3.2.1.3.3 Subsidiary Course: Science

3.2.1.3.3.1 One-Year Course (for Infant/Junior Students): This course is intended for students wishing to teach in infant and junior schools and who have either followed or will be following an environmental course.

The course is based on a foundation of individual or group project work, giving experience in the design of experiments, the construction of apparatus, and an understanding of the wide range of possible methods of recording and evaluating results. It aims to lead students to an appreciation of the various properties of a wide range of living and non-living material, and to give experience of structured and non-structured science courses, such as the Nuffield Junior Science Course and the Schools Council Course, "Science 5-13".

Students as far as possible work at their own level and follow their own interests, seeking at the same time how these may be related to their future work with children in primary schools. Science is pre=sented as a method of conducting an inquiry rather than as a body of facts to be learned. Students are assessed each term on course practical work; essays;

and/....

and individual and group projects.[28]

3.2.1.3.3.2 Middle School Science: Subsidiary Course (one year)

Following current trends in Science education, the course emphasises learning through activity and discovery methods. Some reading outside time-tabled time is necessary.

Science is presented as a way of conducting an inquiry rather than as a body of facts to be learnt. The student works at his own level, but uses methods appropriate to the middle years of schooling.

Syllabus:

1. Educational considerations
   The idea of a concept in science
   The development of scientific concepts in children
   Aims and objectives of science teaching
2. Practical considerations
   Organising the classroom for science
   Safety in the science class
   Improvisation from readily available materials
3. Nuffield Junior Science
   Aims of the course
   Examination of teaching materials
   A project based on open-ended investigations from a focus on interest
4. Schools Council - Science 5-13
   Aims and organisation of the teaching materials
   A project based on one or more of the themes: wood, metals, science from toys, structure and forces etc.
5. Nuffield Combined Science

Assessment is based on the presentation and examination of the project work arising from 3, 4 and 5 above.[29]

3.2.1.3.3.3 Professional Course - Science:

This is a two-year course and is for Physical Science students and a few secondary and Secondary/Further Education students who possess a good science back= ground.

It includes the organisation of laboratory work, storage of equipment, safety rules and improvisation of apparatus.

Students are introduced to the various recently published approaches to science teaching which are relevant to work with secondary school pupils of all age ranges and abilities.

The development of open-ended discovery work and the use of more structured topic work play an important part with students being placed in these learning situations. The selection of themes and the depth to which these are studied will depend on an individual's past experience and interest. Not all students study the same themes to the same depth.

Assessment is based on practical records, essays and project work.[30]

3.2.2 Shortened Two-Year Course:

This is not a 'shortened' course in the sense that it omits part of the syllabus. It is intended for mature students who will be able to cope with the course by virtue of their advantage in age and ex= perience. The work of the three-year course is covered in two years.

Candidates wishing to apply for this course must be over twenty three years of age (normally between twenty five and forty); must have followed some course of training since leaving school; and must have had experience, whether in employment or recreationally, and must have had contact with groups of children or young people.

At Brighton/....

At Brighton College, the course consists of the following:

Education: training for junior teaching (7-11 years)
Main Academic Course: English or Art
Subsidiary Academic Course: English or Art
Professional Courses: English, Art, Mathematics/ Science, Religious Education, Music and Physical Education.[31]

3.2.3 Bachelor of Education Course:

All students admitted to the three-year course are potential candidates for the B.Ed. which is an honours degree awarded at the end of the fourth year. The degree-awarding body is the Institute of Education to which the particular College of Education is affiliated. Some students may enter for the B.Ed. degree at the end of the second year provided they pass the necessary qualifying examination at the end of the year. The course is not merely an additional year attached to the three-year Certificate Course but an integrated course which embraces the work of the three-year Certificate Course. In the fourth year it offers Education and the main course subject which are studied to a level appropriate to a degree in Education. There is also usually a linking subject between the two on some aspect of the teaching of the main subject.

The following are the requirements for entry to the fourth year of study at Homerton College, Cambridge - a pass in the Certificate examination, with a pass at advanced main level in the main subject; a creditable standard in Education; and a satisfactory performance in practical teaching.[32]

At some colleges the course contains two elements, for example at St. Mary's - Cheltenham. Part I consists of the Certificate of Education together

with/.....

with an enrichment course involving additional studies in the final year. Part II which is one year's duration, consists of an intensive study of the main subject, the theory of Education and an option in one of the educational disciplines.

The subjects approved by the University of Bristol and available to students at St. Mary's College, Cheltenham for Part II of the B.Ed. are as follows:-

Art (Painting, Ceramics, Textile Crafts, Sculpture, Graphics)
Biological Science
English
Geography
History
Mathematics
Physical Science
Physical Education
Theology
Music. (33)

Part II courses are organised on a regional inter-collegiate basis and students may be required to attend at colleges other than their own for part or the whole of any fourth year course.

The following are science syllabuses and assessment procedures for the B.Ed. degree at City of Leeds and Carnegie College of Education:-

3.2.3.1 Biology: Scheme of Study

1. Plant and Animal Nutrition

Plant nutrition: Soil as a source of mineral nutrients; photosynthesis, mineral nutrition; nitrogen fixation, growth, development hormones.

Animal nutrition: Essential components of the diet; animal feeding mechanisms; alimentary systems; digestion and the digestive enzymes; recent advantages in digestive physiology.

2. A course/...

2. A course of study in one of the following topics: Plant and Animal associations; Genetics; Ecology; Aspects of comparative anatomy and evolution in vertebrates. Enzymology and cell matabolism.

Linking Study:

An individual piece of work in which the student is interested, and which he chooses with the approval of the Board of the faculty of Education, combining Biology and Education. It will be examined by an assessment of one, two or three long essays written during the year.

Final Examination consists of:

1. A written paper (three hours and common to the candidates of all colleges) one of five possible topics chosen by the candidate from:- Plant and Animal associations; Genetics, Ecology; aspects of comparative anatomy and evolution in vertebrates; Enzymology and cell metabolism.
2. A practical examination
3. Normally an oral examination (which will not take place during the practical examination)

3.2.3.2 Chemistry: Scheme of Study

1. The syllabus covers inorganic, organic and physical Chemistry with practical work.
2. Students must choose one of the following courses: Physical methods of determining molecular structure; Radiochemistry; Geochemistry; Biochemical processes; Natural products; Colloids and Surface Chemistry.
3. Each student will study some special problem (preferably associated with the course he has chosen under 2 above) approved by the board of the faculty of education: He will work under the general supervision of a member of the staff of his college. An assessment of the quality of the

candidates/....

candidates' work and of the methods used in this study must also be presented to the examiners by his supervisor.

Linking Studies:
Candidates are required to present an essay of not more than eight thousand words, or a report of work done during the session on some aspect of chemical education, (for example the historical, the social or the pedagogical aspects of chemistry or chemistry teaching).

The final examination consists of:-

1. Two written papers (each of three hours, and common to the candidates of all colleges) covering inorganic, organic and physical chemistry.
2. One written paper (three hours) on the course chosen by the candidate under part 2 of the scheme of study outlined above.
3. A candidate has to submit a report on the special study he has undertaken (as part 3 of the scheme of study outlined above) this consists mainly of a literature survey and a record of experimental work.

3.2.3.3 Physics: Scheme of Study

Additional Course requirements: Students selecting this subject should have reached a standard in Mathematics equivalent to that of first year university level.

Scheme of Study:

1. Quantum theory and wave mechanics - statistical systems; quantized systems.
2. Physics of the solid state -
   Crystal symmetry; free electrons; strength of solids.

3. Alternating/...

3. Alternating current and semiconductor devices.

Linking studies:
Candidates have to present an essay (or report) of not more than eight thousand words during the session on some aspect of Physics education to be approved by the board of the faculty of Education.

The final examination consists of:

1. Three written papers (each of three hours and common to the candidates of all colleges within the Area Training organisation:
   (a) Quantum theory and wave mechanics
   (b) Physics of the solid state
   (c) Alternating current and semiconductor devices.

2. Each candidate has to submit a dissertation of not more than eight thousand words on a topic which will normally be related to an experimental project undertaken during the session.

3.2.4 In-Service B.Ed. Degree

Some colleges also offer a B.Ed. degree for teachers in service, for example St. Paul's College, Cheltenham. This may be on a full-time or part-time basis and has to be approved by the University of Bristol.

The courses are open to all qualified teachers irrespective of when or where they originally received their training. This course is also divided into two parts. Part I comprises the three-year Certificate course plus certain additional studies; and Part II consists of a programme of study in Education and a principal subject.

Teachers in service are credited with part of the Part I requirements on the basis of their existing Certificate. The remainder of the requirements may be met by completing the course which is usually of

two/....

two years duration. The board of the faculty of Education of the university may exempt a candidate with appropriate qualification and experience from the whole or part of the qualifying course for Part I.

The course for Part II is spread over one year for full-time, and two years for part-time students. All subjects listed for the continuous B.Ed. degree can be offered provided there are sufficient members.[34]

3.2.5 One-Year Post Graduate Course:

A one-year post graduate course is offered by most colleges to candidates who are already university graduates. Training is offered for junior schools and for all types of secondary schools. The following courses are provided at Homerton College, Cambridge:

Education:

All students take a basic course in Principles of Education which includes Philosophy, Psychology and Sociology of Education and Health Education.

Junior Course: Provision is made for training to teach throughout the junior school curriculum.

Secondary Course: Students specialise in one or two subjects of the secondary school curriculum.

Work with children: This course includes three periods of work with children of the age range for which the student is preparing, occupying a total of twelve weeks.

The examination consists of the presentation of three essays on problems within approved educational fields, together with the attainment of a satisfactory standard in practical teaching.[35]

The following is an example of the content in science and, structure of a one-year post graduate course at Brighton College of Education:

Course Content/.....

Course Content:

(a) Investigation of the nature of science and scientific thought and a consideration of the place of science in the general education of the child.

(b) Science in the early years of schooling. Nuffield and Schools Council courses and their implications for secondary school science teaching.

(c) Design of the secondary school curriculum:

  (i) Study of Nuffield and other courses to 'O' and 'A' levels in the appropriate fields of science.

  (ii) Science for the non-specialists: integrated and project-based or topic-based courses of the Nuffield Foundation and the Schools Council likely to be used in middle schools or the early years of secondary schools.

(d) Presentation and development of basic concepts in the laboratory, including practical evaluation of apparatus recently introduced for school use.

(e) Laboratory organisation, including design, maintenance, storage, safety and day to day operation.

(f) Examination and assessment of school science courses.

The content also includes topics from the Nuffield Foundation and Schools Council projects for detailed study.

The following are dealt with as an introductory course:-

(a) The overall pattern of the course in science

(b) Nuffield approach to teaching

(c) Resources/....

(c) Resources available in the college for the preparation of science lessons

(d) The purpose of preliminary school visits

(e) The preparation of teaching practice files.

The work is covered by a series of seminars, science workshops and practical laboratory sessions.

Assessment of Course Work:

1. Three essays of about two thousand words are set during the course.
2. Students are required to present a project on some aspect of science teaching, or education in general of six thousand words.[36]

3.3 Courses offered at Universities in the United Kingdom:

3.3.1 Graduate Certificate in Education:

This is a one-year post graduate teachers training course leading to a certificate in Education of the University and recognised by the Department of Education and science as a teacher qualification.

Entrance Requirements:

Candidates for admission must be graduates of a University in the United Kingdom, or any other approved university, or be holders of a degree awarded by the Council for National Academic Awards (CNAA).[37]

Aims:

The course is designed to present the graduate with a wide range of related ideas and experiences in the field of education to achieve three main aims:

1. The student should become as professionally competent as possible, teaching his pupils in the most enlightened ways;

2. The/.....

2. The development of an abiding interest in the study of education which may lead on to research and further qualifications in the field;

3. To aid the personal development of students by providing a course which produces a challenge worthy of post-graduate students both from an intellectual standpoint and from the opportunities it provides for new interests.[38]

3.3.1.1 Pattern of the Course:

The Certificate Course usually opens one week before the opening of the university session. In the Autumn or first term students first have a one-week introductory programme followed by three weeks school practice in non-selective schools. This is followed by a two-week foundation phase which forms an introduction to the contribution of the major academic disciplines to the study of education, and then a six-week development phase with some inter-disciplinary work. Throughout those phases great attention is paid to curri= culum and method work in preparation for the Spring or second term which is devoted to school practice. The summer or final term is arranged in a series of special studies, 'work-shops' and projects.[39]

3.4 Methods of Instruction:

Generally the following methods of instruction and study were observed at colleges and university departments of Education:

Students are given a list of topics to be studied for the year. They gather their own information from text and reference books. The lecturer in charge meets the whole class once or twice per week for formal lectures or answering of queries.

Practical/....

Practical Laboratory Work:

Students work singly or in groups in the laboratories on experiments, assignments or projects. The lecturers are present for consultation and guidance. At appointed times students are required to give seminars on topics they have chosen for in-depth study. Some students both at college and post-graduate level undertake minor research projects. At the end of the year they may produce a detailed report or thesis.

3.5 Equipment and Resources:

All the institutions visited had very well-equipped laboratories to cater for all the practical work in the syllabus. Libraries in addition to many thousands of reference books, periodicals, journals etc. have very spacious reading rooms with cubicles or carrels. These are provided with slide projectors, loop film projectors, a daylight screen, tape recorders and micro fisch readers. A student may obtain the necessary film, slide or tape from the librarian and use these for private study in the carrel. These facilities supplement the lectures.

3.6 Practice Teaching:

Generally practice teaching is arranged in schools of various kinds. The exact arrangements vary from year to year, but usually there are at least two continuous periods: the first during October and the second in the Spring (second) term.

As far as possible students are allocated to schools in the vicinity of their homes. Tutors visit as many students as they can, listen to their lessons and discuss the lessons with the students before leaving the school.

In assessing students' ability the reports of tutors and of the heads of schools are considered. Some

students/....

students are visited by external examiners appointed by the School of Education. Evaluation and assessment procedures vary from one institution to another. Though there is a bias towards the use of an objective analysis of teaching practice assessment there are some institutions that prefer a subjective approach. (For examples of assessment forms - see appendix xxii-xxiii In most colleges and universities in Britain and America micro-teaching was observed.

3.6.1 Micro-Teaching:

This is a training technique that can be applied at pre-service and in-service stages of training. It is a situation where a student/trainee teaches a lesson or some aspect of a lesson to a small group of four to six pupils. The lesson is recorded on a video-tape while the supervisor also makes his criticisms. Later the supervisor and student-teacher discuss the lesson and view parts of it on videotape. The student may then reteach the lesson to a different group of pupils.

Micro-teaching differs from the normal class teaching situation in that length of the lesson is reduced and its scope narrowed. The teacher, however, receives a great deal of feedback on his performance. The video-tape enables the tutor/supervisor to focus attention on specific skills and techniques, the mastery of certain curricular materials or the demonstration of particular teaching methods. Soon after the lesson the student may be required to fill in response forms. These are then analysed later in the light of his goals.[40]

3.6.2 Microteaching and in-service teachers:
Apart from pre-service training, teachers in service could also benefit tremendously especially in the trial of new approaches and methods, for example many schools have adopted team-teaching. A microteaching clinic would be of great benefit to the team in developing

new/....

new materials. While one member of the team gives the lesson the others act as critics and evaluators. A teacher can thus experiment with several methods and evaluate them. This can stimulate discussion of various approaches among teachers. It is particularly valuable for curriculum developers or consultants who could actually give demonstration lessons for the benefit of teachers rather than merely lecturing about new trends and methods.[41]

At Sterling University, Scotland, micro-teaching is integrated into a coherent theoretical course where educational psychology is seen as providing a relevant conceptual framework and rationale for the skills to be practised in micro-teaching. Initially students practise small-scale interaction with a small group of pupils for short periods of time. This is gradually increased until up to two years later they are given full length lessons to full size classes in schools.[42]

Microteaching is a comparatively new technique in which there is ample scope for experimentation and research. It is one of the few experimental techniques which encourages the combination of theory and practice, research and training, innovation and implementation. This new medium of education may have a strong impact and may well be a catalyst in education.[43]

3.7 The rolē of Teachers' Centres in the United Kingdom:

The origin of teachers' centres goes back to the time of the 1944 Education Act. But it was only after 1965 with the raising of the school leaving age from 15 to 16 that teachers' centres were developed on a large scale throughout the United Kingdom. By 1968 there were well over three hundred.[44]

The centres are run by management committees made up of local authority members as well as teachers. The

primary/....

primary function of these centres is to afford teachers an opportunity to meet in order to review existing curricula. Facilities at most centres include dis= cussion rooms, libraries and laboratories for practical work in science. Most of the centres are attached to schools or Colleges of Education. In 1968, eighty nine of them were exclusively concerned with work in Nuf= field or Schools Council projects in mathematics, science and modern languages. As the needs of the local teachers become known the activities become more varied. There is a continuing programme of national project work and workshop courses and a great deal of in-service training takes place at the centres.[45]

4. The Educational System in America:

Formal education in Colonial America in the early days was limited to children who were able to attend private schools. Poorer children obtained the rudiments of education in charitable and religious schools. At the secondary school level the private academy was the main institution for more than two hundred years. The government granted charters, subsidies and land to private academies and colleges.

After the American War of Independence, each of the colonies which now constitute the United States of America was given the right and responsibility to organise and control its educational system as it thought best. Every state maintains a system of free, public education up to the twelfth grade. School attendance is compulsory up to between sixteen and eighteen years. The concept of education envisaged by those in charge is expressed in the constitution of the state of Indiana in 1816, as follows:

> "A general system of education, ascending in regular gradation from township (district) schools to a state university wherein tuition shall be gratis is equally open to all."[46]

Although/....

Although every State aimed at providing for education from elementary school to university level, private educational institutions at all levels played a significant rolē in American education. Private institutions are responsible for some forty per cent of the total enrolment in institutions of higher education, over ninety five per cent of these being religious bodies. In the United States "a child's right to an education is regarded as an inalienable right which should be available to all children regardless of the economic or social status of the family."[47] Every child is thus assured of an equal opportunity of developing his own intellect and talents to the fullest extent. Education is regarded as the cornerstone of a free society.

The purpose of education in the United States can be summed up under these headings:

1. The development of the individual;
2. The achievement of the maximum welfare of society through the co-operative efforts of individuals and groups.[48]

The educational programme therefore makes provision for the great variety of talents, aptitudes and interests of individual pupils. Individual needs and differences are of vital importance in considering goals and instruction, the ultimate aim being effective citizenship in the immediate community, state, nation and in the world.

4.1 Educational Structure:

Nursery schools which are mostly private cater for three and four year old children while kindergaten schools are for children from four to five years. Thereafter there are three plans, viz. -

1. Eight - four plan: where eight years are spent at elementary school and four years at High school;

2. Six/....

2. Six - three - three plan:

   After kindergarten the pupils spends six years at elementary school, three years at junior and high and three years at senior high school; and the

3. Six - six plan: this involves six years at elementary school and six years at high school.

In all cases they lead to graduation at age seventeen or eighteen years. Vocational education is an integrated part of secondary education. High schools in America are of three types, viz. - Comprehensive, Academic, and Vocational or Technical Schools. The Comprehensive high school provides academic, vocational and technical education in the same school. Students graduating from high school may enter a Junior College, a Technical Institute,, a Four Year College or a Professional School. The Junior College offers the first two years of a standard four year college programme and a broad selection of terminal vocational courses. Academic courses obtained at a Junior College may be transferred for credit to four-year colleges and universities.

4.2 Higher Education:

This includes educational programmes which require for admission twelve years of previous schooling or its equivalent. Higher education is composed of a variety of programmes and there is no consistency in the use of terms such as 'college' or 'university'. Liberal Arts Colleges which offer four-year programmes leading to a bachelor's degree are numerous. A university generally has as its base a Liberal Arts College and a number of professional schools such as Law, Engineering, Education etc., and it offers advanced study leading to a doctor's degree.

Institutes of Technology offer mainly technical subjects such as Science and Engineering. Teachers' Colleges

provide/...

provide four-year programmes leading to a bachelor's degree for elementary and secondary school students.

Many Teachers' Colleges also offer programmes similar to four-year Liberal Arts Colleges and are designated State Colleges. Junior colleges offer a two-year programme of general education (equivalent to two years of a four-year programme at a Liberal Arts College). Many of these are also known as Community Colleges because they are supported and controlled by com= munities in which they are situated.[49]

Each state has its own system with a commissioner or superintendent at the head. There are, however, certain features in common between the various states, for example, the setting up of school boards which are responsible for educational policy and administration on a local basis. The members of the board are elected by the people or in some cases they may be appointed by the state. Though the federal government is not responsible for organisation and administration of education, it nevertheless, has significant interest at the local level.

5. An overview of Teacher-training in the United States of America:

There is great diversity in the pattern of teacher train= ing in the United States of America. Training periods range from two to four years in different states with several types of institutions, and varying curricula. In addition to the normal courses in education, the humanities, natural and social sciences, prominence is given to 'communication'. Institutions responsible for teacher-training are Teachers' Training Colleges, University faculties of Education and Colleges of Education. Many of the institutions have experimental schools, on the campus which are also used for demon= stration purposes.[50]

Normal/....

Normal schools which were established in the nineteenth century were transformed into Teachers' Colleges. Many of them added liberal arts and vocational courses and became degree-granting institutions. They are now State Colleges.

It was recently recommended to the California State Committee on Public Education that a seven-year training course for teachers with a four-year bachelor's degree and a three-year clinical experience be introduced.[51]

Certification also varies from one state to another. Areas where there is a shortage of teachers have two-year courses. In most cases a bachelor's degree is the minimum base for standard certification. California requires five continuous years of preparation for a standard permanent certificate; Indiana requires a bachelor's degree for standard certification and a master's degree based on a full year's work for permanent certification.[52]

In New York for permanent certification a teacher has to have in addition to his bachelor's degree, thirty semester hours of graduate credit. In general, the procedure for arriving at a credit is as follows: a unit of three semester hours is a standard measure of a college course meeting three times a week. Thus to obtain a credit for thirty semester hours the student must attend for ten units (i.e. 3 x 10). A full-time college student usually takes five subjects a semester with each course meeting three times each week. If he passes these courses then he will have fifteen semester hours or 'credits' of academic work.[53]

Some states, for example Georgia, Florida and North Carolina require a teacher to take the National Teachers' Examination for certification and tenure.

6. The Preparation of Science Teachers at some Institutions in the United States of America:

6.1 Undergraduate Programmes:

6.1.1 Admission Requirements:

Admission requirements to a Liberal Arts College, for example the City College of the City University of New York, are a diploma from an accredited high school and a certificate of health.

6.1.2 Courses:

The School of Education of a Liberal Arts College offers two major routes to teacher preparation. The first is through transfer to the School of Education leading to the degree of Bachelor of Science in Education. The programme is required for all elementary education students and for the secondary education fields of Industrial Arts and Physical Education, and is optional for other secondary fields. The second route available to all secondary education students in fields other than Industrial Arts and Physical Education is to remain in the College of Liberal Arts and Science and to take the Education courses as part of the free elective credits. These students will graduate with a B.A. or B.Sc. degree but will have to meet City and State requirements to begin teaching after graduation.[54]

The following groups of students in a Liberal Arts College who want to follow a teacher-training course must transfer to a School of Education since the requirements of their programmes cannot be completed within the limitations of the B.A. or B.S. degrees:

1. All elementary education students, including early childhood education.
2. All those preparing to teach mentally retarded or emotionally disturbed children.
3. All Industrial Arts students.
4. All Physical and Health Education students.

Those/....

Those students who plan to teach any secondary school (junior or senior high school) subjects except Industrial Arts or Physical and Health Education may remain in the College of Liberal Arts and follow a programme of either a B.A. or B.S. degree. These students will take their education sequence as part of their elective credits under the guidance of both Education and Liberal Arts advisers. The School of Education will only certify to the State Education Department those students who have followed programmes of study approved by the School of Education for B.A. or B.S. degrees.

To be admitted to the School of Education, a candidate must first meet the general entrance requirements for matriculation at the City College, and have completed at least thirty credits of work with an acceptable average. Candidates also have to undergo a screening procedure to identify those needing help and to suggest remedial measures.[55]

6.1.2.1 Certification Requirements of New York State:

The programmes offered by the School of Education - of City College are approved by the State Education Department. A student completing the Education course will qualify for provisional certification upon the award of a Bachelor's degree, and for permanent certi= fication upon the award of a Master's degree.

Requirements for Provisional Certificates for Elementary Education:

Nursery to sixth grade: twenty four credits for Education Courses plus student teaching.

Nursery to ninth grade: twenty four credits for Education Courses plus student teaching and one of the following specialisations to the minimum credits specified -

English	30 credits
Foreign language	24 credits
General Science	36 credits (in at least 2 sciences)
Mathematics	18 credits
Social studies	30 credits.

Permanent/...

Permanent Certificates for Elementary Education:
In addition to the above requirements, permanent certification requires a Master's degree in or related to the field of teaching service, or thirty semester hours of graduate study from Liberal Arts, Social and Behavioural Sciences, and professional studies in education.

6.1.2.2 Provisional Certificates for Secondary Education.

Academic subjects for grades 7 - 12:

twelve credits of Education courses plus student teaching and one of the specialisations to the minimum credits specified -

English	36 credits
Foreign Language	24 credits
Mathematics	18 credits
Science	36 credits
Social Studies	36 credits

Special subjects (for Grades Kindergarten to 12)

twelve credits of Education Courses plus student teaching, and one of the specialisations to a minimum of thirty six credits:

Art	Music
Health Education	Physical Education
Industrial Arts	Speech

6.1.2.3 Permanent Certificates for Secondary Education:

In addition to the above requirements for a provisional certificate, permanent certification requires a Master's degree in or related to the field of teaching service, thirty semester hours of graduate study from the Liberal Arts, Social and Behavioural Sciences and professional studies in Education.[56]

The following is a sample of a four-year undergraduate programme in Science Education at Wayne State University indicating the credits for each course:

7.1.2.4 Elementary/...

6.1.2.4 Elementary School Course (Grades 1 - 6)

First Year

Fall Quarter (1st ")		Winter Quarter (2nd ")		Spring Quarter (3rd ")	
Phy. Sc.	4 credits	Geology	5 credits	Astronomy	4 cr.
Electives	3 "	English	4 "	Eng. Elect.	4 "
Soc. Sc.	5 "	Soc. Sc.	5 "	History	4 "
Maths.	4 "	Maths.	4 "	Maths	5 "

Second Year

Biology	5 credits	Biology	4 credits	Biology	4 "
Electives	3 "	Speech	4 "	Psychology	4 "
Hygiene	3 "	Geography	4 "	Phy. Ed.	1 "
Anthro.	4 "	Phy. Ed.	1 "	Electives	6 "
Phy. Ed.	1 "				

Third Year

Chemistry	4 credits	Sc. Ed.	4 credits	Sc. Ed.	4 "
Education	4 "	Sc. Elec.	4 "	Sc. Elect.	3 "
Sc. Educ.	3 "	Elem. Ed.	4 "	Institut.	3 "
Sc. Elec.	4 "	Ed. Psy.	4 "	Technology	

Fourth Year

Elem. Ed.	8 credits	Elem. Ed.	8 credits	Humanities	4 "
Scien.Ed.	4 "	Elem. Ed	4 "	His. Ph. Ed	4 "
Art Ed.	4 "	Elec.	4 "	Electives	12 "

6.2 Four-Year Programme for Junior High School Teachers:

First Year

Fall Quarter (1st ")		Winter Quarter (2nd ")		Spring Quarter (3rd ")	
Soc. Sc.	4 credits	English	4 credits	Eng. Elec.	4 cr.
Biology	5 "	Soc. Sc.	4 "	Soc. Sc.	4 "
Maths.	5 "	Biology	4 "	Biology	4 "
Elective	4 "	Math. El.	4 "	Maths Ele.	4 "
		Phy. Ed.	1 "	Phy. Educ.	1 "

Second/....

Second Year

Fall Quarter (1st ")		Winter Quarter (2nd ")		Spring Quarter (3rd ")	
Elective	4 credits	Social Science	4 credits	Chemistry	4 cr.
Chemistry	4 "	Chemistry	4 "	Geology	4 "
Geology	5 "	Geology	4 "	Psychology	4 "
Hygiene	3 "	Speech	4 "	Elective	4 "
Phys. Ed.	1 "				

Third Year

Physics	4 credits	Physics	4 credits	Physics	4 "
Science El.	4 "	Psychology	6 "	Sc. Elect.	6 "
Electives	8 "	Educ. Psych.	4 "	Sc. Educ.	4 "
Education	4 "				

Fourth Year

Sc. Educ.	8 credits	Science Educ.	4 "	Astronomy	4 "
Sc. Educ.	8 "	Sc. Elect.	4 "	His/Phil.Ed	4 "
		Electives	8 "	Sc. Elect.	4 "
				Elective	4 "

(57)

6.2.1 Some Science Education Courses:

The following are some Science Education Courses at Wayne State University from which students may choose:

1. Science in the Elementary Schools: (4 credits)

   Objectives and significant areas of study in science appropriate to the elementary school curriculum. Introduction to teacher resources, including experiments, field trips, library materials, equipment, audio-visual resources

2. Field Course in Natural Science (3 credits)

   Field and laboratory observations and study of ecological relationships. Research and experimentation in interrelationships of biological factors in the environment. Emphasis on implications for use in school science curriculum.

3. Methods/....

3. Methods and materials of instruction in secondary school science: (4 credits) -

   The role of science in the secondary curriculum. Problems and techniques of teaching science in secondary schools: Objectives, planning, laboratory experiments, demonstrations, directed study, student projects, text and reference materials, audio-visual resources, evaluation.

4. Recent advances in the Teaching of Science in the Junior High School (4 credits)

   Innovations and improvements in junior high school science as part of a K-12 (Kindergarten to grade 12) science curriculum. Exploration of appropriate areas of study, development and selection of learning activities and materials, laboratory experiences in selected areas.

5. Recent research in curriculum development and instruction in science (4 credits):

   Analysis of recent research in Science education, K-12, and consideration of implications for curriculum designing in science and for improvement of classroom teaching. Consideration of research tools needed by teachers of science.

6. Professional Course - Biological Sciences in the Elementary school (4 credits):

   Significant biological principles, generalisations and understandings with relation to their use with children. Appropriate learning activities including experiments, field trips, reference materials, audio-visual resources.

7. Professional Course - Physical Sciences in the Elementary School (4 credits):

Significant/....

Significant principles, generalisations and under=takings in the Physical Sciences with relation to their use with children. Appropriate learning activities including experiments, field trips, reference materials, audio-visual resources.[58]

6.3 GRADUATE PROGRAMMES

6.3.1 Admission Requirements:

A candidate must hold a Bachelor's degree from an accredited college or University; in the case of Trenton State College he must be in possession of a Standard New Jersey Teacher's Certificate; and must have completed the equivalent professional work required for such a certificate.

6.3.2 Courses:

Trenton State College offers a Master of Arts in Teaching in -

Elementary School Teaching: This is designed for college graduates who wish to prepare for teaching in the elementary school. Forty eight semester hours of work are required for the course and this will entitle the student to a Master of Arts in Teaching Degree, and a standard elementary teaching certificate.

Secondary School Teaching: This is designed for college graduates who wish to become secondary school teachers of Mathematics, English, Science or Social Studies. Forty semester hours of work will entitle the student to a Master of Arts in Teaching Degree and a New Jersey standard secondary teaching certi=ficate in the appropriate field.[59]

6.4 Experimental Programme:

Many institutions run experimental programmes in various aspects of teacher-training. An example of such a programme offered at City College is described here.

Generally/....

Generally, the students who qualify for teaching are capable of handling middle-class school children in suburban schools but are unable to deal with children from impoverished areas. Hence the School of Educat= ion at City College in New York has a modified programme which prepares teachers to deal with children from disadvantaged areas. Instead of the usual sequences in Education, students undergo a series of experiences with the child, the school and the community with appropriate educational studies in the various fields.

In the first year emphasis is on the psychological study of the child in the school setting, culminating in the selection of six children from one grade in the elementary school to be studied, tutored and worked with intensively so as to follow them through the junior high school years.

In the second year stress is on the child's community, the local board, the church, the social service agencies and all the social units that shape the child's background and growth. The prospective teacher is expected to attend meetings of these groups, visit the children's homes and become thoroughly conversant with the life style of the children.

In the third year emphasis is on the teaching-learning process: individually, in groups, in school, out of school, on trips, through programmed instruction and teaching machines etc. Emphasis is also placed on problems of children from lower socio-economic areas and ways of dealing with them.

In the fourth year, the student will serve as an assistant to a teacher in the public school. These four years of intensive field work are accompanied by seminars in which the experiences of the student are analysed, discussed and synthesised.

Graduates/....

Graduates of such a programme will go into the schools with an insight and sensitivity that they would not have had through the more conventional type of programme.[60]

6.5 Practice Teaching:

There is considerable diversity in practice teaching both in requirements and arrangements, for example, some institutions require full-time practice teaching while others require part-time practice teaching, the duration of which ranges from six to sixteen weeks, the average being twelve weeks.

Students may teach at only one grade level or at two levels. Supervision of students is generally handled by the methods and curriculum instructors or by special full-time staffs. Observation and practice teaching take place in the first year (freshmen), second year (sophomore), third year (junior) or fourth year (senior).[61]

The actual time required for practice teaching ranges from four to eleven semester hours. Most institutions specify full time for half a semester; a certain number of weeks; a full quarter or a certain number of hours a day for a quarter or semester. The number of clock hours for credits also varies though there is a tendency to equate one semester hour of credit with approximately thirty clock hours of observation and practice teaching.

Some institutions have laboratory schools for practice teaching on the campus. These may be public schools assigned by the local administration to co-operate with the college or university.[62]

6.6 Methods of instruction:

Generally course work is covered by formal lectures, seminars and discussions, assignments and individual and group projects. Students for the most part work on their own but lecturers are available for consultation

when/....

when difficulties arise. Students who show an interest and aptitude in any particular field in science are allowed to undertake minor research projects. These are assessed and if a high enough standard has been attained the student may be given an exemption in that subject.

6.7 Resources and equipment:

The science laboratories are well equipped to cater for the various courses offered. Libraries and resource centres have adequate materials for research projects as well as teaching aids. Facilities are available for pre and in-service teachers to try out new approaches with an entire class at these centres. These were observed at the science teaching centres at Teachers' College in New York and at the University of Maryland.

Science museums in the large towns and cities are open to teachers and lecturers who may take their groups of students to view demonstrations of various phenomena in science.

6.8 In-service training:

In-service training for teachers forms an essential part of teacher education in America. Many institutions offer a multiplicity of courses, for example:

professional education courses such as philosophy of education and educational psychology; methods courses; special education such as courses in instruction for the mentally retarded or unusually gifted or the physically handicapped; courses leading to a master's or doctor's degree in fields such as curriculum planning, guidance and administration.[63] Such courses may be held in the evenings, over weekends or over vacations. These courses help the teacher to grow intellectually; are desirable as the four-year training period is never adequate and they keep the teacher up-to-date regarding new developments.

Many/....

Many universities and colleges in conjunction with the National Science Foundation run in-service courses in science and mathematics over the summer vacation to which teachers from foreign countries are also invited. Credits obtained at these summer institutes may count towards a master's or doctor's degree for American teachers provided that the certifying body does not consider the courses too elementary.[64]

In-service training in Britain also forms an important part of the teacher education programme. Similar courses to those offered at institutions in America are also organised at universities, colleges of education or teachers' centres. Courses are also held for personnel who need administrative know-how for various promotion posts.

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CHAPTER 4

SCIENCE TEACHING IN INDIAN HIGH SCHOOLS

1. A brief introduction to the Educational System in S. Africa:

The educational system in South Africa is highly centralised. The government through the Minister of Education is responsible for all facets of education, viz, policy, administration as well as planning of curricula and syllabuses.

Education in South Africa is divided horizontally into:

(1) Higher education under the control of the government through the Minister of Education. This includes

a) University education
b) Schools of art, music, agriculture, mining, pharmacy and nautical training
c) Vocational institutions other than those provided by the provinces
d) Continuation classes
e) The training of secondary and nursery school teachers
f) Any education which the Minister may declare to be higher education;

(2) Education "other than higher" i.e. primary and secondary education which was allocated to the provinces. As far as the training of teachers is concerned, it is felt that on the one hand it is a national function and should therefore be the responsibility of the central government, and on the other hand that it should be in the hands of the provinces since they controlled primary and secondary education. As a compromise the provinces trained the majority of teachers while the universities and central state department also undertook the training of teachers. There was consequently much overlapping and duplicating.[1]

Apart/....

Apart from the horizontal division there was also a vertical segmentation of education. Vocational and Technical Education of a secondary type, the training of specialist teachers and nursery teachers, and special education which included both primary and secondary work were gradually moved from the hands of the provinces and placed under the State Department. All other forms of education for Whites, Coloureds, Asiatics and Bantu were under the control of the provinces.

Vertical segmentation was carried further when the control of education of the non-white groups was taken away from the provinces and placed under State Departments. This was in accordance with the government's policy of separate development. The first of the non-white groups to be transferred to the State was the Bantu. This was done by the passing of the Bantu Education Act No. 47 of 1953. The report of the Eiselen Commission in 1951 formed the basis of the Bantu Education Act. The main provisions were:

1. A central State Department, viz. the Department of Bantu Education was to be responsible for education of the Bantu
2. There was to be a centralised headquarters and six decentralised regions, each under its own director
3. Bantu school boards and committees were to control schools locally.

The second racial group to be transferred from the provinces to the State was the Coloureds. This was effected by the passing of the Coloured Persons Education Act No. 47 of 1963. The Coloured Education Department of the Department of Coloured Affairs was to be responsible for the education of Coloureds.

The third step in the separation into State Departments was the transfer of the education of Indians from provincial control to the Department of Indian Affairs

by the/....

by the Indian Education Act No. 61 of 1965.[2]

Hence there are at present in South Africa four provincial departments and one central State Department of education controlling white education, and three central State Departments controlling the education of non-whites.

1.1 The Department of Indian Affairs:

The division of education of the Department of Indian Affairs is responsible for the education of Indians in South Africa. At the head is the Minister for Indian Affairs, followed by the Secretary for Indian Affairs and the Director of Education. There are two deputy directors, viz. one for professional services concerned with the control of educational standards, courses and syllabuses, and the provision of psychological services; and the other for administrative services concerned mainly with the provision of school accommodation.[3]

Education committees were established to provide a link between the home and school, and to ensure that the needs and interests of children are catered for. Some of the functions of these committees are: to collect funds for the school; to investigate and report on truancy; to inspect the school buildings and equipment and to investigate and report on the need for the establishment of part-time and continuation classes.[4]

1.2 Compulsory Education for Indians:

Sub-section (1) of section 23 of the Indian Education Act 61 of 1965 was amended in Parliament to read as follows:

"(1) The Minister may, by notice in the gazette declare that regular attendance at a state or state-aided school shall, to such extent and under such circumstances as may be specified in such notice, be compulsory for every Indian belonging to a category or class so specified."

The/....

The amendment bacame operative with retrospective effect from 1 December 1972, and is contained in Section 31 of the General Law Amendment Act, 1973 (Act 62 of 1973) which was published in the government gazette 3947 of 27 June 1973.[5]

1.3 The New System of Differentiated Education for Indians:

The basis of the new differentiated system of education for Indians is contained in sub clause 2(1) (f) of the National Education Policy Act No. 39 of 1967 which states that -

"education shall be provided in accordance with the ability and aptitude of and interest shown by the pupil, and the needs of the country, and that appropriate guidance shall, with due regard thereto, be furnished to pupils."[6]

On the 12 November 1971 the Minister of National Education, Senator the Hon. J.P. van der Spuy put forward to Parliament the plan for differentiation and the new system came into being by proclamation R2029, and it took effect in schools from January 1973. It is an extension of the school curriculum to give a better balance between academic and vocational subjects. It aims at giving children the education that suits their skills, interests, abilities and aptitudes, and ensuring the proper use of manpower resources in the best interests of national concern.[7]

Implications of the New Differentiated System:

The normal period of school education which is twelve years is divided into four phases of three years each, viz.

1. The Junior Primary Phase:
   This is the infant stage for children between the ages six and eight years. It is the commencement of formal education during which the child adapts himself to school life through the teaching of basic skills mainly in reading and number concepts.

2. The Senior/...

2. The Senior Primary Phase:
This is the second phase and includes standards II, III, and IV. Foundations for meaningful learning and understanding are laid in these standards. Apart from speaking, reading and writing, concept formation is most important during this phase in preparation for the secondary phase.

3. The Junior Secondary Phase:

The third phase includes standards V, VI and VII. This is a transition period which allows the child to find himself and gain a clearer picture of his potential. Although the first year and in some instances the second year of this phase are continued at primary schools the curriculum, nevertheless, is geared to the junior secondary phase. There is a core of examination subjects comprising the two official languages, mathematics, general science, history/geography; non-examination subjects such as scripture, music, physical education and a choice of one or two electives to suit individual interests.[8] There is no streaming in this phase and assessments of the child's aptitudes, skills and interests are made in order to determine the course he will pursue in the last phase. He needs counselling and guidance to help him choose the courses best suited to him in the senior secondary phase. The regulations in regard to guidance are as follows:-

"With due regard to the wishes of the parents and of the pupils, the identification, placing and grouping of pupils (i.e. in the senior secondary phase) shall take place by the application of criteria including progress at school; scholastic achievement; standardised scholastic tests; biographical particulars; medical reports; personality, aptitude and intelligence tests; and age."[9]

4. Senior/....

4. Senior Secondary Phase:

This is the final phase comprising standards VIII, IX and X during which the pupil sits for the matriculation or senior certificate examination. A wide choice in the curriculum is provided, and differentiation is course-directed rather than subject-directed. The following courses or fields of study are offered:

1. General
2. Humanities
3. Natural Sciences
4. Commercial
5. Home Economics
6. Technical.[10]

Subjects are offered at higher and standard grades. A candidate has to present six or seven subjects for examination and must pass in at least five, including both official languages, one at higher and the other at higher or standard grade. Three subjects must be passed at higher level and two at standard level. The pass mark is 45% in each subject.

1.4 Brief history of science education in Indian high schools in Natal:

Prior to 1966 the control of Indian education was in the hands of the Natal Education Department. The science subjects offered at high school up to matric level were Biology and Physical Science. Pupils had the option of choosing one of these sciences from standard seven.

After 1966 when the control of Indian education was transferred to the central government under the Department of Indian Affairs, Division of Education, General Science was introduced as a subject for the junior certificate in standards VII and VIII in place of Biology and Physical Science as separate subjects. This was effected from the beginning of 1969.[11]

Practical/....

Practical work in the science subjects prior to 1966 though stipulated in the syllabuses was not taken into account for the final examination in standard X. But from 1966 onwards practical work in Biology and Physical Science had to be tested and assessed.

The marks obtained out of fifty are added to the final theory marks.[12] Controlled tests are conducted by a panel of examiners appointed by the Education Depart= ment. The purpose of these tests is to gauge the standard of assessment by the science teachers. If necessary, block adjustments are then made to marks submitted by teachers of individual schools.

With effect from 1971 provision was made for both Biology and Physical Science to be taken for senior certificate.[13]

1.4.1 Science subject committee:

In 1965 when plans were afoot for the transfer of Indian education from the Natal Education Department to the central government, the Secretary for Indian Affairs Mr J.H. van der Merwe recommended to the Minister of Indian Affairs Mr W Maree, that subject committees be instituted. This was approved on the 10 May 1965.[14]

In accordance with this recommendation the science subject committee was formed. The purpose of the committee was to advise the Director of Education on the following matters:

1. Syllabuses and changes that should be made.
2. Audio-visual aids and equipment.
3. Physical aspects, viz. special facilities and classrooms.
4. Teachers and their training; the need for change in educational programme at Colleges of Education.
5. The formulation of a "guide and direction" for teachers regarding aims for teaching of the subject, methodology, preparation, reference material, prescribed works and other text books.
6. The planning and organisation of orientation and refresher courses.

Members/....

Members of the committee are appointed by the Director of Education and hold office for two years. Only Indians may be nominated as full members. Whites may serve in an advisory capacity.[15]

1.4.2 Number of students taking science subjects in standard X; number of passes and analysis of symbols: The following statistics indicate the number of pupils in std. X who took Biology and Physical Science at advanced grade in government high schools in Natal and their performance in these subjects over the period 1962 - 1973. Figures for 1969 were not available. The figures quoted were obtained from the Department of Indian Affairs, Division of Education.

Table 1/....

I

examination (A level) in Biology for the period 1962 - 1973

	1967		1968		1970		1971		1972		1973	
	No	%	No	%	No	%	No	%	No	%	No	%
	1454	100	1721	100	1318	100	1596	100	1920	100	1696	100
	812	55,85	1279	74,4	1082	82,10	1287	80,63	1359	70,78	1357	80,02
	642	44,15	442	25,6	236	17,90	309	19,37	561	29,22	339	19,98
	46	3,16	20	1,16	8	0,61	18	1,14	5	0,27	17	1,00
	400	27,51	247	14,35	136	10,32	161	10,10	200	10,41	180	10,61
	195	13,48	175	10,16	92	6,98	130	8,13	356	18,54	142	8,37
	422	28,95	538	31,26	281	21,32	390	24,46	516	26,88	409	24,09
	319	21,94	499	28,99	494	37,48	627	39,27	534	27,82	579	34,13
	61	4,2	193	11,21	233	17,68	222	13,91	249	12,96	277	16,33
	11	0,76	46	2,67	65	4,93	44	2,73	60	3,12	80	4,71
	-	-	3	0,17	9	0,68	2	0,13	-	-	12	0,70
	-	-	-		-	-	2	0,13	-	-	-	-

TABLE

Performance of candidates in the Senior Certificate examination

YEAR		1962		1963		1964		1965		1966	
		No	%	No	%	No	%	No	%	No	%
Entered		43	100	109	100	79	100	97	100	109	100
Passed		19	42	69	63	50	63	77	79	78	71,6
Failed		24	58	40	37	29	37	23	21	31	28,4
SYMBOL ANALYSIS	H	5	11,63	6	5,57	4	5,06	3	3,1	1	0,91
	G	17	39,53	19	17,43	17	21,52	15	15,5	16	14,6
	FF	2	4,65	15	13,76	8	10,13	5	5,1	14	12,8
	F	14	33,55	29	26,61	20	25,32	14	14,4	30	27,5
	E	3	6,98	19	17,43	22	27,85	19	19,6	25	22,9
	D	1	2,33	15	13,76	5	6,33	24	24,7	14	12,8
	C	1	2,33	6	5,51	2	2,53	8	8,2	5	4,6
	B	-	-	-	-	1	1,26	7	7,2	2	1,8
	A	-	-	-	-	-	-	2	2,1	2	1,8

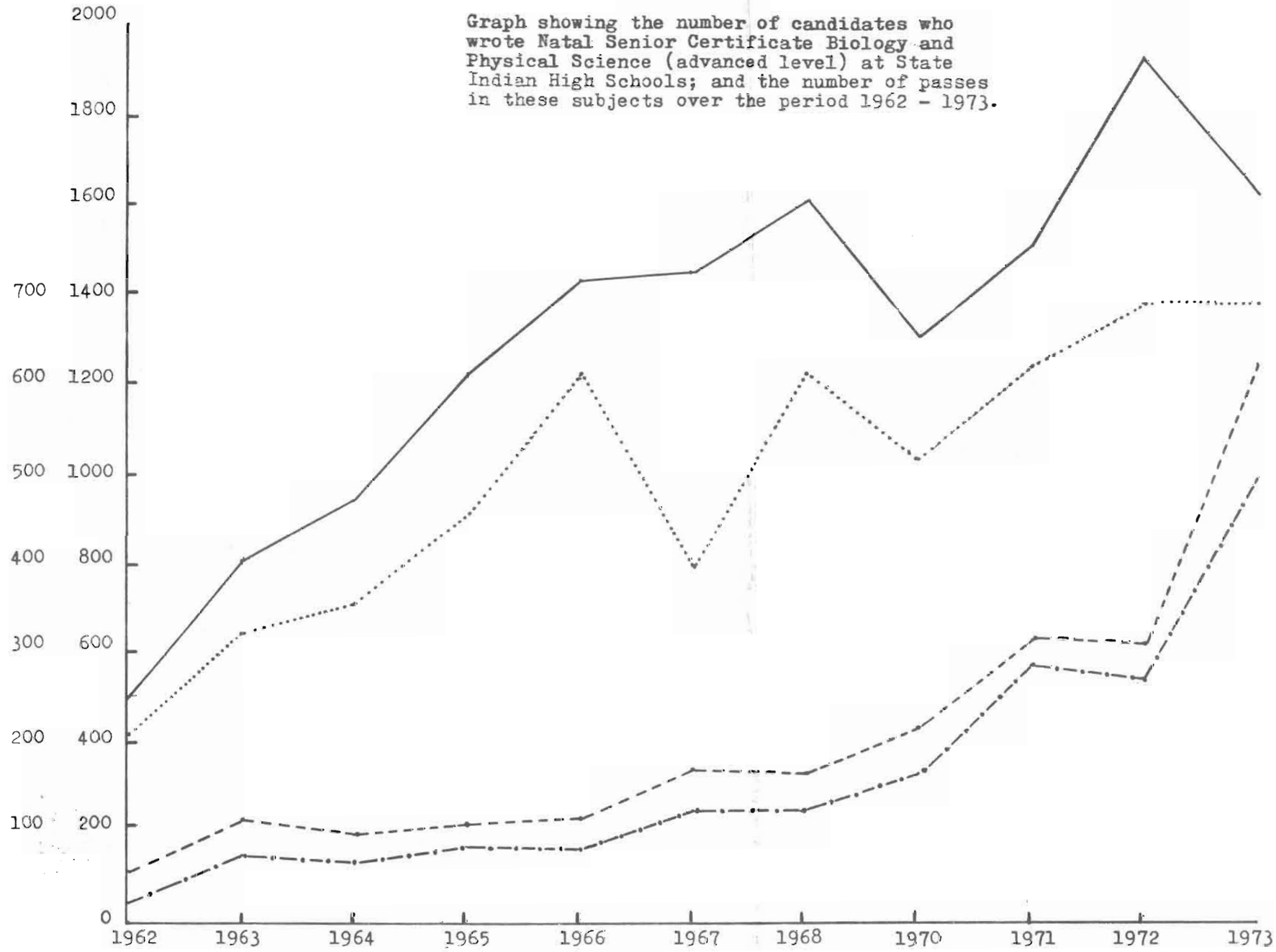
II

(A-level) in Physical Science for the period 1962 - 1973

	1967		1968		1970		1971		1972		1973	
	No	%	No	%	No	%	No	%	No	%	No	%
	159	100	156	100	203	100	312	100	303	100	610	100
	131	82,39	115	73,68	174	85,8	294	94,24	268	88,45	511	83,77
	28	17,61	41	26,32	29	14,2	18	5,76	35	11,55	99	16,23
	2	1,26	1	0,64	-	-	-	-	1	0,33	3	0,49
	16	10,06	18	11,53	19	9,36	10	3,25	17	5,61	62	10,16
	10	6,29	22	14,10	10	4,93	8	2,60	17	5,61	34	5,57
	52	32,7	30	19,23	42	20,69	47	14,93	65	21,45	110	17,86
	59	37,11	55	35,25	69	33,99	121	38,64	99	32,68	203	33,36
	11	6,92	17	10,89	40	19,70	79	25,32	74	24,42	124	20,32
	7	4,40	10	6,41	15	7,39	37	12,01	22	7,26	42	7,00
	2	1,26	2	1,28	4	1,97	4	1,30	7	2,31	29	4,75
	-	-	1	0,64	4	1,97	6	1,95	1	0,33	3	0,49

G R A P H I

Graph showing the number of candidates who wrote Natal Senior Certificate Biology and Physical Science (advanced level) at State Indian High Schools; and the number of passes in these subjects over the period 1962 - 1973.

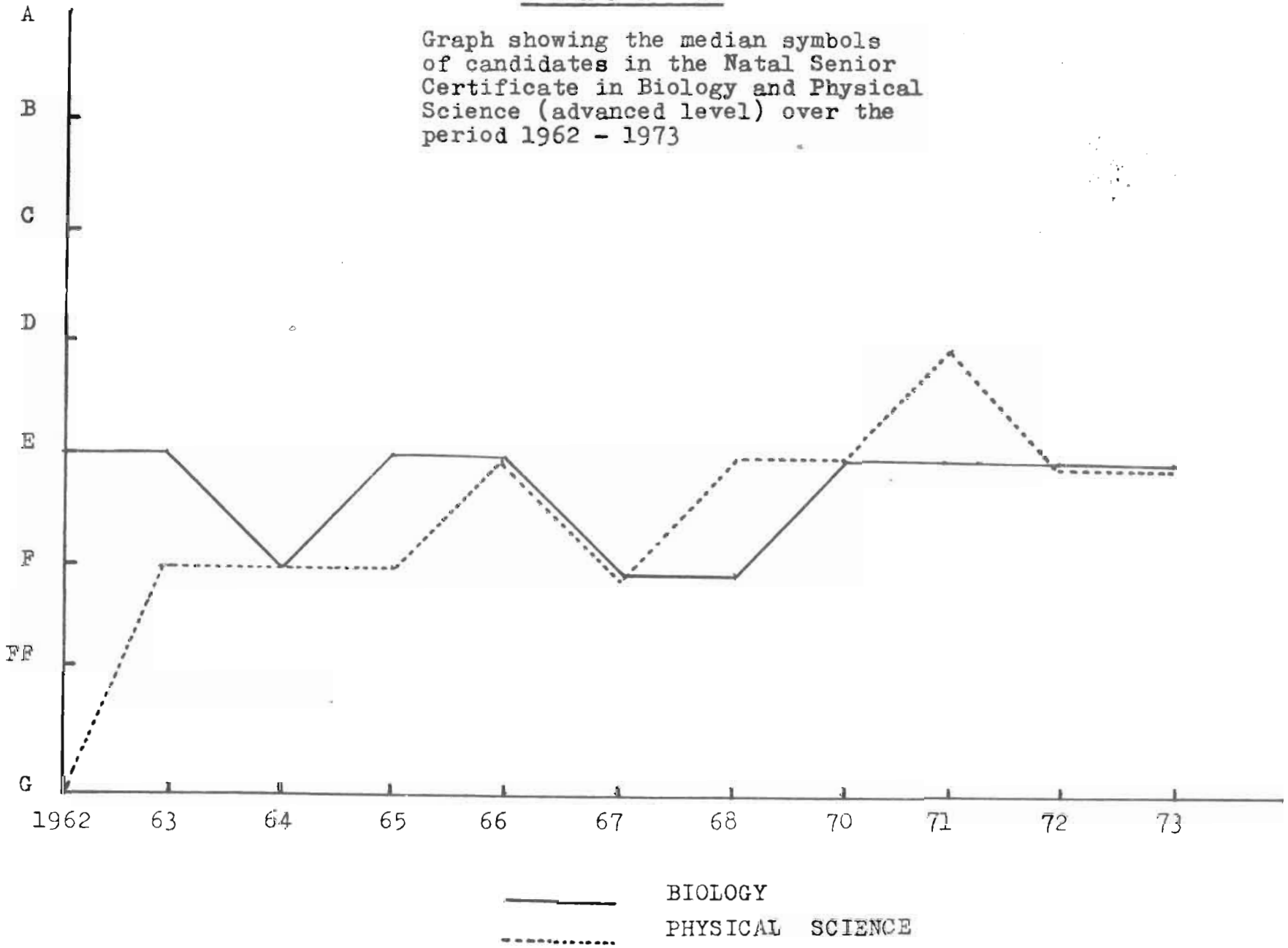


SCALE : 0 - 2000 : Biology
0 - 700 : Physical Science

No. of candidates who wrote Biology
No. of candidates who passed Biology
No. of candidates who wrote Physical Science
No. of candidates who passed Physical Science

G R A P H II

Graph showing the median symbols of candidates in the Natal Senior Certificate in Biology and Physical Science (advanced level) over the period 1962 - 1973



Tables I and II and graphs I and II indicate the fol= lowing trends in Biology and Physical Science:

1. While the number of students taking Biology is steadily increasing, the number of passes seems to have reached its maximum and is tending to show a downward trend.

2. The numbers of students taking Physical Science is also increasing. There is a corresponding increase in the number of passes.

3. The standard in both Biology and Physical Science, however, remains low with the median symbol obtained by candidates being an E.

The above position raises the following questions: Why are the number of passes in Biology showing a down= ward trend? Are more students taking Biology because they have to take a science subject? Are the teachers adequate enough in number and competency? Are facilities and equipment at high schools adequate? Are teachers using modern methods and approaches? Are only the best students taking Physical Science or are they specially selected? Why are the standards in these science subjects generally low? Hence an investigation of aspects of the teaching of science which have a bearing on some of the above-mentioned problems follows in the next section.

1.5 Aspects of the teaching of science in Indian secon= dary and high schools in Natal:

The following aspects of the teaching of science were investigated:

1. The position/....

1. The position regarding the academic and professional qualifications of science teachers; their years of service in the profession.
2. Aims of science teaching
3. Facilities at high schools for the teaching of science
   a) laboratories
   b) practical work
   c) libraries
4. Methods of instruction
5. Problems encountered by teachers.

The method of investigation was through the means of questionnaires.[16] Questionnaires were sent to science teachers at high schools in Natal. More schools in and around Durban, however, were chosen for convenience and personal contact with teachers.[17]

Number of questionnaires sent:	82
Number of questionnaires returned:	70 or 85%

1.5.1 The position regarding academic and professional qualifications, and years of experience of teachers teaching science subjects in high schools in Natal:

In previous chapters it has been shown that high qualifications and experience play an important part in the effective teaching of science. It is also essential for science teachers to keep abreast of modern trends and approaches.

Academic/...

Academic and professional qualifications of science teachers employed by the Department of Indian Affairs; Division of Education in 1972 (70 of whom responded to the questionnaire).

Table III

Qualifications	No.	%
B.Sc. only	1	1,4
B.A. only	0	0
B.Sc. + UED/NTD/JSTD.	28	40,0
B.A. + UED/NTD/JSTD	3	4,3
B.Sc. II + professional qualification	9	13,0
B.Sc. I + professional qualification	1	1,4
B.A. II + " "	6	8,5
B.A. I + " "	2	2,8
No degree subjects but only NTD/NTSD/LSTD	20	28,5
Total	70	99,9

Teaching experience of teachers in high and secondary schools in Natal in 1972

Table IV

No. of Years	No.	%
1 - 4	28	40
5 - 9	30	42,85
10 - 14	7	10
15 - 20	5	7,14
20	0	0
Total	70	99,99

Refresher Courses attended by teachers

Table V

	No.	%
Teachers who attended a refresher course	56	80
Teachers who did not attend a refresher course	14	20
Total	70	100

Of the/....

Of the teachers teaching Biology and Physical Science at high schools 28 (40%) of the respondents possess a B.Sc. degree and a university or college diploma, while 10 (14,4%) have first and/or second year science degree courses and professional qualifications. The remainder have arts courses and diplomas which entitle them to teach up to junior certificate level.

Most of the teachers 58 (82,85%) by 1972 had up to nine years of teaching experience, and 56(80%) of them had attended a refresher course.

1.5.2 Aims of science teaching:

Apart from being qualified and experienced in the teaching of science, a teacher needs to have definite aims so as to be able to evaluate his teaching and pupils' progress in terms of his aims.

The questionnaire stated ten aims. The teachers were required to select five aims and to rank them in order of importance in their opinion. The procedure followed in working out rank scores and position is illustrated by the following example:[18]

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total
No. replying to first aim	29	14	10	3	5	61
Weighted rank	29 x 1	14 x 2	10 x 3	3 x 4	5 x 5	
	29	28	30	12	25	

$$\text{Total rank score} = \frac{\Sigma \text{ weighted ranks}}{\text{No. of responents to aim}}$$

$$= \frac{124}{61}$$

$$= 2,03$$

The following/....

The following table indicates the rank scores and positions for the ten aims:

Table VI

Statement of aim	Rank score	Rank position
To develop an enquiring mind and and a critical attitude	2,03	1
To develop logical thinking so as to enable pupils to draw conclusions and make generali= sations	2,2	2
To give pupils scientific know= ledge which has practical value in everyday life	3,07	3
To develop pupil's powers of observation	3,23	4
To let pupils understand and appreciate natural phenomena	3,25	5
To prepare pupils for examinations	3,3	6
To create new avenues of interest	3,4	7
To let pupils discover relations= ships and the interdependence of living organisms which will lead to broader concepts.	3,6	8
To develop manipulative skills	3,8	9
To cultivate a love for nature which can lead to the conservation of nature	4,1	10

1.5.3 Facilities/....

1.5.3 Facilities for science teaching at high schools:

Laboratories:

The position regarding laboratory accommodation at secondary and high schools in 1972 is shown in the following tables:

Table VII

	No.	%
Teachers who teach in schools with no laboratories	2	2,8
" " " " " " 1 laboratory	14	20
" " " " " " 2 laboratories	54	77,1

1.5.4 Average number of pupils per class for science subjects:

Table VIII

	General Science	Physical Sc.	Biology
under 20	-	4	-
20 - 24	-	4	-
25 - 29	1	2	7
30 - 34	15	2	30
more than 35	46	-	15

The above figures indicate the number of teachers who teach class units from under 20 to more than 35 pupils.

It is evident that while the class units for Physical Science are mainly up to 29 pupils per class, the majority of class units for Biology fall within the range of 30 - 40 pupils per class and almost all the class units for General Science exceed 35 pupils per class.

1.5.5 Practical Work:

Practical work forms an integral part of the learning of science and should therefore be emphasised. The recording of practical work is of vital importance to the learner.[19]

The table/....

The table below indicates the position regarding the recording of practical work at high schools.

Table IX

	Number	%
Practical work recorded	64	91,42
Practical work assessed	55	78,54
Practical work taken into account for promotion	31	44,28

Though the large majority of teachers 64(91,42%) require their pupils to record their practical observations and results of experiments, 55 (78,54%) of them assess their pupils' work and 31 (44,28%) of them take assessment of practical work into account for promotion purposes. One would have expected that a greater number of teachers would take practical work into account for assessment and promotion purposes in view of the fact that this is done at the end of the standard X year.

1.5.5.1 Nature of practical work:

Teachers were required to indicate the kind of practical work which their pupils were given.

Table X

Kind of practical work	No.	%
Observation and discovery	58	82,85
Problem-solving	39	55,71
Verifying textbook information	18	25,71

From table X it is observed that most teachers (82,85%) use the 'observation and discovery' approach in practical work though the other methods indicated in the above table are also used. Not all schools were equipped with

adequate/....

adequate basic equipment. 41 (58,57%) of the teachers indicated that their schools were adequately equipped with basic apparatus for the carrying out of practical work.

Laboratory manuals or workbooks form an integral part of the materials of all modern science curriculum projects such as BSCS, PSSC etc. referred to in Chapter 2. Only 18 (25,71%) of the teachers use laboratory manuals or workbooks for practical work.

1.5.5.2 Use of specimens for practical work:

In most institutions in Britain and America it was observed by the writer that practical work in Biology entailed the use of live specimens. This allows for practical work of an investigatory nature rather than mere descriptions from preserved material. In this investigation 40 teachers (57,14%) use live specimens whereas 61 teachers (87,14%) use preserved material for practical work.

Each class spends two periods per week on practical work in the laboratory.

1.5.6 Library facilities:

The importance of a good library in any institution cannot be overemphasised. It is essential that schools have well equipped libraries in order to inculcate in pupils a habit of reading and searching for information. In this investigation 67 teachers (95,71%) indicated that their schools had libraries, and 65 stated that their libraries had a science reference section..

55 teachers (78,57%) guide their pupils in the use of the library; 25 teachers (35,71%) feel that pupils do not make adequate use of the library.

1.5.7 Methods/....

1.5.7 Methods of instruction:

Examinations are a means of assessing pupils' progress and attainments. Teachers were therefore asked to state to what extent examinations influenced their teaching methods. This is shown by the following table:

1.5.8 Influence of examinations:

Table XI

Influence of exams on teaching	No.	%
To a great extent	46	65,71
To a slight degree	20	28,57
Not at all	4	5,71
Total	70	99,99

From the above table it is evident that in a large number of cases teaching is examination-oriented.

In addition to practical laboratory exercises pupils are given assignments and projects. The following aids are most commonly used:

films, filmstrips, overhead projectors, models and charts.

Many teachers are familiar with modern overseas science curriculum projects as shown in table XII and they find them useful.

Acquaintance with overseas science projects:

Table XII

Science curriculum project	No.	%
Nuffield Biology	38	54,28
Nuffield Chemistry	20	28,57
Nuffield Physics	16	22,85
CHEM Study	7	9,99
CBA (Chemistry)	2	2,85
PSSC (Physics)	18	25,71
HPP (Physics)	10	14,28
BSCS (Biology)	29	41,42

Field/....

Field trips and excursions are essential in the teaching and learning of science. Teachers made the following statements regarding the advantages of excursions:

Pupils come into direct contact with organisms and their environment; they are able to make first hand obser= vations of adaptations of plants and animals in their natural habitats; pupils discover relationships and interdependence of living organisms; a greater interest is created in the subject. However, 31 teachers (44,28%) organised field trips and excursions during the course of 1972.

Activities such as science clubs help to promote an interest in science. Only 2 teachers (2,85%) have science clubs at their schools.

1.5.9 Problems encountered by science teachers:

The following are some of the problems listed by teachers in general:

1. Laboratory accommodation is inadequate. All classes taking science subjects at high school have to perform practical work in a laboratory. Because of limited accommodation the number of laboratory periods is reduced to two. Justice cannot be done to practical work in this time.

2. The number of pupils per class is on the average thirty five. This number is too large and does not allow for individual attention by the teacher.

3. Apparatus in some cases is inadequate, for example most schools have six microscopes. Work requiring the use of microscopes cannot be dealt with staisfactorily with this number.

4. The teaching load per teacher is too high. Teachers do not have sufficient time for preparation of practical work.

5. The need/....

5. The need for laboratory assistants. With large numbers of pupils per class and too few non-teaching periods it becomes very necessary for high schools to have laboratory assistants to help with setting up apparatus before, and clearing up after a practical lesson, and to help with general care and maintenance of equipment.

6. Pupils arriving at high schools have had little or no training in modern approaches requiring observation, discovery and inquiry. Teachers find great difficulty in using such methods at high school.

7. Too much emphasis is placed on examination results consequently teaching tends to become examination-oriented.

8. In some schools advanced grade and ordinary grade (now higher and standard grade) pupils are in the same classes. Teaching at these two levels becomes a problem.

9. Some school libraries do not have adequate and up-to-date reference books.

10. Problems related to science syllabuses:

    a) Many teachers stated that the syllabuses are far too extensive. With the time allotted to science subjects it is not possible to do justice to the topics in the syllabus.
    b) There is no guidance as to depth in the various topics in the syllabuses.
    c) The differentiation into advanced and ordinary grades is not distinct.
    d) There is not enough guidance regarding the teaching of topics in the syllabus. The compilation of a teachers' guide has been suggested by some teachers.

In addition/....

In addition to the problems mentioned in general the following are some verbatum statements:

1. Terminology and language in science text books is not easily understood by the average pupil.
2. The majority of the pupils expect to be told everything. They are as yet not accustomed to thinking and reasoning for themselves. Emphasis should therefore be laid on this aspect in the primary school.
3. There are too many tests such as periodic tests, weekly tests, office tests, half-yearly tests and trial exams. Too much time is spent on testing the pupils' knowledge of what was taught and making them constantly aware of preparation for examinations, consequently pupils tend to concentrate only on text book knowledge and very little time is spent on reading any other material.
4. More opportunities should be made available for field studies. Not much time can be spent on this because the completing of the syllabus is of prime importance.

1.5.10 Evaluation of science courses taken by teachers:

The following table indicates aspects of training in which teachers received instruction while at college or university.

Table XIII/....

Table XIII

Aspects of Instruction	Number	%
1. Planning and presentation of different types of lessons	61	87,1
2. Laboratory organisation and control	51	72,8
3. Selection and use of audio-visual aids	50	71,4
4. Planning of work based on syllabus	47	67,1
5. Planning of projects	43	61,4
6. Planning of excursions and field trips	41	58,5
7. Keeping abreast of and collection of information regarding latest developments in science	38	54,2
8. Skill in preparation and improvisation of apparatus	37	52,8
9. Correct care, maintenance and storage of apparatus	35	70,0
10. Construction of tests for measuring progress of pupils	33	47,1
11. Procedure in ordering science equipment	19	27,1
12. The keeping of a science stock book	18	25,7
13. Knowledge of science organisations or research institutions	18	25,7

1.5.10.1 Time spent on practical work in science course:

Practical work here refers to subject content, not method. Teachers who took a post-graduate diploma (UED) did no practical work in their fourth year as this was covered in the degree courses. It needs to be pointed out here that the majority of the science graduate teachers who answered the questionnaire did their University Education Diploma at the University of Natal.

Teachers/....

Teachers who took a college diploma spent on the average three forty-minute periods per week on practic work.

1.5.10.2 Practice teaching:

1. College diploma courses:

   Practice teaching was done on the following basis: First year - one day per week throughout the year. Second year - four weeks of continuous teaching. Third year - four weeks of continuous teaching. Supervisory lecturers discussed the lessons with students before and after the lessons were taught. The teaching of science lessons in the first and second years was optional but compulsory in the third year.

2. University diploma courses (UED)

   Practice teaching was done over a continuous perio for one term. Lessons were discussed with the supervisory lecturers only after they were taught. The teaching of science lessons was compulsory.

1.5.10.3 Aspects that should be included in the teacher-training programmes:

From their experience teachers felt that the training programme at the College and University should include the following aspects:

1. More emphasis should be laid on the school science syllabus. Student teachers should become more familiar with the topics they will be required to teach in the schools.

2. Students should be given instruction in typewritin as it is essential for every teacher.

3. There should be more guidance and training in the organisation of practical work in the laboratory.

4. The construction of work-sheets and making of

diagnostic/....

diagnostic analyses. Teachers are required to make diagnostic analyses of class tests. The purpose of these analyses is to determine high frequency errors so that remedial work can be done in those sections.

5. Methods of preservation of museum specimens.

6. The conducting of remedial work on different sections of the syllabus.

7. Instruction in first aid in the laboratory.

1.5.11 Opportunities science teachers have for meeting:

The following are some of the opportunities science teachers have for meeting to share ideas, discuss common problems and up-date their knowledge:

1. The Science society under the auspices of the South African Indian Teachers' Association.

2. A bi-annual convention of Indian teachers of science and mathematics.

3. Regional meetings held by science Inspectors to discuss problem areas in the syllabus.

4. Refresher and orientation courses through which teachers are able to keep abreast of modern trends in the teaching of science.

1.5.12 Feedback from post-senior certificate students:

Some aspects regarding the learning of science subjects by high school pupils were also investigated. This was done by means of a questionnaire which was administered to first year students at the Springfield College of Education in 1972.[20] The first ten students from each of the six classes were selected.
(selection from class lists)

	No.	%
Questionnaires handed out	60	100
Questionnaires returned	58	97

Passes/....

Passes in Senior Certificate

Table XIV

	No.	%
Candidates who obtained Senior Certificate with exemption	17	29,3
Candidates who obtained Senior Certificate without exemption	41	70,6
Total	58	99,9

Science subject taken for Senior Certificate

Table XV

	No.	%
Candidates who took Biology for matric	47	81
Candidates who took Physical Science for matric	11	19
Total	58	100

Symbols obtained in science subjects:

Table XVI

Biology		%	Physical Science		%
A	0	0	A	1	9,0
B	0	0	B	0	0
C	4	8,5	C	4	36,3
D	11	23,4	D	4	36,3
E	30	63,8	E	2	18,2
F	2	4,2	F	0	0
G	0	0	G	0	0
	47	99,9		11	99,8

Tables/....

Tables XIV to XVI indicate the following:

1. The majority of the entrants (41) who responded to the questionnaire possess the senior certificate without matric exemption.
2. 47 of the 58 students took Biology for senior certificate and 11 took Physical Science.
3. The performance of students in Physical Science was far better than that in Biology.

Students' attitude to science subjects:
The following table indicates the attitude of the students to their science subjects.

Was science enjoyed at school?

Table XVII

	Number	%
Did you enjoy your science subject? yes	54	93,1
no	4	6,9
Total	58	100

Was science difficult?

Table XVIII

Did you find your science subject	Number	%
Beyond you	1	1,7
A little difficult	22	37,9
Not difficult	32	55,1
Easy	3	5,1
Total	58	99,8

Was/....

Was science interesting?

Table XIX

Did you find your science subject	Number	%
interesting?	54	93,1
dull?	3	5,1
boring?	1	1,7
Total	58	99,9

Hobbies related to science:

Table XX

	Number	%
Did you have any hobby related to science - yes	21	36,2
no	37	63,7
Total	58	99,9

Students' hobbies:

Table XXI

	Number	%
horticulture	10	17,2
astrology	1	1,7
electronics	5	8,6
photography	3	5,1
collecting sea shells	2	3,4
no hobbies	37	63,7
Total	58	99,7

Science/....

Science clubs

Table XXII

	Number	%
Do science clubs exist at your school? - yes	7	12,0
no	51	87,9
Total	58	99,9

Importance of science:

Table XXIII

	Number	%
Do you consider science to be an important subject - yes	56	96,5
no	2	3,4
Total	58	99,9

Reasons given for stating why science subjects are important:

Table XXIV

	Number	%
Teaches one the facts of life	21	36,2
Enables one to understand nature	15	25,9
Leads to new discoveries	10	17,2
Teaches us interdependence	10	17,2
Number who did not answer	2	3,5
Total	58	99,8

Ranking/...

Ranking of Senior Certificate Subjects:

Method for obtaining rank order scores was that followed on page 112.

The following were the subjects taken for senior certificate in rank order:

Table XXV

Subject	Rank Score	Rank position
English	1,7	1
Phy. Science	2,5	2
Biology	2.6	3
Mathematics	2,8	4
Afrikaans	3,4	5
Geography	4,7	6
History	4,8	7
Accounting	5,0	8
Latin	5,1	9

Of the 58 students who answered the questionnaire 21 (36,2%) stated their intention to specialise in science subjects.

1.6 Number of students at Springfield who took science subjects in 1973:

First Year		78
Second Year	Junior Secondary	16
	Senior Primary	24
Third Year	Junior Secondary	18
	Senior Primary	33

The following/....

. The following reasons were given for choosing to specialise in science:

Table XXVI

	No.	%
I find science very interesting	9	15,5
I have the ability and liking for science	3	5,1
I find science enjoyable and fasci=nating	3	5,1
No response	43	74,2
Total	58	99,9

1.7 Students' Suggestions:

Students were asked to suggest ways and means by which they think science subjects could have been made more interesting at high school.

In the main it was felt that more time should be devoted to practical work in the laboratory; science lessons as far as possible should be related to the environment; there should be more outdoor activities; more project work is necessary so as to encourage students to work individually or in groups; if students are to develop an interest in science there should be activities such as science clubs to cater for their needs.

In chapter 3 an attempt was made to give a brief history and an overview of the position regarding the teaching of science in Indian high schools in Natal. This was deemed necessary before investigating the preparation of science teachers which follows in the next chapter.

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16. See appendix IV, pp. 174-181 for specimen of questionnaire. sent to high school science teachers.
17. See appendix I, p.171 for list of schools to which questionnaires were sent.

18. BEHP/....

18. BEHR, A.L.: Methods and techniques in Educational Psychological research. Pretoria, J.L. van Schaik Ltd., 1973, p. 78.

19. GREEN, T.L.: op. cit., p. 95.

20. See appendix V, pp.182-186 for specimen of questionnaire answered by first year students at Springfield College of Education.

CHAPTER 5

THE PREPARATION OF SCIENCE TEACHERS IN NATAL

1. A brief history of Teacher-Training amongst Indians in Natal:

The history of the training of Indian teachers dates back to the year 1904 when the St. Aidan's College, Sydenham undertook the training of teachers mainly for mission schools. It was better organised by 1919. The entrance requirement was standard VI. In addition, part time classes were held to meet the demands. The need for a full time training college bacame urgent, and it was through the efforts of Mr Srinivasa Sastri in 1927 that a teacher-training college was assured.[1] Sastri College opened in Durban in 1929 and the teacher training section commenced in 1931.

The Teachers' Fifth Class certificate was awarded after a two-year course. Candidates who passed the junior certificate examination were awarded the Teachers' Third Class B Certificate after a two-year course, and later this certificate was awarded after a one-year course to students who completed the matriculation examination.[2]

External training and examination still continued for those who could not attend classes full time at Sastri College. The new grades of certificates were then Teachers' Third Class B (T3B), Teachers' Fourth Class (T4) - for externals only, and Teachers' Fifth Class (T5). There was also a post matriculation Teachers' Second Class certificate (T2) but no provision was made for training. Conditions for admission to this course were approved courses in a bachelor's degree for part I. Part II could be written after four years of teaching experience by a teacher who had the T3B, and after the sixth year of service by a graduate teacher.[3]

For/.....

For practical teaching a candidate generally had to prepare a series of twelve to twenty four lessons which had to be taught in primary schools under the supervision of a senior teacher. Notes of lessons had to be sub= mitted for inspection during the examination in practical teaching.[4]

Later teacher training for girls was offered at the Indian Girls' High School. As the numbers of pupils entering Girls' High and Sastri College increased, accommodation in the teacher-training section became acute, and since the number of students who qualified was inadequate to meet the demands, the Education Department had no alternative but to employ professionally unqualified teachers.[5]

In 1950 there was a change in nomenclature of Teachers' Certificates, as follows -
The Natal Teachers' Third Class Certificate became known as the Teachers' Diploma (two years); the Teachers' Diploma (matric plus three years) was known as the Teachers' Senior Diploma; the T3B Certificate became the Natal Teachers' Senior Certificate; the Natal Teachers' Fifth Class Certificate became the Natal Teachers' Junior Certificate; and the Natal Teachers' Third Class (External) became the Natal Teachers' Diploma (External).[6]

2. Springfield College of Education:

The opening of the Springfield College of Education in August, 1951 was the beginning of a new era in the training of Indian teachers in Natal. It was the first co-educational institution, and fulfilled a long felt need. Students from Indian Girls' High and Sastri College (Teacher-training section) were transferred to Springfield. The Natal Teachers' Fifth Class Certificate and Natal Teachers' Junior Certificate examinations were discontinued in 1952. In the same year the two-year post Senior Certificate Course was introduced, and the one-year post Senior Certificate and Junior

Diploma/.....

Diploma Courses were discontinued, From 1953 the entrance requirements for male students was the Senior Certificate or its equivalent.

In 1958 the Natal Teachers' Senior Diploma (NTSD) was instituted, and was open to both Indian and Coloured Teachers in possession of the Natal Teachers' Diploma (Internal or External) or its equivalent. Successful candidates were to be graded Matriculation + 3 years (M + 3). The course was divided into two sections. Section 1 consisted of three subjects, viz. - English, Education and History or Afrikaans if not taken under Section II. These subjects were taken to first year University level, and students could, if they desired enrol as external students of the University of South Africa at their own expense, and write the University examinations. This, however, did not exempt them from attending the college course and taking the college examinations. Section II consisted of the intensive study of a special subject. The aim was to fit the student to teach the subject in Stds. VII and VIII. Special subjects offered in 1960 were the following: Domestic Science; General Science (including Biology and Physical Science); Mathematics (including Arithmetic); and Afrikaans (if not taken under Section I).

To be awarded the Natal Teachers' Senior Diploma, a candidate had to pass all four subjects plus methods of teaching in the secondary school in two of the subjects included in the course.

In 1968, an external (matric + 2 years) course was instituted for poorly qualified and unqualified teachers. This was spread over three years and tuition was given by correspondence. The entrance requirements for the lowly qualified teachers in service were a recognised junior or senior certificate plus an approved profes= sional certificate, while the requirements for the professionally unqualified teachers in service was the Matriculation or Senior Certificate or its equivalent.[8]

2.1 Courses/....

2.1 Courses offered at Springfield College of Education in 1973:

1. Junior Primary orientated Course:

   This course is offered to female students only. Those students who successfully complete the course will be placed in charge of infant classes which include class I, II and standard I.

2. Senior Primary Orientated Courses:

   Students who successfully complete these courses will as a rule be made responsible for standards II, III and IV.

3. Junior Secondary Courses:

   Students who successfully complete these courses will as a rule be made responsible for classes ranging from standards V to VII, and in certain circumstances standards VIII to X.

Duration of Courses:

The duration of every course is three years. All students follow the basic first year course. At the end of the first year, students elect to continue with one of the undermentioned courses for a further period of two years:

1. Junior Primary Course
2. Senior Primary Course
3. Junior Secondary Course.[9]

2.2 Entrance Requirements:

A student seeking admission to the College must fulfill the following requirements:

1. A candidate must be at least sixteen years of age on the 1 January of the year in which the course of training is commenced.

2. A copy of the birth certificate or proof of date of birth of a candidate must be submitted to the Director.

3. A statement/....

3. A statement of satisfactory health must be submitted.
4. A candidate must have the minimum entrance qualifications, viz. Senior Certificate on the advanced grade or equivalent with at least 40% in the main language. (Candidates who still have to pass supplementary examinations for the senior certificate cannot be admitted).[10]

2.3 External Course:

As a special concession to Indian teachers in service, the Education Department has introduced a new external teachers' course to enable professionally lowly qualified teachers to improve their qualifications. The course commenced in January, 1974 and is to be spread over two years. Only teachers in service and who are in possession of the Matriculation plus two years qualification and or are graded "B" are eligible.

Teachers who pass the examination will receive either the Education Diploma Junior Primary; or the Education Diploma Senior Primary/Junior Secondary depending on the course they pursue and will be graded Matriculation plus three years (M+3) or (Grade C).

The courses are equal in all respects to the courses offered to full time-students, and candidates will write the same examinations as full-time students of the College.

Tuition is provided by correspondence.[11]

2.4 Sciences Courses at Springfield College:

In the absence of any regulations and syllabuses regarding the training of Science teachers at Springfield College at the time it opened, the information had to be obtained from past students by personal interviews.

The science subjects offered from 1951 to 1960 were Nature Knowledge and General Science for the Natal Teachers' Senior Certificate and Natal Teachers' Diploma respectively.

The syllabus/....

The syllabus consisted of topics taken from the Natal Education Department Handbook - standards I to VI. The topics which formed the nucleus were: air, water, heat, plant life, animal life, soil erosion, and in addition in std. VI mixtures, compounds and measurements.[12]

The treatment of topics at lectures was mainly theoretical with occasional demonstrations to the whole class. Emphasis was on content and learning of facts in order to be able to teach primary school classes. No practical work of any kind was done.

In 1958 a new syllabus in General Science for the Two-year post matriculation Diploma Course was drawn up, and this entailed practical laboratory work. The topics included in the syllabus were as follows:

2.4.1 Biology:

Distinguishing characteristics of the major groups of the animal kingdom, with a knowledge of the morphology, physiology and reproduction of representative types selected from the Coelenterata, Annelida, Mollusca and Arthropoda. General characteristics, locomotion, respiration, circulation and reproduction of fishes, reptiles, birds and mammals.
Anatomy and physiology of the frog (dissection required).
A typical cell; mitosis and meiosis; principles of heredity.
General view of the plant structure; reproduction and evolution by the study of one example of each of the following:

Fungi; Bryophyta; Pteridophyta; Gymnospermae. External and internal morphology, physiology, life cycle of an Angiosperm e.g. Helianthus.
Ecology of one plant community.

As far as possible local examples and the practical approach were to be stressed.

2.4.2 Physical/....

2.4.2 Physical Science:

Density, specific gravity, Archimedes' principle.
The barometer; the thermometer, heat and temperature; the gas laws; change of state; melting and boiling points; transference of heat.
Magnetism: construction and properties of magnets, magnetic fields.
Ohms' law; current, potential difference and resistance.
Elements, mixtures and compounds; Laws of chemical combination; equivalent weights; atoms and molecules; atomic and molecular weights.
Valency; formulae and equations; chemical calculations.
Preparation and properties of oxygen, hydrogen and carbon dioxide.
Oxidation and reduction; acids bases and salts.
Properties of water; hard and soft water.
Properties of sulphur, hydrogen sulphide, sulphur dioxide and of sulphuric, hydrochloric and nitric acids.

Methodology consisted of the teaching of selected topics from the primary school General Science syllabus (stds. I to VI).

In 1958 the Natal Teachers' Senior Diploma was instituted.[13] The science subjects offered were Botany and Zoology with Physical Science as an ancillary taken up to the end of the second year.

The syllabus consisted of the following:

2.4.3 Botany:

External morphology of Angiosperms - roots, stems, leaves, floral structure and formulae, fruit and seeds.
Cytology - the cell, structure, mitosis and meiosis; plant tissues.
Internal morphology of seed plants - structure and arrangement of primary tissues of Dicotyledons, Monocotyledons and Gymnosperms.
Ecology of South African Angiosperms - hydrophytes, mesophytes and xerophytes, parasites, symbionts and carnivorous plants.

Plant/....

Plant physiology - absorption, transpiration and photosynthesis; tropisms.
Range of plant life - Bacteria, Algae, Fungi, Bryophyta, Pteridophyta, Gymnospermae.
Angiosperm families and economic Botany.
Genetics - Mendelian laws as illustrated by mono- and di-hybrid crossing.

2.4.4 Zoology:

Taxonomy, anatomy, reproduction and in broad outline the physiology of representative examples of:
Protozoa, Coelentrata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Pisces, Amphibia and Mammalia.
Cytology; Histology; Embryology; Genetics and Evolution.

Methodology: Aims of science teaching; methods and materials for teaching Biology.

2.4.5 Physical Science:

Molecular motion and forces; matter; elements and compounds; solutions.
Inorganic chemistry - the chemistry of oxygen, hydrogen, carbon, nitrogen, chlorine and sulphur; organic compounds.
Force and motion; Heat; Light.

2.4.6 Science courses offered in 1973:

2.4.6.1 General Science:

This is a common course taken by all first year students. It is exploratory and deals basically with methodology and teaching of science topics taken from the upper primary classes. Two forty-minute periods are allocated to it.
The syllabus is as follows:

Introduction:

What is science; General Science as a subject and its place in the curriculum.

Methodology/...

Methodology:

The aims of science teaching as seen against the back= ground of the general aims of education; how the pupil sees his/her environment and how this influences the teaching of science; the science teacher (ideal attributes - his rolē in the learning situation).

Methods of learning science:

a) observation of natural phenomena
b) experimentation
c) reading
d) audio-visual aids

Methods of teaching science:

a) controlled observation and study
b) planned experimentation/demonstration
c) Individual projects, collections and group work.
d) Inductive/deductive methods.

Topics from the standards II, III and IV school sylla= buses to be selected to illustrate the above-mentioned methods.

From the second year students have the option of following either a senior primary or junior secondary course. Those students who follow the senior primary course take General Science. The course prepares students to teach science in standards II, III and IV of the primary school. Six forty-minute periods are allocated in the second and third years. Those students who follow the junior secondary course take Biology and Physical Science as separate subjects. The course prepares them to teach these subjects in standards V, VI and VII of the junior secondary schools. Eight forty-minute periods are allocated to these subjects in the second and third years.

The following are the syllabuses:

2.4.6.2 General Science (Senior Primary):

Animal diversity; plant diversity; sorting and classifying; nutrition; respiration; the role of water in living organisms; soil; reproduction in plants and animals; the flower; the cell; sensitivity and movement; ecology; measuring; force; effects of force; thrust and pressure; heat and temperature; magnetism; electricity; waves; effect of heat on matter; particle nature of matter; classifying matter; investigation of properties of oxygen, hydrogen, carbon dioxide and water; reaction between substances; atomic structure.

Methodology:

Resources for science teaching.
Organisation and control of the subject:

a) science subject committee
b) schemes of work
c) personal planning and preparation
d) the teaching cycle.

Evaluation of pupils' work: testing; types of questions; analysis of high frequency errors; remedial work.
Improvisation of apparatus.

2.4.6.3 Biology (junior secondary)

Sorting and classifying; the cell; plant organisation - anatomy and physiology of Angiosperms; energy and the biological energy pathways; gaseous exchange in plants - respiration and photosynthesis; diversity in plants; flowering families; ecology.
Body plans of animals - skeletons, locomotion and aspects of their transport systems; mammalian tissues; nutrition and respiratory exchanges in animals; excretion and homeostasis, reproduction and co-ordination in animals; Chemical co-ordination; heredity.

2.4.6.4 Physical Science (junior secondary):

What is physics? time and measurement; measurement

and/....

and mathematics; motion and vectors; forces in equilibrium; graphs of motion; equations of motion; force and motion; work, energy and power; heat; electrostatics; the electric field and potential difference; electrical con= duction; the magnetic field and electromagnetism; magnetic induction; the electrical circuit - Ohms' law; measure= ment of current; electromagnetic induction; the nature of waves; the wave nature of light; geometric optics; dispersion of light.

Matter; molecules; atomic structure; valency and bonding; chemical reactions; phases of matter; solutions; chemical reactions; acids and bases; oxidation and reduction; organic chemistry.

2.4.6.5 Methodology:

Resources for Biology/Physical Science teaching;
Organisation and control of the subject;
Evaluation of pupils' work;
Care and maintenance of apparatus;
Improvisation of apparatus;
Laboratory and storeroom procedure and rules;
Control of stock and requisitioning;
First aid in the laboratory.

2.4.7 Methods of Instruction:

2.4.7.1 Lectures:

This is the basic method of instruction. During the lectures opportunities are allowed for questioning and discussion by the students. Most of the lectures are held in the laboratories and this facilitates lecture - demonstrations.

2.4.7.2 Seminars:

Part of the syllabus is covered by seminars given by students. They are allocated topics for preparation and delivery in advance. The seminars are then presented to the whole group. The class participates by question= ing and making comments. The lecturer is present throughout for guidance. An assessment is made at the end. This counts towards the student's college record.

2.4.7.3 Assignments/...

2.4.7.3 Assignments and Projects:

These involve individual and group work. Projects may be done over short periods or spread over a whole year, for example, ecological studies. Written reports together with statistics, mounted specimens, etc. are submitted. Students may also be required to give oral explanations of particular aspects of their study.

2.4.7.4 Field Trips:

These are organised by lecturers for class groups. Students also undertake field trips and excursions for ecological studies in smaller groups on their own.

2.4.7.5 Practical Work:

Practical work forms an integral part of the course and takes up about two-thirds of the time allotted to the subject. Emphasis is placed on the discovery approach, though some of the practical work involves confirming text book information. Students follow laboratory manuals and record their observations and results of experiments in practical books which are scrutinised and assessed by the lecturer in charge.

There is much scope, however, for work which involves the designing of experiments and testing of hypotheses such as in the Nuffield Projects, and minor research projects using scientific methods.

2.4.8 Equipment and Facilities:

At present there are three laboratories equipped with basic standard apparatus in all branches of science. New buildings are in the process of construction and three new laboratories, storerooms and a science lecture theatre have been planned. These should be ready for use in 1976.

Teaching aids such as 16 mm. projectors, overhead projectors, strip and loop film projectors, 35 mm. slide projectors, tape recorders, models etc. are available to students. They are also instructed in the use and handling of these aids.

Library:/...

Library:

The College has a library with a science section. Though new books in science are added regularly, the reference section is inadequate. Only a small number of science periodicals and journals are available. A new library is also planned in the new buildings. In addition the Science Department has its own reference library with only a limited number of books which are available to students. Students use the library in non-lecture periods and during breaks.

2.4.9 Teaching Practice:

Teaching practice is organised on the following basis:
First Year:

Students are assigned to tutors who meet their groups for two periods per week in the first term. Lectures in Didactics give the students some background in classroom management, and the role of the teacher. In the tutorial periods students are instructed in lesson planning and preparation. They also get practice in various aspects of presentation of lessons which may be taped. The tapes are later played back to the student and faults discussed by the tutor.

In the second and third terms students are assigned to primary schools within easy reach of the College. They spend one day per week at the practising school. Prior to going to the school each student prepares his lessons in draft outline. The lesson notes are corrected by the tutor and discussed with the student. The tutor then listens to as many students as he can, makes a report and assesses each lesson. Major faults and weaknesses are discussed with each student. Outstanding positive features and major weaknesses are recorded on a form and an assessment indicated. Two students are assigned to each class. While the one teaches the other observes and also makes his/her remarks on the

report/...

report form. These are submitted to the Head of Department - Educational Studies and filed for record purposes and also for remedial work.[14]

Second Year:

Second year teaching practice is arranged over a continuous period of four weeks. During this period students are under the guidance of a tutor at the college and a supervisory teacher at the practising school. Students arrive a few days before the commencement of teaching practice and together with the supervisory teacher draw up a programme for the whole block period. Lesson notes and other records are kept from day to day. During this period the students are integrated with the staff and come under the direct charge of the principal. Apart from actual teaching in the classroom, they also get training in the keeping of records and participate in extra-mural activities.

The tutor from the college visits each student to give guidance and advice about any problems the students may have. The supervisory teacher and principal make detailed reports on each student and forward these to the Rector of the college. These are then discussed with the students and filed.[15]

A second block period for teaching practice for about two to three weeks is arranged towards the end of the year. Students may choose schools near their homes as there is no supervision by tutors. The main purpose is for them to gain experience in examination procedure, viz. setting and marking of papers and invigilation.

Third Year:

Teaching practice in the third year is also arranged over a four week period usually in the first semester. It follows much the same pattern as for second year students. Three days before the commencement of practice

teaching/....

teaching each student goes to the practising school and together with the supervisory teacher draws up a scheme of work for the entire block period. This is then discussed with the tutor. At the first visit of the tutor, the student produces his final scheme of work. The specialist tutor listens to as many lessons as he can and scrutinises the students' lesson notes. A report is made, and the major faults and weaknesses discussed with the student before the tutor leaves the school.

An assessment is made on a five point scale as follows: Excellent (75%+); very good (65%-74%); good (55%-64%); satisfactory (50%-54%); and weak (below 50%). Each student also evaluates his own lesson, and these comments are recorded in his book. At the end of the block practice teaching period, the supervisory teacher and principal draw up a report on a prescribed form. These are forwarded to the Rector. Major faults and weaknesses are referred to the respective specialist tutors. The reports are then discussed with each student and filed by the head of department - Educational Studies. Record books and lesson notes are assessed by tutors on a three point scale as follows:

A - very good; B - average; C - weak. Students whose teaching was outstanding are recommended to the Rector for merit awards.[16]

2.4.10 Examinations, testing and evaluation:

First Year:

Assessment for the year includes tests, assignments, projects, a half-year and an end of year examination. The papers are set and marked internally except for final papers which are subject to external moderation. For promotion from the first to the second year of study, a candidate may not fail in more than two academic subjects, and one professional subject, provided that these shall not be main language and practice teaching or specialist subjects.[17]

Second/....

Second Year:

Promotion from second to third year is based mainly on continuous assessment. A year mark is made up of assessment of tests, assignments, projects and practical work. A student whose work was not satisfactory is required to write a formal examination at the end of the year.

Third Year:

At the end of the third year a candidate writes a final examination in all subjects. The pass mark in individual subjects is 50%. Recognition is given for the year's work, one-third of the year mark is taken into account for the final assessment.

A candidate is awarded a pass with distinction on the whole examination (final) if he obtains a mark of 75% or over in practical teaching; and 75% aggregate or over for the whole examination.

Partial credits may be carried forward for a period not exceeding three years. A student is allowed to write a supplementary examination usually held in March of the following year if he has failed in one subject only. "Aegrotat" examinations may be conducted in special circumstances if approved by the Director on the recommendation of the rector.[18]

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13. Referred to on p.134

14. See appendix XIII p. 204 for specimen report form.

15. See appendix XIV p. 205 for specimen report form.

16. See appendix XVI p. 206 for specimen report form.

17. DEPARTMENT OF INDIAN AFFAIRS, DIVISION OF EDUCATION: op. cit., p. 16.

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CHAPTER 6

. THE PREPARATION OF SCIENCE TEACHERS AT THE UNIVERSITY OF DURBAN WESTVILLE

1. Introduction:

From its inception in 1961, the University College Durban - now University of Durban Westville offered diplomas in teacher-training in the faculty of Education.

The University was the first to implement the main provisions of the National Education Policy Amendment Act No. 73 of 1969.[1] The chief recommendations were that the Training Colleges be responsible for the training of primary school teachers; that the minimum period of training be three years; that the training of secondary school teachers be the function of the universities and that the minimum period of training be four years' duration consisting of an integrated academic and professional course leading to a degree in education or an equivalent education diploma.[2]

2. Courses offered in 1974:

2.1 Degrees:

Baccalaureus Paedagogiae in Arts. B.Paed. (Arts)
Baccalaureus Paedagogiae in Science B.Paed. (Science)
Bacealaureus Paedagogiae in Commerce B.Paed (Commerce)
Baccalaureus Paedagogiae in Home Economics B.Paed (Home Ec.
Baccalaureus Paedagogiae in Primary Educ. B.Paed. (Pr. Ed.)
Baccalaureus Educationis - B.Ed.
Magister Educationis - M.Ed.
Doctor Educationis - D.Ed.

2.2 Diplomas;

University Diploma in Education (Senior Primary)
University Diploma in Education (Junior Secondary)
University Higher Diploma in Education
Diploma in School Counselling

Diploma/....

Diploma for teachers of children handicapped in speech and hearing.
Diploma in Remedial Education.
Diploma in Special Education.
Diploma in the teaching of Physiotherapy.

2.3 Entrance requirements:

2.4 B.Paed. degrees:

Matriculation with exemption with at least 40% in four subjects including a language on the higher grade, and a second language on the lower grade, mathematics or a third language.[3]

B. Paed. (Science):

Curriculum

The curriculum for the degree must include two major subjects, one of which must be Education and the other a science subject related to a subject taught at school. The following is the curriculum for the B.Paed. (Science).

First Year:

a) Education I
b) Three first courses in approved science subjects.

Second Year:

a) Education II
b) A second course in one of the science courses chosen in the first year.
c) A first course in an approved science subject not chosen in the first year.

Third Year:

a) A third course in the subject chosen from the science subjects in the first year.
b) A second course in an approved subject, or a first course in an approved science subject.
c) Practice teaching
d) Communication.

Fourth/....

Fourth Year:

a) Education III
b) Special method of two subjects related to the curriculum followed.
c) Practice teaching.
d) Educational Technology.
e) English usage.
f) Afrikaans usage.
g) Health, Physical and Recreation education.
h) Moral and civic education.[4]

The following are the science subjects which a student may choose:

Botany, Chemistry, Mathematics, Physics, Physiology, Technical Drawing, Zoology.

Syllabuses for the academic subjects are those of the various science faculties. Syllabuses for the special methods subjects -

Biology, Physical Science and General Science include:

The place of the subject in the school curriculum.
Aims and objectives of the special subject.
History of the teaching of the special subject.
Present day approaches and trends in the teaching of the special subject here and in overseas countries.
Principles of syllabus construction.
Drawing up of schemes of work and lesson planning.

Specific methods:

Lecture and demonstration
Text book - workbook method.
Discussion and questions.
Individual and group practical work.
Problem-solving.
Projects, field trips.

Testing/....

Testing and evaluation:

Tests and examinations.
Continuous evaluation.
Marking, diagnosis for remediation.
Self-evaluation by the teacher of his own work.

Teaching aids, textbook and reference material.

Material and supplies for practical laboratory work.
Criteria used for selecting suitable teaching aids and text books.
Preparation and techniques for display of teaching aids.

Organisation:

Methodical arrangement of equipment, specimens and chemicals in the laboratory; planning for meaningful experience in the laboratory; safety and first aid in the laboratory.[5]

2.5 University Diploma in Education (Senior Primary)

2.5.1 Entrance requirements:

Matriculation or school leaving certificate of the Joint Matriculation Board - on the advanced grade with at least 40% in the main language. This is a full-time three-year course.

2.5.2 Curriculum:

Science subjects included in the curriculum are Biology and Physical Science. The Biology syllabus consists of - a comparative study of the morphology, anatomy, histology, physiology, reproduction, embryology, habits and habitat of a variety of representatives of the main groups of living organisms. Practical work involves observation, dissection, identification and classification of organisms, experimental investigations and demonstrations of biological principles.[6]

The Physical Science syllabus includes the following: The particle structure of matter; gases, solids and liquids; phase equilibrium and equilibrium concepts; solutions; principles of chemical change; types of chemical reactions;

electricity/....

electricity and magnetism; waves; electro-magnetic waves and light; geometric optics; sound; electronics; electrolytic cells.[7]

The syllabus for methodology includes the following sections:

General Science as a primary school subject; General Science syllabus; preparation for and follow up of practice teaching; methods and organisation; evaluation and teaching aids.[8]

2.6 University Diploma in Education (Junior Secondary):

The syllabus in the first and second years consists of the following topics:

2.6.1 Biology:

A study of life - atomic basis, cells, tissues and organs; homeostasis; reproduction; the biosphere - interaction of environment and organisms; functional organisation of cells; development of multicellularity; a study of a few examples of the main groups of plants and animals; the principles of heredity and gene action.[9]

2.6.2 Physical Science:

General introduction; classical mechanics; the atomic nucleus; the atom; molecules and intermolecular forces; systematic and fundamental inorganic and organic chemistry; some aspects of applied inorganic and organic chemistry; the particle structure of matter; gases, solids and liquids equilibrium concept; solutions; principles of chemical change; types of chemical reaction; electricity and magnetism; electromagnetic waves and light; geometric optics; sound; electronics; electrolytic cells and reactions.[10]

In the third year method courses are followed. The syllabus follows the same pattern as that of the senior primary course except that Biology and Physical Science for the junior secondary classes are substituted for General Science in the senior primary classes.

2.7 University/...

2.7 University higher diploma in Education:

This is a post graduate course of one year duration for full-time students. An approved degree in compliance with the regulations is a prerequisite.[11]

Curriculum:

The following subjects are prescribed:

Administration of Education (including school Librarianship),
Empirical Education
History of Education
Method of Education (including audio-visual techniques)
Philosophy of Education
Special method of teaching two principal subjects in the secondary school.
Practice teaching
Afrikaans
English
Health, Physical and Recreational Education
Moral and Civic Education.[12]

2.8 Organisation and Time allocation:

2.9 University Education Diploma - Junior Secondary and Senior Primary:

First Year:

Five periods per week are allocated for theory and practical work in Biology and Physical Science. There are no definite periods for theory or practicals.

Second Year:

Senior primary - five periods per week are allotted for in-depth study of content.
Junior Secondary - Students take Biology I in common with the academic course. Five periods for theory and four periods for practicals are allotted.

Third/....

Third Year:

Three periods per week are allotted for method only in Biology and Physical Science.

2.10 University Higher Diploma in Education and B.Paed. (Science):

Fourth Year:

Biology and Physical Science - two periods per week; General Science method - two periods per week.

2.11 Methods of Instruction:

In the first and second years students have formal lectures and practical laboratory work.
In the final year of study there are no formal lectures or laboratory work as such but tutorials involving discussion; examining of project materials, examination of question papers and work sheets, individual projects and assignments. Discussion on problems arising from practice teaching, laboratory experiments and first aid in the laboratory.

2.12 Practice Teaching:

The following pattern is followed for the different courses.

2.12.1 U.D.E. - Junior Secondary & Senior Primary:

First Year:

There are 2 weeks of continuous teaching practice in the first term and 3 weeks in the third term. In addition to these block periods every Monday throughout the year is used for practice teaching.

Second Year:
There is no teaching practice in the second year.

Third Year:

The same arrangement holds as for first years.

2.12.2 U.H.E.D/...

2.12.2 U.H.E.D. and B.Paed.:

There is basically the same pattern as for the U.D.E. except that two weeks are spent in the primary school for observation just before commencement of the academic year.

2.12.3 Supervision of practice teaching:

Guidance in lesson planning is given during method lectures. During teaching practice students are under the guidance and direction of supervisory teachers at the schools. Regular visits are paid by the supervisory lecturers. Lessons are listened to and criticisms made. Two types of reports are made. On Mondays prescribed forms are used.[13]

For the continuous periods overall assessment is made after consideration of the supervisory teacher's and principal's report.

Final year students undergo a teaching test at the end of the year. An external moderator also makes an assessment of every student. Borderline cases, failures and students with distinctions have a further opportunity for confirmation.[14]

2.13 Resources:

Apart from the main library, the Education Faculty has its own resoruces centre. Students may obtain school text books, reference books, project materials, periodicals, journals, specimens, models and charts for their practice teaching lessons.

2.14 Examinations and Evaluation of Students' work:

Formal examinations are written in every year. 50% is the pass mark. In addition to this 25% of the year mark is added to the final mark. This is made up of marks obtained for assignments, projects and tests.

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13. See appendices XVI - XX, pp. 207 - 211

14. See appendix XXI, p. 212.

CHAPTER 7

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

1. The importance of science in the present era:

It has been shown in Chapter I that science plays a vital rolē in man's life. He uses technology to make his environment more comfortable, and technology as was pointed out is dependant to a large extent on science. Advances in technology have also had a pro= found influence on society as Lord Balfour states that science is the great instrument of social change.[1]

Science education should therefore form an important part of the school curriculum as it not only provides the child with scientific knowledge but it also creates an awareness and an appreciation of the things around him.

Science education took on new dimensions after the launching of the first earth satelite in 1957. Science education programmes in all modern countries underwent drastic changes. In South Africa also steps are being taken to modernise science programmes. Eminent overseas science educators are invited to South Africa by the Foundation for Education, Science and Technology, and many science teachers from South Africa have partici= pated in leadership-exchange programmes in Britain and America.

2. The development of science curriculum projects:

As a result of great strides that are being made in science, new approaches to the teaching of science are also being devised. Some of these science curriculum projects are outlined in Chapter 2. It is important to note that many of the projects referred to were started by the teacher in the classroom situation when he realised the need for change. Writing teams

consist of/.....

consist of officials in authority as well as ordinary teachers. The chief differences between these projects and traditional texts are that they are the effort of team work; many hundreds of students and teachers use the trial materials after which constructive criticism is made to the organisers; research is on-going and the materials are constantly being evaluated and revised in the light of criticism.

3. The education of teachers in Britain and America:

Because of the great importance of teacher education in any country teacher-training programmes should be constantly evaluated in terms of new developments in education. This is noticed particularly in Britain where several commissions were appointed to investigate various aspects of teacher-training. These are referred to in chapter 3. The system of schools or institutes of education whereby the colleges of education come under the jurisdiction of the universities has merit. High standards set by universities have to be maintained by the colleges. There is a close link between the lecturing staff of colleges and universities. Post graduate diplomas and degrees are also offered by the colleges thereby raising their status.

The courses offered by the colleges and universities cover a wide range. In the science courses great emphasis is laid on practical work both in content and on the teaching aspect. If a student chooses science subjects for specialisation or in-depth study then the major part of his time is devoted to these subjects. He has ample scope for individual work. Research is encouraged and the writing of a minor dissertation is required in most institutions. Libraries and laboratories are well equipped with programmed tutorial materials for individual study. Formal lectures are reduced to a minimum. The major part of the syllabus is covered by seminars, assignments and project work.

Practical/....

Practical teaching is arranged in block periods in neighbouring schools. Supervisory teachers at schools are selected and there is close liaison between the colleges, universities and practising schools.

A noteworthy aspect is microteaching with the aid of videotape. Microteaching is used not only with pre-service teachers but also with in-service teachers to great advantage. It is particularly useful when experimenting with new approaches in teaching. Typical microteaching introductory exercises appear in appendix XXV p. 224. There is continuous experimenting with teaching practice. Some institutions in America have laboratory schools for practice teaching on the campus.

4. In-service training:

In-service training in Britain and America forms an essential part of teacher education. Most institutions offer a multiplicity of courses in the evenings and during weekends or vacations. Courses are designed according to the needs of the teachers as well as for persons who need administrative know-how for various promotion posts. Courses for heads and potential heads of science departments were held at Leeds University.[2]

In addition to courses run by universities and colleges Local Education Authorities also conduct in-service courses on science, technology and society.[3] The first in-service refresher course for senior teachers of Biology and Physical Science was held at the Springfield Training College from the 10 April 1967 to the 14 April 1967.[4]

From 1969 national conventions for Indian teachers of Mathematics and Science were sponsored and organised by the Foundation for Education, Science and Technology bi-annually at the University of Durban Westville.[5]

5. Some/...

5. Some aspects of science education in Indian high schools in Natal:

5.1 Practical Work:

Practical work in science in high schools is being emphasised more than in the past. As a result assessment of practical work is now taken into account in the final examination in standard X.

5.2 Passes in Science Subjects:

While the number of students who passed Biology and Physical Science in standard X at advanced level between 1962 and 1973 may appear to be fairly satisfactory percentage-wise, the standard achieved in these subjects remains low and this gives cause for concern.[6]

5.3 Qualifications of Science Teachers:

The investigation shows that of the 70 respondents to the questionnaire in 1972 only 40% of them have a science degree and university diploma; 28,5% possess no degree subjects but only a college diploma with either Biology or Physical Science as specialisation subjects and the remainder (31,5%) have some degree courses in science or arts. The majority of teachers (82,85%) had up to 9 years teaching experience.

5.4 Aims of Science teaching:

The following five aims were ranked in order of importance:

To develop an enquiring mind and a critical attitude; to develop logical thinking; to give pupils scientific knowledge which has practical value in everyday life; to develop the pupils' powers of observation and to let pupils understand and appreciate natural phenomena. These aims are in agreement with the figures quoted in Table X on page 115 regarding the nature of practical work but are contrary to the response in Table XI on page 117 which shows that teaching to a large extent is examination-oriented.

5.5 Laboratory/....

5.5 Laboratory facilities:

Laboratory facilities and accommodation at the time this investigation was carried out were generally inadequate to cope with modern approaches to the teaching of science. This also is not consistent with the figures quoted in Table X which shows that 'observation and discovery' and problem-solving methods are given prominence. The average number of periods for practical work in the laboratory is 2 per week. This is inadequate to be able to do justice to the syllabus, consequently teachers have to resort to the demonstration method to a large extent.

In Biology most of the practical work done deals with preserved material. This is indicative of the fact that practical work is more descriptive and confirmation of textbook information rather than of an investigatory and discovery nature. This also is in conflict with the information supplied in Table X which indicates that observation and discovery and problem-solving methods are given preference to other methods.

Though the majority of school libraries have a section for science they are poorly equipped with reference material.

5.6 Some problems mentioned by teachers:

Practically every teacher stated that the syllabus was too long and with the time allotted to science subjects, justice could not be done to the teaching of the topics. The syllabuses in some sections are somewhat vague. There is need for some guidance as to depth and approach especially in the light of the fact that 40% of the teachers had between 1 and 4 years teaching experience.[7]

Science teachers experience great difficulty in obtaining materials and in preparing the laboratories for practical lessons. None of the teachers indicated that their schools have laboratory assistants.

Pupils entering high schools find themselves at a loss when confronted by situations requiring reasoning, logical thinking and opportunities for discovery. This could be overcome to some extent if discovery and problem-solving methods are used in the primary schools as well.

6. Evaluation of science courses taken by teachers at college or university:

It was generally felt that the time allotted for practical work in content was inadequate. The time devoted to teaching practice on the whole was insufficient. This could be overcome to some extent by students giving lessons at college or university. Because of the importance of this aspect the teaching practice programme should be constantly reviewed. Some suggestions about aspects that should be included in the teacher training programme appear on page 122.

Science teachers do have opportunities for meeting, for example at refresher courses, regional meetings convened by science inspectors and meetings of the Science Society of the South African Indian Teachers' Association.

7. Feedback from post-senior certificate students:

Tables XVIII to XX show that most pupils enjoyed their science subjects at high school, found them interesting and not difficult. On the basis of this one would expect a fairly good standard in the examinations in standard X in Biology and Physical Science but this is contrary to the results obtained between 1962 and 1973. Although the majority of teachers indicated their preference for the observation and discovery approach in their teaching very little opportunity exists in schools for encouraging this approach outside the classroom situation. Only 36,2% of the respondents to the questionnaire have hobbies related to science, and 12% stated that there are activities such as science

clubs/....

clubs at their schools. This is not consistent with the professed aims of the teachers.[8] 96,5% of the students consider science subjects to be important. Of the 9 subjects taken for senior certificate, Physical Science and Biology were ranked second and third respectively but despite this the number of students taking science subjects at the Springfield College is comparatively small.[9]

In order to make the learning of science more interesting at high school, students made suggestions such as the need for relating science lessons to the environment; the need for more project work and, to create an interest in science, the introduction of activities such as science clubs.

8. The preparation of science teachers in Natal and some differences and similarities with overseas institutions:

Science courses offered at Springfield prepare teachers for the senior primary and junior secondary classes while the University of Durban Westville in addition to these also prepares teachers for the high school. The syllabuses for the under-graduate diploma courses consist of content and methodology while the post graduate course emphasises methodology. Topics in the syllabus are covered by lectures, seminars, assignments and projects. There is much in common in the syllabuses and methods of instruction between the institutions visited overseas and those in Natal. The chief difference is that at colleges in Britain and America students for most of the time are left alone for individual study. Science subjects taken as specialisation courses are studied in great depth. Students are given the option of doing their own research and presenting a minor dissertation if they so wish. If the work is of a sufficiently high standard credit is given for it and the student may be exempted from the rest of the course.

There/....

There is also much in common in teaching practice arrangements between the institutions visited overseas and the University of Durban Westville and Springfield College of Education. Guidance is given to students prior to their first teaching practice regarding the preparation of lessons and generally what is expected of them while at the practising schools. Specimens of guide notes to students at some of the institutions appear in appendices VI-XII.

Assessment procedures are also basically the same. Specimen forms used at institutions locally and overseas are found in appendices XIII - XXIII

Because of the importance of teaching practice, assessment procedures are continually being evaluated in the light of new developments and experiences. Such an evaluation was done by the University of Oxford - Department of Educational Studies. Details of the survey carried out appear in Appendix XXIV, pp. 216-223.

9. Recommendations:

9.1 Science teaching in high schools:

It has already been pointed out on page 109 that the overall performance of students in science subjects at senior certificate level is low. Several factors such as inadequately qualified teachers; large classes; inadequate laboratory facilities; insufficient time; lack of laboratory assistants and heavy teaching loads of teachers may be contributory factors to the low standards. It is suggested that a thorough investigation into the whole question of science teaching be made and a detailed report similar to the Haasbroek[10] report on the teaching of science at South African high schools be submitted to the Education Department and science subject committees for careful consideration with a view to improving the standards. Immediate steps, however, should be taken to alleviate the

position/....

position by reducing the teaching load of the science teacher; increasing the number of laboratories in high schools and the appointment of laboratory assis= tants at all Indian high schools in South Africa.

There is need for some incentive for the above average student. The teaching of science needs to be made more stimulating and challenging. Organisation of a science week and exchange programmes with students overseas should be considered for Indian high school students. Students who show an aptitude for science should be allowed to work ahead and should be given additional tuition if necessary during vacations. This may instil in them a habit of research, for among such students may be future leading scientists.

Many teachers stated among the problems they encount= ered the science syllabuses were somewhat vague in certain sections. In this connection it is suggested that a study committee or panel consisting of science teachers, lecturers and science inspectors be formed. The ideal situation would be for this committee to operate on a full time basis. But if this is not pos= sible immediately then in the interim period arrangements should be made for the committee to meet at least once a week to carry out some of the following functions:

a) Study the syllabuses and make recommendations for changes in the light of new developments.
b) Consider teaching behavioural objectives in terms of directions which pupils can pursue after leaving school.
c) Work together with teachers in trying out new approaches and testing new apparatus.
d) Give demonstration lessons to illustrate possible new methods in problem areas in the syllabus.
e) Compile a teacher's guide to be used with the syllabus.
f) Review and recommend new text and reference books.

g) Organise/...

g) Organise regional meetings and science workshops or refresher courses.

h) Keep in touch with latest trends in science education and disseminate useful information to all teachers.

i) Study overseas science curriculum projects with a view to adapting information relevant to syllabuses here.

The members of the panel should be experts in their fields and should be consultants to teachers in need of help. This should be an on-going committee that should undertake research in various aspects of the teaching of science subjects. There should also be some remuneration in order to compensate for the added effort and responsibilities.

9.2 Teacher training:

In the feedback obtained from ex-students of Springfield College many stated that the time allotted for science subjects was insufficient. This was further endorsed by lecturers when they were interviewed.

It is suggested that additional time if possible be made available or students make use of their non-lecture periods for practical laboratory work. There is need for more individual work by students. The setting up of a science resources centre is strongly recommended. Materials and aids such as loop films, strip films, slides, projectors reference books etc. should be made available. The provision of study cubicles or carrels referred to in chapter 3 should be seriously considered. This would allow for individual study. These facilites would greatly assist in making the students more responsible and develop in them a habit of inquiry which is highly desirable in science teachers.

9.2.1 Practice/....

9.2.1 Practice teaching:

Arrangements for practical teaching should be flexible and experimental with opportunities for evaluating and making changes in the light of new developments and needs of students.. Lecturers at the Springfield College of Education have stated that the present allocation of 1 day per week for 2 terms in the first year and 4 weeks of continuous teaching in the second and third years is inadequate. Students specialising in science subjects should have the opportunity of teaching science lessons from the first year under the guidance and supervision of science lecturers. For the second and third year students in addition to the continuous period it is recommended that 1 day per week be allowed for practice teaching. This should ensure a continuity during the year. It is also recommended that microteaching using video tapes be investigated with a view to its introduction at Springfield College of Education and the University of Durban Westville in the near future. The details and advantages of microteaching with the aid of video tape as a method of preparing students for teaching are discussed in chapter 3.

9.2.2 In-service training:

The need for and value of regular in-service programmes for teachers cannot be overemphasised. In-service training is particularly useful when new approaches and syllabuses are introduced in schools. Regular courses over weekends or vacations are essential for teachers to up-date their knowledge.

9.3. Four-year course:

It is evident from information in Table III page that there is need for more teachers to be better qualified for teaching science subjects at high school. In the three-year course in science particularly the junior secondary course offered at Springfield it is

not possible/....

not possible to cover much background work because of the lack of time. It is therefore recommended that consideration be given to the institution of a four-year course in science for the junior and possibly senior secondary phases at high schools.

The major portion of the time in the fourth year should be devoted to science (i.e. either Biology or Physical Science). The syllabus should cover content in depth as well as methodology. The course should be open to students who have completed the three-year diploma provided that they attained a sufficiently high stand= ard at the end of the third year, and also to teachers in service who are engaged in the teaching of science subjects at high school. There should be consultation with the university in the planning of the course.

9.4 Teachers' Centres:

Teachers' centres are of tremendous value to teachers. These are discussed in chapter 3. It is recommended that the South African Indian Teachers' Association give some attention to this and explore the possibility of the setting up of teachers' centres.

9.5 Liaison with university:

The Springfield and Transvaal Colleges of Education and the University of Durban Westville are responsible for the preparation of Indian science teachers. There is need for liaison between the staff of these three institutions so that common problems related to syllabuses, practice teaching etc. could be discussed.

References/....

REFERENCES

1. Refer to Chapter 1, p.4.

2. Refer to appendices XXVIII-XXX, pp. 233-236 for copy of programmes.

3. Refer to appendix XXXI, pp. 237-238 for copy of programme.

4. Refer to appendix XXVI, pp. 226-228 for programme.

5. Refer to appendix XXVII, pp. 229-232 for programme of Convention held in 1973.

6. Discussed in Chapter 4, p. 109.

7. Refer to Table IV, Chapter 4, p. 111.

8. Refer to Table VI, Chapter 4, p. 113.

9. Refer to Chapter 4, p. 128.

10. HAASBROEK, J.B. (1964): The teaching of Science at South African high schools. A publication of the Department of Education, Arts and Science, National Bureau of Educational and Social Research (Research series No. 25).

APPENDIX I

List of high schools to which questionnaire A was sent:

1. Avoca High
2. Burnwood High
3. Centenary High
4. Chatsworth High
5. Clairwood High
6. Gandhi Desai
7. Darnall High
8. Glenover High
9. Durban Indian Girls' High
10. Lakehaven High
11. Loram High
12. Mayville High
13. Meadowlands High
14. Merebank High
15. M.L. Sultan - Stanger
16. Orient High
17. Raisethorpe High
18. Sastri College
19. Southlands High
20. Stanger High
21. St. Oswalds - Newcastle
22. Tagore High
23. Tongaat High
24. Umzinto High
25. Verulam High
26. Westcliffe High
27. Windsor High - Ladysmith
28. Woodlands High - Pietermaritzburg.

APPENDIX II

Colleges of Education visited in Britain:

1. Goldsmith's College - University of London
2. City of Leicester College of Education (Leicester)
3. City of Leeds & Carnegie College (Leeds)
4. St. Paul's College of Education (Cheltenham)
5. St Mary's " " " "
6. Brighton College of Education (Brighton)
7. La Sainte Union College of Education (Southampton)
8. Homerton College of Education (Cambridge)
9. Nottingham College of Education (Nottingham)
10. Moray House College of Education (Edinburgh)
11. Dundee College of Education (Dundee - Scotland)

University Departments of Education visited in Britain:

1. King's College - (London)
2. The London Institute of Education
3. Chelsea College - centre for Science Education
4. Oxford University
5. Cambridge University
6. Birmingham University
7. Bristol University
8. Leeds University - centre for Science Education
9. University of Bath
10. University of Cardiff - (Wales).

Colleges and Universities visited in America:

1. City College - New York
2. Teachers' College - Columbia University - New York
3. Hunter College - New York
4. Trenton State College
5. University of Maryland - Science teaching centre.

APPENDIX III

LETTER TO HIGH SCHOOL SCIENCE TEACHERS

Re - Questionnaire

Dear Mr/Mrs/Miss .....

I am undertaking a project on "The preparation of Science Teachers" at Colleges of Education and the University. Some aspects of the project deal with problems in Science teaching at High Schools; and an evaluation of the Teacher training programme at Colleges and the University. I am seeking inform= ation in this regard from High School teachers engaged in the teaching of Science, and who have received their training at College or University.

This information which is being sought through the medium of a questionnaire will also be useful for the improvement of the Teacher training programmes presen= tly being followed. Your co-operation in this regard will therefore be much appreciated.

Thanking you for your kind co-operation,

Yours faithfully

L.E. PETERS

APPENDIX IV

Questionnaire A - sent to high school science teachers

INSTRUCTIONS

Please read the following before answering the questionnaire.

1. Most questions have circles next to them. All you need do is put a tick ✓ in the circle next to the answer you choose.
2. Dotted lines are provided for your answers.
3. Please complete the questionnaire independently of your colleagues and give honest answers and opinions where required. All information will be treated confidentially. No names of persons are required.
4. Kindly return questionnaire in stamped envelope provided at your earliest convenience.

A. PERSONAL/.....

A. PERSONAL

1. Name of school in which you teach .....

2. Academic qualifications

2.1 If graduate state degree taken .....

2.2 Subjects taken for degree -

First Year .....

Second Year .....

Third Year .....

2.3 If undergraduate state subjects to your credit

.....

3. Professional qualifications

3.1 Name of diploma taken .....

3.2 At which institution? .....

3.3 Year in which obtained .....

3.4 Science subjects specialised in .....

.....

4. Total teaching experience in years .....

5. Experience in Science teaching in years .....

6. What Science subjects do you teach? Also state in which standard. .....

.....

7. Have you attended a refresher course in Science since you left College/University? Yes ◯ ; No ◯

8. If yes, state when .....

Level of course .....

9. How often in your view should refresher courses be held?

Every year ◯ ; once in two years ◯ ; once in three years ◯ ; once in five years ◯

10. Are you a member of any Science organisation?

Yes ◯ ; No ◯

11. If yes, give the name .....

B. Professional/....

B. PROFESSIONAL TRAINING

1. In your teacher training in Science, state in which of the following aspects you received instruction -

1.1 Laboratory control and organisation ◯

1.2 Planning of work based on syllabus ◯

1.3 Planning and presentation of different types of lessons ◯

1.4 Planning of excursions and field trips ◯

1.5 Planning of projects ◯

1.6 Construction of tests for measuring progress of pupils ◯

1.7 Selection and use of audio-visual aids ◯

1.8 Procedure in ordering Science equipment ◯

1.9 Correct care, maintenance and storage of apparatus ◯

1.10 The keeping of a Science stock book ◯

1.11 Skill in preparation and improvisation of apparatus ◯

1.12 Keeping abreast of and collection of information regarding latest developments in Science ◯

1.13 Knowledge of Science organisations or research institutes ◯

2. What percentage of time in Science was spent on practical laboratory work during the professional years of your teacher training course? Give details for each year and course.

.....
.....
.....

C. PRACTICE TEACHING

1. In which year of study was practice teaching offered?

First Year ◯ ; Second Year ◯ ; Third Year ◯

2. Was it in continuous periods ◯ ; or one day per week spread over the year? ◯

3. Any/....

3. Any other arrangement? .....
.....
.....

4. Did you have discussions with your tutor before your lessons? ◯ ; after lessons ◯ ; both before and after? ◯

5. Were Science lessons compulsory ◯ ; or optional? ◯

6. From your experience now as a Science teacher are there any other aspects which you think should be included in the teacher training programme at College/University?

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D. AIMS

Select any five from the list below which you consider **important** in the teaching of Science. Then insert the numbers 1 to 5 in the circles next to them in the order in which you think they are important.

1. To develop an enquiring mind and a critical attitude ◯
2. To create new avenues of interest ◯
3. To prepare pupils for the passing of examinations ◯
4. To develop pupils' powers of observation ◯
5. To let pupils understand and appreciate natural phenomena ◯
6. To develop logical thinking so as to enable pupils to draw conclusions and make generalisations ◯
7. To give pupils scientific knowledge which has practical value in everyday life ◯
8. To cultivate a love for nature which can lead to the conservation of nature ◯

9. To let/....

9. To let pupils discover relationships and the inter= dependence of living organisms which will lead to broader concepts ◯

10. To develop manipulative skills ◯

E. HIGH SCHOOL LABORATORIES

1. How many laboratories does your school have? .....

2. Indicate for what Science subjects they are used. General Science ◯ ; Biology ◯ ; Physical Science ◯

3. What is the average number of pupils in your Science classes? General Science .....; Biology .....; Physical Science .....

4. How many periods per week are spent on practical lab= oratory work.....

5. Do pupils record their observations or results of experiments individually? Yes ◯ ; No ◯

6. Is practical work assessed? Yes ◯ ; No ◯

7. If yes, are these marks taken into account for promotion purposes? Yes ◯ ; No ◯

8. What is the nature of practical work? verifying text book information ◯ ; observation and discovery ◯ ; solving problems through experiments ◯

9. Are there opportunities for advanced work for brighter pupils? Yes ◯ ; No ◯

10. Do you have adequate basic equipment for practical work? Yes ◯ ; No ◯

11. Do pupils use laboratory manuals or books dealing with laboratory work? Yes ◯ ; No ◯

12. Do pupils use live specimens? ◯ ; or preserved materials? ◯

F. HIGH/....

F. HIGH SCHOOL LIBRARIES

1. Does your school have a library? Yes ◯ ; No ◯

2. Does the library have a section for the Sciences?
   Yes ◯ ; No ◯

3. Are there sufficient reference books? Yes ◯ ; No ◯

4. Give the names of some Science periodicals the library receives regularly. .....
   .....
   .....

5. Do pupils get guidance in the use of the library?
   Yes ◯ ; No ◯

6. Do your pupils make sufficient use of the library?
   Yes ◯ ; No ◯

G. THE TEACHING OF SCIENCE

1. Are A and O level pupils mixed? ◯ ; or in separate classes? ◯

2. If they are mixed, how do you overcome this problem in teaching and testing? .....
   .....
   .....
   .....
   .....

3. With regard to General Science in Std. 7 and 8 - are the Biology and Physical Science sections taught separately i.e. Biology in the one year and Physical Science in the next year? ◯ or are both sections taught in the same year? ◯

4. Do you have any particular problems regarding the syllabus? Specify .....
   .....
   .....
   .....
   .....

H. METHOD OF INSTRUCTION

1. To what extent do examinations influence your teaching?

   Greatly ◯ ; To a slight degree ◯ ; Not at all ◯

2. Are pupils given assignments? ◯ ; and projects? ◯

3. Is credit given for such work? Yes ◯ ; No ◯

4. Indicate which of the following aids you use in your teaching.

   Films ◯ Diagrams ◯

   Film strips ◯ Wall charts ◯

   Slides ◯ Living material ◯

   Overhead projector ◯ Preserved material ◯

   Models ◯ Loop films ◯

   Epidiascope ◯

5. Do you use any aids not mentioned above?

   Specify .....
   .....
   .....
   .....

6. Indicate whether you are acquainted with any of the following Curriculum studies - Nuffield Biology ◯ ; Nuffield Physics ◯ ; Nuffield Chemistry ◯ ; Biological Science Curriculum Study ◯ ; Chemical Education Material Study ◯ ; Chemical Bond Approach ◯ ; Physical Science Study Committee ◯ ; Harvard Physics Project ◯

7. Do you use any of the above materials in your teaching?

   Yes ◯ ; No ◯

8. If yes, which ones? .....
   .....
   .....

9. Do you find them helpful? Yes ◯ ; No ◯

10. Do you give your pupils dictated or roneoed notes?

    Yes ◯ ; No ◯

11. Are/....

11. Are pupils taken out on organised excursions?

Yes ◯ ; No ◯

12. What benefits do they derive from excursions? Specify.

.....
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.....
.....
.....

13. Do facilities exist for pupils to promote Science e.g. Science clubs? Yes ◯ ; No ◯

14. If yes, give details .....
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I. GENERAL

State any other problems encountered by you in your teaching of Science to which you would like to draw attention .....
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APPENDIX V

QUESTIONNAIRE B

To College Students:

Instructions

Please read the following instructions carefully before answering the questions.

1. The information given and the names of schools mentioned will be treated confidentially. No names of students are required.
2. Answer the questions honestly and independently of your neighbours.
3. The questions refer to your experience while in Stan= dard X at High School.
4. Wherever there are circles you are required to put a tick in the one next to the answer you choose. (✓)
5. Where there are dotted lines you are required to fill in your answers.

A. PERSONAL/....

A. PERSONAL

1. Name of school and year in which you matriculated
.....

2. Did you obtain a Senior certificate ◯; Matric with exemption ◯

3. Your sex Male ◯; Female ◯

4. What Science subject did you take for Matric?
Biology ◯; Physical Science ◯

5. Symbol obtained in Biology ..... Physical Science ...

6. Did you enjoy doing your Science subject at High School?
Yes ◯; No ◯

7. Did you find it beyond you? ◯; a little difficult? ◯
not difficult? ◯; easy ◯

8. Did you find it interesting? ◯; dull? ◯ boring? ◯

B. PRACTICAL LABORATORY WORK

1. How many periods per week were spent on laboratory work? .....

2. Were they single ◯; or double periods? ◯

3. Did you do any preparation for your practical work before entering the laboratory? Yes ◯; No ◯

4. Did you do your practical work individually? ◯;
in pairs? ◯; in groups of more than two? ◯

5. Were you given any guidance in your practical work?
Yes ◯; No ◯

6. Did you record your observations or results of experiments in a practical book? Yes ◯; No ◯

7. Was this work marked and assessed? Yes ◯; No ◯

8. What was the nature of your practical work? Verifying text book information ◯; experimental ◯;
observation and discovering ◯

9. Did/....

9. Did you use a laboratory manual or guide book?

   Yes ◯ ; No ◯

10. If yes, give name .....

C. METHOD OF STUDY AND LEARNING

1. Did you use a text book? Yes ◯ ; No ◯

2. Did you refer to any books other than your text book?

   Yes ◯ ; No ◯

3. Did you compile your own notes? Yes ◯ ; No ◯

4. Were you given cyclostyled notes by the Science teacher?

   Yes ◯ ; No ◯

5. Were you given any assignments? Yes ◯ ; No ◯

6. Were you given any Science projects? Yes ◯ ; No ◯

7. If yes, were they individual ◯ ; or group? ◯

8. Were you taken out on any excursion(s) related to your Science subject? Yes ◯ ; No ◯

9. If yes, state where .....

10. What did you gain from the experience?

    .....
    .....
    .....
    .....
    .....

11. Was there a discussion and follow up after the excursion?

    Yes ◯ ; No ◯

12. Did you have sufficient time to use the library?

    Yes ◯ ; No ◯

13. Did you read any Science periodicals or magazines at school? Yes ◯ ; No ◯

14. Give the names of those available in your school library.

    .....
    .....
    .....

D. GENERAL

1. Do you have any hobby related to Science? Yes ◯ ; No ◯

2. If yes, give details .....
.....

3. Were there any organisations such as a Science Club at your school? Yes ◯ ; No ◯

4. If yes, were you a member? Yes ◯ ; No ◯

5. Do you think Science is an important subject? Yes ◯ ; No ◯

6. If yes, give reasons .....
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7. How would you rate Science in relation to other school subjects? Enumerate subjects taken for Matric in order of importance.

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8. Are you intending to specialise in a Science subject? Yes ◯ ; No ◯

9. If yes, give reasons.

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10. Could/....

10. Could you suggest any ways by which your Science subject could have been made more interesting.

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APPENDIX VI

SPRINGFIELD COLLEGE OF EDUCATION

Department of Educational Studies

Practice Teaching

Guide to Students:

1. Practice Teaching Record Book.
Students are required to keep an eighty page foolscap exercise book to record:

1.1 A Scheme of Work for the four weeks

1.2 A Daily Forecast

1.3 Lesson Sketches in outline - that is, one of the five lessons taught for the day (a major lesson) should be outlined according to the College pattern or along the lines set out by your Supervisory Lecturer. The other four lessons briefly outlined on foolscap sheets should be filed.

1.4 A Diary, that is, notes made daily - a self appraisal of lessons taught, problems encountered, interesting ideas etc.

2. Students' Responsibility

2.1 Students are under the jurisdiction of the Principal.

2.2 The codes of conduct set by the Principal of the school should be adhered to. Please fall in line with what is required of Staff members of the school, that is, dress, punctuality, playground duties, etc.

2.3 Each student to teach not less than five lessons per day.

2.4 Students are urged to make the most of the four-week practical experience. Please note: A student who fails practice teaching will have to repeat the year of study.

2.5 Students must take the initiative to become au fait with all aspects of teaching, that is, Register control, the Journal, School Records, operation of the duplicating machine, extra-mural activities, etc.

Do enjoy your four-week teaching experience, students.

Head: Department of Educational Studies.

APPENDIX VII

SPRINGFIELD COLLEGE OF EDUCATION

Department of Educational Studies

Practice Teaching

For the kind attention of Supervisory Lecturers

1. Will Lecturers please note the guide on practice teaching given to students. Do feel free to add other points pertinent to your specific subject.

2. Please make arrangements to call on the Principal on any of the following three days in August: 11th, 12th & 13th.

3. Details of Practice Teaching: Commencement - 19/8/74, Termination - 13/9/74, Students' Preliminary Visit - 15/8/74 (one day), Report back to College for Final meeting with Lecturers 16/8/74.

4. Clarification regarding Senior Primary Students - Please note that SP students are general "practitioners"; while they study subjects at the "in-depth" level, they are not specialists in those subjects.

5. Discuss and finalise with the Principal the attachment of students to Supervisory Teachers (ST). Please note that all negotiations with the Principal should be at the level of "requests" ... please approach the Principal in such a manner that we get maximum co-operation from him and his members of Staff.

6. Request to meet the Supervisory Teachers. Confer with the ST on all aspects of practice teaching e.g. Timetable, Record Books etc. Enlist the total co-operation of the ST - after all he/she will be responsible for the student's daily performance.

7. Make arrangements to visit the students at least twice a week. Consult the ST on the student's progress, listen to lesson or part of a lesson, check the Record Book, check attendance and compile notes on the lines set out in the Report Form.

7. A Report/....

7. A Report on each student will have to be submitted to the Department of Educational Studies at the end of the four-week period. In addition to the verbal comment you make under General Assessment in the Report Form, please write in a percentage (in units of 5) - this should be a global assessment (N.B. 50% is pass mark). In view of the importance of your report please ensure that a true and clear picture of each student's performance is reflected in the Report Form.

Head: Department of Educational Studies.

APPENDIX VIII

SPRINGFIELD COLLEGE OF EDUCATION

Private Bag
DORMERTON
4015
5 August 1974

DEPARTMENT OF EDUCATIONAL STUDIES

The Principal
.....
.....

Dear Sir

CONTINUOUS TEACHING PRACTICE

We shall be grateful if you will kindly accommodate our students (names and other details appear on the attached sheet) for continuous teaching practice, the details of which are outlined below.

1. Period of Continuous Teaching

1.1 Commencement: 19 August 1974

1.2 Termination: 13 September 1974

2. Supervisory Lecturer's first visit

2.1 The Supervisory Lecturer will call on you during the week ending 9 August 1974.

2.2 Please finalise with the Supervisory Lecturer the placement of students in the charge of Supervisory Teachers.

2.3 The Supervisory Lecturer and the Supervisory Teacher should confer and concur on the various aspects of the student's teaching programme such as time-table, notes of lessons, daily record of work, etc.

3. Students' Preliminary visit

3.1 Students will report to your school on 15 August 1974 for one day only.

3.2 During the one day visit students should become

au fait/....

au fait with the total school situation, consult the Supervisory Teacher and collect information in respect of their four week teaching experience.

3.3 Students are to report to College on 16 August 1974 to meet their Supervisory Lecturers before they com= mence teaching at your school.

4. Students' Experience other than subject teaching

4.1 Students should have practical experience in matters such as playground duty, extra-mural activities, Register control, procedure regarding the collection of monies, use of the duplicating machine, supervision of written work, conduct of tests and examinations, recording of weekly entries from the Forecast into the Journal etc.

4.2 A special appeal is made in respect of the above-mentioned matter.

5. Report on Students

5.1 Please find attached report forms in respect of students placed at your school.

5.2 Kindly complete, in consultation with Supervisory Teacher a report on each student. The Supervisory Lecturer, also in consultation with the Supervisory Teacher, will com= plete a separate report on each student at your school.

5.3 In view of the vital importance of your report, please ensure that a true and clear picture of each student's strengths and weaknesses is reflected.

5.4 Report Forms should be completed at the end of the teach= ing practice period and returned to reach the College on or before 1 October 1974.

Kindly address your envelope as follows:

The Head of the Department of Educational Studies
Springfield College of Education
Private Bag
DORMERTON 4015

Thank you in anticipation for your co-operation

Yours sincerely

.....	.....
HEAD: Department of Educational Studies	RECTOR Springfield College of Education

APPENDIX IX

SPRINGFIELD COLLEGE OF EDUCATION

PRACTICE TEACHING FIRST YEARS SCIENCE LESSONS

(A) LESSON PLANNING - Some Guidelines

1. Statement of Aims and Objectives

The AIMS of the present primary school science syllabus are two-fold:

(a) to arouse the interest of pupils in natural phenomena, the wonders of nature and scientific investigation;

(b) to train pupils in logical thinking in order that they may use and apply scientific principles.

The OBJECTIVES by means of which these aims can be achieved are:

(a) training pupils in scientific observation;

(b) leading pupils (by means of observation and experimental work) to discover the laws of nature and to form concepts that facilitate the explanation of these laws.

Objectives should not be 'teacher objectives' or 'one-way objectives' e.g. 'to show pupils the parts of the flower'; 'to demonstrate what happens when a copper rod is heated'; and so on. Rather use 'behavioural objectives' i.e. what the pupil should be able to do at the end of the lesson (or unit of study). Statement of these objectives are introduced by action verbs e.g. 'to lead pupils to make a collection of leaf-prints'; 'to enable pupils to measure the lengths of straight lines'.

2. TOPICS AND MOTIVATION

The topic should be chosen well in advance so that the student teacher can plan and make his teaching aids.

He must/....

He must guard against attempting too much in one half-hour lesson. He should discuss with the class teacher what exactly of the topic must be taught (each topic in the syllabus is a unit of study).
Preliminary questioning should be two-fold:

(a) linking with the previous lesson taught;
(b) linking with pupils' previous knowledge - questions asked should be such that answers to them could be drawn from the pupil's own experience and his immediate environment.

The student teacher must establish in pupils a need to know - questions posed should lead to a mental tussle, which can only be solved by the pupil seeking for answers through observation, discussion, experimenting, and reading.

3. TEACHING AIDS

Student teachers should use simple, improvised apparatus. They must improvise apparatus wherever possible.
Actual specimens should be used - charts and pictures should be used only in certain instances e.g. where certain parts of the specimen or apparatus used are not clearly visible to the naked eye; or in certain topics e.g. soil ercsion, uses of water.

4. METHODS AND PRESENTATION

The student teacher must indicate the method he will follow. The lesson notes should, in the main, be an indication of method. This should show -

(a) possible questions;
(b) instructions to pupils during practical work;
(c) teacher's role during pupils' practical work;
(d) how he will organise the class for practical work.

The teacher must assume the role of a guide during practical work. The inquiry-discovery approach by pupils is strongly recommended.

5. RECAPITULATION/....

5. RECAPITULATION

In the main, this should consist of a review, by means of questions and a collation of pupils' findings from their practical work. A write-up of experiments, diagram work and other manual activity by pupils can be done here.

Application of all work done to the outside world must be stressed - see Objectives.

6. CHALKBOARD WORK

This will depend on the method followed. If, for example, the narrative method is used (a topic like Nature Conservation), a summary will be built up as the lesson proceeds and will consist of short, logical, crisp statements.

In some cases, a summary on the chalkboard during recapitulation, of pupils' findings, may be done.

All new, technical and scientific terms must appear on the chalkboard.

APPENDIX X

PGCE
PG/SP.16/72.

The University of Birmingham
University School of Education

GUIDANCE TO STUDENTS ON FIRST SCHOOL PRACTICE

INTRODUCTION

The School of Education and the schools are both concerned to give you every assistance in becoming a competent teacher. School practice offers you a great opportunity to take advantage of the wisdom, skill and experience of members of staff of schools.

The first two or possibly three days should be spent observing experienced teachers at work in the classroom. When you begin teaching you will probably feel more at ease teaching in your own subject area but you should try to get some experience in similar or related areas also. Later in the three weeks try to get opportunities to see teaching in areas which contrast with your own.

The general aim is for you to be teaching for about half the teaching periods in a week. We hope that your work will not be confined to one class and that you will arrange to observe and teach in classes other than your main one.

Observation should continue intermittently together with teaching. Experienced teachers have knowledge and expertise which will be of considerable value to you. You will also be able to learn something of what is involved in being a member of a profession which has great responsibilities to young people.

In addition to your work in the classroom you will have an opportunity to enter into the general life of the school e.g. after-school societies, and we hope you will take full advantage of this. As a member of a team you will be expected to keep school hours and respect the customs of the school in which you are placed.

OBSERVATION/....

OBSERVATION

A separate sheet gives some guidance about how to make the most of your observation periods.

LESSON PREPARATION AND ASSESSMENT

Your school practice notebook should be a full record of your preparation, teaching and observation in the school. It should contain your teaching time-table, the notes of your lessons and records of general ob= servations. The nature, size and use of the notebook will depend upon the advice given to you by your tutors as well as upon the subjects you teach.

We cannot stress too strongly the importance of good preparation for successful teaching. A great deal of your success depends on the imagination and care with which you approach the planning of your lessons to ensure that your pupils learn. Your lesson notes are primarily to help you with this planning. They should outline procedures and the development of the lesson; enough detail should be given to show how a technique is to be used e.g. examples of the types of questions to be asked. Factual information is only needed in the notes to explain your method and the development of the lesson.

Notes of lessons should be written in advance and arranged for each day in the order in which the lessons are to be given. It is an advantage either to divide your notebook into sections, one for each of your main subjects, or by classes. An index helps the tutor to refer quickly to the notes of any lesson.

Notes should record at the beginning

(a) The specific aim of the lesson.
(b) The date, time and length of the lesson.
(c) The name of the class and its average age.
(d) Any books, apparatus or illustrations to be used by the teacher and the pupils.

The body/....

The body of the notes should indicate

1. How the lesson is to be linked with a previous les= son or with pupils' background knowledge.
2. In what way the new material is to be introduced e.g. film strip, reading, discussion... This will not necessarily apply if the lesson is simply a practice or revision lesson.
3. The development of the lesson step by step, out= lining if necessary the stages to be reached during the course of the lesson. The notes should clearly reveal procedure, indicating not only what the teacher is proposing to do but what the pupils will be expected to do, e.g. if pupils are to read a passage or conduct an experiment, what the expected outcomes are.
4. Where appropriate, how the material taught is to be applied or extended or how it is to be revised.
5. Set out briefly the nature of any blackboard sum= mary, notes or exercises.

Evaluation

A very important way in which teachers develop their teaching ability is through assessment of their own lessons. After each lesson you should attempt an evaluation of your work. Talk it over with staff and fellow students and record your own comments on the lesson in your notebook.

TIME-TABLES

Students are asked to report immediately to their tutors and to the Postgraduate Office any time-table alterations. It is important that a tutor does not make a journey to a school to find that a student is not teaching.

All students should send two copies of their time-tables to the office of the School of Education as soon as possible after the first day of the teaching practice. One copy will then be sent by the office to the tutor.

APPENDIX XI

UNIVERSITY OF CAMBRIDGE

DEPARTMENT OF EDUCATION

SUGGESTIONS FOR TEACHING PRACTICE ARRANGEMENTS

The student's course is planned to provide a balance of practical work with participation in the life of a school, and to integrate theory with practice. The Department therefore wishes to work in the closest collaboration with schools, and in particular appre=ciates their willingness to assume general responsi=bility for a student during the second term of the course.

These notes are being sent out in the hope that they will be of help to the member of staff appointed by the Head of the school to act as School Supervisor during the practice term.

1. The student's place in the life of the school

It is hoped that the student will, during the term, take an active part in the life of the school, prepare his lessons well and take careful stock of them afterwards, and still have enough time to continue his reading. Most students will also need time to continue their written work already started in the previous term. We expect the student to comply with the school regulations and customs, within reason carrying out supervision duties and helping with games, societies etc., as these would be expected of a member of staff.

A student is expected to attend for the full period of the school term, and ought not to be absent, unless ill, without previous arrangement with his school Supervisor. (Occasionally, when this arrangement leaves him with less than a fortnight free for the Easter vacation, the school is asked by the Department to release him earlier). If, owing to illness, a student is absent from the school for more than two days, he should inform the Department.

2. The/....

2. The student's programme of work

In consultation with the student, the Supervisor is asked to arrange for him a suitable programme of observation and teaching, the details of which will inevitably vary from school to school. However, Supervisors may wish to know the general pattern that has been found most useful in the past:

(a) A period of observation - less than a fortnight - devoted primarily to observing the teaching methods of the Supervisor and other teachers, and discussion with teachers of the work seen.

(b) A teaching programme to start not later than the third week of term, increasing by half-term to about half a full time-table. If feasible, such teaching might initially involve work with groups of pupils rather than with whole classes. Lessons with one class, or more, throughout the major part of the term, have been found particularly valuable. Where the student is appropriately qualified, experience of teaching in areas other than his main subject is desirable.

(c) Throughout the term, invitations from several teachers to observe and discuss lessons that may offer experience of value to the student. A certain amount of observation of lessons should continue throughout the term.

(d) Regular and frequent discussions (not less than one per week) between Supervisor and student, not only on the student's own work but also on connected topics which the Supervisor regards as important for consideration during training.

It is hoped that, as far as possible, students will be asked to teach classes which are normally taught by experienced teachers, and not classes generally recognised by staff as presenting special problems.

If/.....

If, exceptionally, a student is asked to take over a lesson not on his regular time-table, it is hoped that adequate notice will be given. In the case of any heavier commitments, such as taking over an absent teacher's timetable, prior consultation between the student's School Supervisor and his Tutor in the University Department is requested.

3. Liaison between the School and the University Department

The student will be visited at least once during the term by his Departmental Tutor who will observe some of his lessons and discuss them with him afterwards. The Departmental Tutor will on that occasion also hope to talk to the School Supervisor and the Head of the School, about the student's progress and performance. In due course the School Supervisor and the Head of the School will be asked to send to the Department confidential reports on the work, capacity and progress of the student. The Supervisor will be asked to send two such reports, one at half-term and one at the end of term, on forms that will be sent for this purpose during the term. The Head of the School will be asked to send one such report at the end of the term.

The Department would appreciate it if School Supervisors were to inform the student's Departmental Tutor of any signs of undue stress as soon as these are detected in the student. In particular, prompt action would be necessary if it becomes plain that the student and school are completely unsuited to each other.

4. Assessment

The assessment of the student's work on teaching practice is based on the reports and a grade provided by the Supervisor, together with the report and a grade given by the Head of the School (or someone acting on his behalf). In these reports comments will be

requested/....

requested on the student's work in general as well as on his teaching in the classroom. The student's Departmental Tutor may also submit a report to the Examiners, though his assessment of the student is only of significance in exceptional circumstances.

5. Accommodation

Students sometimes have difficulty in finding accommodation during their teaching practice term, and any help or advice that the school staff or parents can give (perhaps on the occasion of the student's preparatory visit to the school) would be very much appreciated.

APPENDIX XII

UNIVERSITY OF OXFORD
DEPARTMENT OF EDUCATIONAL STUDIES

Notes on School Practice

1. The period of practice is a complete school term, but we may sometimes have to ask that a student should leave a few days early in order to join an educational tour of some foreign country.

2. The student is normally expected to remain in the school during regular school hours, unless a free afternoon is convenient; students are to hold themselves at the disposal of the Head in the same way as members of the staff.

3. The student should be under the guidance of an experienced member of the staff, who will act as his supervisor.

4. The student should spend the first few days observing the teaching methods of the supervisor and other colleagues, and learn the routine of the school. As soon as possible students should begin to take classes themselves, some under guidance, some alone; and within a fortnight they should have established for the rest of term a balanced timetable of teaching (between a third and a half of the timetable), observation (approximately five periods), and free time for the preparation of lessons and work required by the Department.

5. Students are expected to take part in the general life of the school and to make themselves useful in any way they can. They are sometimes diffident of putting themselves forward, and may need encouragement and specific guidance.

6. The student is expected to take any opportunity during his practice term of visiting other schools of various types in the neighbourhood. We are grateful to Heads

who/....

who can allow time off for this and for any help they can give in making the arrangements.

7. A member of the tutorial staff of this Department will visit the school by arrangement with you to assess the teaching and to discuss the work of the student with you or other members of the staff. This normally happens during the second half of term when the students have found their feet. If for any reason you feel in the first weeks that things are not going too well, it will be most valuable if you will let us know at once so that an immediate visit can be paid before the visit for assessment.

8. Students are required to make notes in preparation for their lessons, and it will be a help if the supervisor could comment on these, as well as on occasional lessons taught.

A.D.C. PETERSON
Director

APPENDIX XIII

SPRINGFIELD COLLEGE OF EDUCATION

DEPARTMENT OF EDUCATIONAL STUDIES

E V A L U A T I O N

1st YEAR

Name ..... No. ..... Group .....

Subject ..... Std./Class .....

Topic .....

*	A	B	C	Remarks
A. TEACHING PERFORMANCE				
1. Planning and Preparation of Lesson Notes				
2. Effectiveness of Motivation of Lesson				
3. Use of Teaching Aids/Apparatus				
4. Presentation of Lesson				
5. Pupil Participation				
6. Class Management and Discipline				
7. Chalkboard				
8. Conclusion of Lesson				
B. PERSONALITY				
9. Speech and Language				
10. General Appearance and Attitude in Class				
C. GENERAL				
11. Initiative and Resourcefulness				
D. ASSESSMENT				
12. Overall Success				

(*Mark applicable column with an X)

GENERAL REMARKS .....

.....

Date ..... Lecturer .....

(Key to Symbols: A. Good B. Average C. Below Average)

EVALUATION BY OBSERVING STUDENT

*	A	B	C	Remarks
A. TEACHING PERFORMANCE				
B. PERSONALITY				
C. GENERAL				
D. ASSESSMENT				

GENERAL REMARKS

.....

Date ..... Student .....

APPENDIX XIV

DEPARTMENT OF INDIAN AFFAIRS : DIVISION OF EDUCATION

SPRINGFIELD COLLEGE OF EDUCATION

REPORT ON STUDENT TEACHER 2nd YEAR

A. i. Name of Student ..... Adm. No. .....

ii. Name of School .....

iii. Name of Supervisory Teacher/Lecturer .....

iv. Special Subjects (a) ..... Std. .....

(b) ..... Std. .....

(c) ..... Std. .....

v. Date of Teaching Practice: From ..... to .....

AWARD A SYMBOL BY MEANS OF A CROSS FOR THE FOLLOWING:

B. TEACHING PERFORMANCE:	A	B	C	D	E	F	G
i. Planning and Preparation of Lessons							
ii. Use of Teaching Aids							
iii. Presentation							
iv. Pupil Participation							
v. Class Management & Discipline							

C. PERSONALITY:							
i. Speech & Language: (a) English							
(b) Afrikaans							
ii. General Appearance							

D. GENERAL:							
i. Initiative & Resourcefulness							
ii. Control of Written Work							
iii. Extra-Mural Activities							

E. REMARKS:

_____

_____

F. GENERAL ASSESSMENT .....

Key to Symbols:

A - Outstanding D - V. Satisfactory

B - Very Good E - Satisfactory

C - Good F - Unsatisfactory

G - Weak

.....

Supervisory Teacher/Lect.

.....

PRINCIPAL

APPENDIX XV

PRACTICE TEACHING REPORT

Springfield College of Education
Department of Educational Studies

Adm. No. ....Group...
Name:
Third Year

1. School _____

2. Class/Std. taught _____ Special Subjects (if any) _____

3. Period of Practice Teaching: From _____ to _____

A. Brief General Report

(Please tick appropriate block as is applicable. Refer to *key below)

(Do comment in the space provided should this be necessary)

1. STYLE (Bearing, manner, delivery, forcefulness etc.)

A	B	C	D	E

2. CLASS CONTROL (Discipline etc.)

A	B	C	D	E

3. CLASS CONTACT (Activity and pupil involvement)

A	B	C	D	E

4. GENERAL REMARKS _____

5. OVERALL ASSESSMENT: %

80 +	70-79	60-69	50-59	- 50

B. Report on Record Book

1. GENERAL REMARKS _____

2. Overall Assessment: Symbol

A	B	C	D	E

*Key to Symbols:

A	B	C	D	E
80 +	70-79	60-69	50-59	- 50

Date: _____

Supervisory Lecturer _____

FOR OFFICE USE .....

.....

APPENDIX XVI

UNIVERSITY OF DURBAN-WESTVILLE

Faculty of Education

RECORD OF LESSONS

STUDENT (Mr/Miss): ..... REG. NO: .... COURSE.....

SCHOOL: ..... PERIOD OF PRAC. TEACHING.....

DATE OF VISIT	STANDARDS TAUGHT	SUBJECTS	COMMENTS/PROBLEMS
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
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.....	.....	.....	.....
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.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....

DATE

LECTURER

APPENDIX XVII

UNIVERSITY OF DURBAN-WESTVILLE

Faculty of Education

BRIEF REPORT BY PRINCIPAL ON OBSERVATION PERIOD

BEGINNING OF YEAR

(Please submit to the Faculty of Education on completion of the observation period)

SCHOOL: ..... PERIOD: (from)....(to)...

NAME OF STUDENT (Mr/Miss): .....

REG. NO.: ....., COURSE: .....

1. ATTENDANCE: .....

.....

2. ATTITUDE: (Co-operation, willingness, punctuality, reliability) .....

.....

3. PERSONALITY: .....

.....

.....

4. GENERAL ASSESSMENT AND/OR FURTHER REMARKS: (If any)

.....

.....

.....

---------- ----------

DATE PRINCIPAL

(and school stamp)

APPENDIX XVIII

UNIVERSITY OF DURBAN-WESTVILLE

Faculty of Education

REPORT ON SPECIAL PRACTICE TEACHING

(as an example to lecturers and students)

DATE OF LESSON: ..... LECTURERS: 1. ..... 2. .....

STUDENT: ..... COURSE: .....REG.NO. ...

SCHOOL: ..... CLASS: ..... MEDIUM: .....

SCHOOL SUBJECT: .....

LESSON TOPIC: .....

ASPECTS	SYMBOLS	GENERAL REMARKS
A. PREPARATION BOOK	(Ring Letter)	
General appearance, specific aim of lesson, preparation of subject matter and method, quality of written language.	PD P B F	
B. PROGRESS OF LESSON		
1. Introduction	PD P B F	
2. Development (knowledge and grasp of subject matter, logical and psychological presen= tation, use of questions class activity.)	PD P B F	
3. Conclusion (recapi= tulation, application, achievement of aim.)	PD P B F	
C. TEACHING AIDS		
(Use by teacher and children, suitability, chalkboard work.)	PD P B F	
D. CLASS MANAGEMENT	PD P B F	
E. PERSONALITY		
(confidence, initiative, adaptability and leadership, relationship with class, quality of speech and voice, appropriateness of language.)	PD P B F	

F. COMMENTS: .....

.....

SYMBOL VALUES

PD - Merit Pass B - Borderline Case

P - Pass F - Fail

APPENDIX XIX

UNIVERSITY OF DURBAN-WESTVILLE

Faculty of Education

REPORT BY PRINCIPAL ON PRACTICE TEACHING

1. Mid-year period: Please submit this report to the lecturer concerned on the last Wednesday of the practice teaching period.
2. End-of-year period: Please submit this report to the lecturer concerned by mid-November.

SCHOOL: ..... P.T. period: ....Term, 19..

NAME OF STUDENT (Mr/Miss): .....Reg. No.: .....

COURSE: ..... LECTURER: .....

1. Personality, attitude and relationship (co-operation with principal and staff, attitude to schoolwork, punctuality and reliability; relationship with and educational impact upon pupils; personality).

   .....
   .....
   .....
   .....

2. Teaching performance (preparation and presentation of lessons, pupil activity, aids, speech, class management, etc.)

   .....
   .....

3. General assessment or further remarks (if any) .....

   .....
   .....

4. The student was absent on the following date(s)

   .....

   Reason(s) for absence: .....

KEY TO SYMBOL:
A - Merit Pass
B - Pass
C - Borderline Case
D - Fail

SYMBOL:

DATE
(and school stamp)

PRINCIPAL

APPENDIX XX

UNIVERSITY OF DURBAN-WESTVILLE

Faculty of Education

PRACTICE TEACHING

CUMULATIVE ASSESSMENT RECORD

STUDENT (Mr/Miss): ..... REG. NO.: .....

	PRIN= CIPAL	LEC= TURER	TUTOR	SPECIAL	RESULT Pass/Fail
YEAR: ..... COURSE:					
Sem.1 T....L.....S.....					
Sem.2 T....L.....S.....					
YEAR: ..... COURSE:					
Sem.1 T....L.....S.....					
Sem.2 T....L.....S.....					
YEAR: ..... COURSE:					
Sem.1 T....L.....S.....					
Sem.2 T....L.....S.....					
YEAR: ..... COURSE:					
Sem.1 T....L.....S.....					
Sem.2 T....L.....S.....					
			FINAL	RESULT:	

ASSESSMENT KEY:

A - Merit Pass
B - Pass
C - Borderline Case
D - Fail

T - Tutor
L - Lecturer
S - School

(Assessment to be based upon Teaching Performance and General Attitude - Including other activities within and without the school.)

APPENDIX XXI

UNIVERSITY OF DURBAN-WESTVILLE

Faculty of Education

EXAMINERS' PRACTICE TEACHING REPORT FORM AT END OF FINAL YEAR FOR DIPLOMA COURSES

SURNAME OF STUDENT: ..... INITIALS: ....

REGISTRATION NUMBER: ..... SEX: ..... COURSE: .....

SPECIAL METHOD BEING EXAMINED (especially for U.E.D. students): .....

.....

SCHOOL: ..... STANDARD: .....

SCHOOL SUBJECT: .....

LESSON TOPIC: .....

DATE: .....

NOTE:

PASS MARK

The pass mark for teaching ability is 50%

Distinction is 75%

EXAMINERS' SIGNATURE: 1. .....

2. .....

APPENDIX XXII

UNIVERSITY OF OXFORD DEPARTMENT OF EDUCATIONAL STUDIES

Post-Graduate Certificate of Education

Tutor's Report on School Practice

Date .....

Name of student ..... School .....

Lessons heard (classes and subjects) .....

.....

Assessment ..... Signature .....

I. THE STUDENT'S PERSONALITY AND FITNESS:
(Relations with pupils, individually and as a group; voice; keenness and vitality; mannerisms &c. Preparation of work, standard of scholarship, lesson-notes, &c.)

II. THE STUDENT IN THE CLASS-ROOM:
(The course of the lesson, presentation and response, its effect; order and discipline)

APPENDIX XXIII

BATH UNIVERSITY SCHOOL OF EDUCATION

SCHOOL PRACTICE REPORT

SCHOOL .....

TERM .....

1. Name of Student .....

2. Nature of student's work. Please state subjects taught, forms or groups, with some indication of age and ability.

3. Quality of lesson preparation and planning.

4. Presentation of lessons, i.e. quality of subject matter, use of blackboard, apparatus, visual aids, oral questioning, and so on.

5. Relationship/....

5. Relationship with classes/groups, i.e. management of routine arrangements, handling of behaviour situations, pupil response and attitude.

6. Personal qualities: voice and accent, appearance, bearing in classroom.

7. Relationship with School Staff.

8. Contribution to school community - routine duties, out-of-school activities.

9. Other remarks.

10. Grade .....

Signed: .....

STATUS: .....

Scale for assessment:

A = Very good
B = Good
C = Competent
D = Weak
E = Very weak

APPENDIX XXIV

AN EVALUATION OF TEACHING PRACTICE ASSESSMENT

It has become apparent from past meetings concerned with the assessment of students on teaching practice that there is a need for a greater correlation between the number and types of skills, etc., being assessed by tutors than exists at present. This may well be attributed to the rather vague outlines of the present form used for teaching assessment, and hence the proposal for a revi= sion of the form.

This desired-for uniformity of standards in assessment would have been important in itself, but now that the method work carried out in the Department is changing to a continuous assessment process it is more desirable to have a continuous uniformity of standard for method work and teaching practice.

A revision of the form is also desirable on the grounds that it could provide a more positive guide for new mem= bers of staff to the Departmental approach to teaching practice than given in the present form.

To try to reach a consensus of what could be desirably incorporated into a revised form a circular was sent to all staff, and teaching practice forms obtained from 6 universities and 3 training colleges. Eight members of the P.G.C.E. staff replied, and seven of the replies contained proposals concerning the form's structure. Of these, four were generally in favour of a more objective approach being adopted, two were for a more subjective approach, and the seventh wanted no change. It should, however, be pointed out that one of the two replies for a subjective approach, whilst advocating the use of a blank sheet as the format for the form, also contained a list of 25 specific objectives to be incorporated into the assessment. Therefore it would appear that from these replies, there is a bias towards a more objective approach, or at least the incorporation of an objective part in the revised form.

Of the/....

Of the six university forms obtained, three required the completion of a detailed, analytical form - Chelsea, Sheffield, and York, (see appendix A). The Sheffield forms also included separate assessment forms for students of science and modern languages. York is not continuing with its present form after this year.

A more subjective approach was provided for in the forms used by Exeter and Bristol, and the new one to be used by York. Nottingham does not use forms at all and the basis of assessment rests on discussions between tutors and between tutor and school staff.

The three college of education forms (a local, a rural and a London college) show a distinct bias towards the use of an objective analysis of teaching practice assessment. An example of the most objective is provided, (see appendix B).

From this small sample it appears that there is generally a balance existing between the use of detailed, analytical forms and those of a more subjective nature. The bias amongst the staff, as far as one can tell, is for a more objective approach to be incorporated into the form.

On the basis of this I propose that the amended form be basically divided into three sections. The first of these to be an objective analysis of general teaching skills and incorporating those relative to classroom technique, lesson preparation, and communication. This would replace, basically, section one of the present form.

Section two would allow for a more subjective approach to the lessons observed, and would provide an opportunity for observations based on a consideration of the specialist area involved.

The third section is inserted so as to try to provide some correlation between tutor's observations and assessment and that of the school in which the teaching practice was spent. Consequently the form might have the appearance and content as shown, (see appendix C)

N.D. Daglish

APPENDIX A

PLEASE INDICATE WITH A TICK THE EXTENT TO WHICH THE STUDENT SHOWS THIS BEHAVIOUR

NO OPPORTUNITY TO OBSERVE THIS BEHAVIOUR		Excellent	Above Average	Average	Below Average	Poor	COMMENTS
	LESSON PREPARATION & PLANNING Subject						
	Shows thorough knowledge of the subject.						
	Has tapped sources other than standard textbooks.						
	Preparation takes account of previous knowledge and ex= perience of class.						
	Planning shows clear thought.						
	Planning pays attention to the timing and pace of the lesson.						
	Takes account of the level of pupils' understanding.						
	Is able to illustrate lessons with relevant examples or material.						
	Plans blackboard work where necessary.						
	CLASSROOM TECHNIQUE Is able to get the attention of all the class particularly before commencing a lesson.						
	Gives clear instructions which all can follow.						
	Shows originality and variety of procedures.						

Tries to/....

NO OPPORTUNITY TO OBSERVE THIS BEHAVIOUR		Excellent	Above Average	Average	Below Average	Poor	COMMENTS
	LESSON PREPARATION & PLANNING Subject						
	Tries to involve the whole class with questions or discussion.						
	Deals constructively with both right and wrong answers.						
	Keeps class usefully occupied throughout the period.						
	Exercises enhance pupils' knowledge						
	Uses the blackboard well for illustrations and summaries.						
	Flexible. Can depart from lesson plan if necessary.						
	Takes problems of bad pupil behaviour in his/her stride.						
	COMMUNICATION & RELATIONSHIPS Speaks clearly.						
	Appropriate tone and emphasis in speech. Not monotonous.						
	Phrases questions well.						
	Shows power of lucid statement.						
	Establishes responsive relationships with pupils.						
	Communicates enthusiasm and interest in subject.						
	At ease in the classroom.						
	Responsive to advice and criti= cism.						

APPENDIX B

LESSON PREPARATION

4. Account taken of varying abilities in class	No account taken	Failed to help most students	Some attempt to adjust	Successful adjustments made	Lesson well-suited to all types
5. Appropriateness of material selected	Highly appropriate	Aptly chosen	Appropriate	Not quite suitable	Quite inappropriate
6. Value of teaching notes	Inadequate	Of little value	Adequate	Of consid= erable value	Of very marked value
7. Organisation of lesson	Very well organized	Well Organized	Adequate	Poorly organised	No apparent plan

PERSONAL QUALITIES

8. Audibility of voice	Inaudible	Not always audible	Moderately clear	Always audible	Very clear and effective
9. Agreeableness of voice	Very un= pleasant	Poor	Acceptable	Good	Very agreeable
10. Command of language	Excellent	Good	Adequate	Restricted	Inadequate
11. Distracting mannerisms	None apparent	Seldom distracting	Occasion= ally dis= tracting	Often distracting	Very seriously distracting
12. Acceptability as colleague in the staff= room	Very acceptable	Good	Acceptable	Poor	Quite unacceptable

CLASSROOM PERFORMANCE

13. Use of teaching aids (blackboard, film, overhead projector, etc.)	Failed to use	Little or ineffective use	Some use	Good use	Very effective use
14. Skill in demonstration	Very highly skilled	Very skilled	Adequately skilled	Insufficiently skilled	Quite unskilled and ineffective
15. Use of discussion	Stimulated lively discussion	Interesting discussion	Useful discussion	Little discussion	No discussion
16. Application and drive	Very vigorous	Vigorous	Some drive	Little drive	Complete absence of drive
17. Stimulation and maintenance of interest	No interest	Little interest	Some interest	Sustained interest	Strong interest
18. Class contact or rapport	No contact	Little contact	Some contact	Good contact	Very harmonious contact
19. Skill in use of questions	Very skilful	Good	Of some value	Ineffective	Futile
20. Degree of adaptability	Highly adaptable	Adaptable when necessary	Reasonably adaptable	Few attempts to adapt	Unable to adapt
21. Involvement of students in class	Students apathetic	Insufficiently active	Fairly active	Sufficiently active	Very active and involved
22. Order and class control	Ineffective	Poor	Adequate	Good	Very effective

APPENDIX C

SCHOOL ..... DATES VISITED .....

LESSONS OBSERVED .....

.....

1. GENERAL TEACHING SKILLS 5 point scale

   (a) Overall approach to lesson

   (b) Clarity of instructions

   (c) Involvement of pupils

   (d) Questioning skill

   (e) Flexibility on part of student

   (f) Use of teaching aids

   (g) Knowledge of subject

   (h) Awareness of pupils' needs

   (i) Attitude of pupils

   (j) Plan of lesson

   (k) Achievement of lesson's aims

   (l) Standard of lesson notes

   (m) Mannerisms

   (n) Audibility

   (o) Order and class control

2. SPECIFIC TEACHING SKILLS

   (i) Evidence of good teaching:

   (ii) Weaknesses:

3. The School/....

3. THE SCHOOL AND STAFF

(a) Type of school: .....
.....

(b) General approach by school to discipline, pupils, etc:

.....
.....

(c) Facilities available for subject: .....
.....
.....

(d) Student's relationship with supervisor:

.....
.....

(e) Student's relationship with rest of staff:

.....
.....

(f) Student's participation in total life of school:

.....
.....

(g) Student's personality .....
.....
.....

(h) Other comments: .....
.....
.....

Assessment of (a) teaching skills

(b) integration, etc.

Overall assessment

Tutor's signature .....

APPENDIX XXV

MICROTEACHING - INTRODUCTORY EXERCISES

You will be asked to perform some simple teaching tasks in front of a television camera. You will then discuss the recording of your performance with a tutor, after which you will repeat the exercise with a different group. Finally you will see, alone or in company, the recording of your repeat lesson. All recordings are treated as confidential and the tapes are erased at the end of the afternoon.

The exercises increase people's self-awareness and self-confidence, by demonstrating that you can improve your presentation of information to small groups of your colleagues.

There are four exercises, one for each week:

Week 1. The student reads to the camera a piece of her own choice, lasting about one minute.

Week 2. The student explains to a small group of her colleagues a wall chart, map or diagram that she has made.

Week 3. The student builds up on the blackboard, and explains, a chart, table, map or diagram.

Week 4. The student elucidates by questioning her class, and records on the blackboard, information about a chart, table, map or diagram.

In all four exercises, our interest is in your contact with your audience, particularly the way you use your eyes to give them information about yourself and your intentions. You should attempt to use your eyes to tell

us that/....

us that you're interested in your material, that you know and care about us, and that you're giving the job your undivided attention.

It is usually a mistake to choose elaborate or difficult material: keep it simple.

These are not exercises in the dramatic arts - do not expect your audience to pretend to be, say schoolchildren, and do not assume a role yourself.

PLEASE BE PROMPT. The equipment (and the tutor) will be in use for every minute from 14.00 to 18.30.

APPENDIX XXVI

PHYSICAL SCIENCE AND BIOLOGY
IN-SERVICE REFRESHER COURSE
SPRINGFIELD TRAINING COLLEGE

10:4:1967 - 14:4:1967

P R O G R A M M E

MONDAY, APRIL 10:

8 - 9 a.m.	Both Groups	Welcome: Mr Levine Opening: Mr J.H. Stander: Deputy Director of Indian Education.
9 - 9.30 a.m.	Both Groups	Address: Mr R.L. Charles
9.30 - 10.15 am.	(i) Biology	Announcements: Mr O. Beyer
	(ii) Phys. Science	: Mr F. Hawkins
	T E A	
10.30 - 12.45 p.m.	Both Groups	LABORATORY WORK
	L U N C H	
1.30 - 3.00 p.m.	Both Groups	Chemistry lecture: Prof. H.P. Malan
	T E A	
3.15 - 4.30 p.m.	Both Groups	Chemistry Lecture: Prof. H.P. Malan
	S U P P E R	
7.00 - 9.00 p.m.	Both Groups	"The Modern Approach to School Science" - Lecture: Prof. A.L. Behr.

TUESDAY, APRIL 11:

8 - 10.15 a.m.	(i) Biology	LABORATORY WORK Photosynthesis: Prof. O.A.M. Lewis
10.30 - 12.45 p.m.	(ii) Physical Science:	LABORATORY WORK
1.30 - 3.00 p.m.	(i) Biology	Ultrastructure of the cell and ultrafunction of the cell: Mr Burger
	(ii) Physical Science:	Lecture on Electrostatics: Mr R. Charles
3.15 - 4.30 p.m.	(i) Biology	Lecture on photosynthesis: Mr J.v. Coller
	(ii) Physical Science:	Lecture on Electrostatics: Mr R. Charles (continued)
7.00 - 9.00 p.m.	Both Groups	Exhibition of Audio-visual aids.

WEDNESDAY, APRIL 12:

8.00 - 10.15 a.m.	(i) Biology	Animal dissections (Invertebrate and Mammal): Mr L.E. Peters; Mr A.S. Thandar and L.J.Moodley
	(ii) Physical Science:	LABORATORY WORK
1.30 - 3.00 p.m.	(i) Biology	Zoology lecture: Mr T.K. Moodley
	(ii) Physical Science:	Oxidation & Reduction reactions: Mr K.G. Moodley
3.15 - 4.30 p.m.	(i) Biology	Botany lecture: Mr Ward
	(ii) Ph. Sc.	Chemical changes, energy & equilibrium: Dr H.S. Govinden
7.00 - 9.00 p.m.	Both Groups	PSSC, CHEMS and other films related to the subjects.

Thursday/.....

THURSDAY, APRIL 13:

8.00 a.m. - 12.45 p.m.	Biology	Laboratory technique, floral illustrations and microscopy - Univ. College, Salisbury Island.
	Phy. Sc.	Physics and Chemistry Demonstrations - Univ. College, Salisbury Island.
1.30 p.m. - 3.00 p.m.	Both Groups	Display of Subject literature and recommended reference and text books.
3.15 p.m. - 4.30 p.m.	Both Groups	Radiation, its application and its dangers: Prof. A.J. Burton.
Evening	Both Groups	Free.

FRIDAY, APRIL 14:

8.00 a.m. - 12.45 p.m.	Both Groups	Excursion - Clover Dairies
1.30 p.m. - 3.00 p.m.	Biology:	Mr O. Beyer
	Ph. Sc.:	Mr F. Hawkins
3.15 p.m. - 4.30 p.m.	Both Groups:	Evaluation and Criticism of the course. Suggestions for future courses.

APPENDIX XXVII

THIRD NATIONAL CONVENTION FOR INDIAN TEACHERS OF MATHEMATICS AND SCIENCE

9 - 13 JULY 1973

PROGRAM * PROGRAMME

MONDAY, 9 JULY

09h05:	Welcome to the Campus:	Prof. S.P. Olivier, Rector
09h20	Welcome to Westville:	His worship the mayor of Westville, Councillor H.W. Bamber
09h30	Opening Address:	Dr M.B. Naidoo, Executive Member of the South African Indian Council
10h30	Tea	
11h00:	"Assessment". Dr D.J. Daniels	

	MATHEMATICS	PHYSICAL SCIENCE	BIOLOGY
14h00:	"Visual aids in the teaching of high school mathematics". Mr W.J.H.R. Höne	"Observation and scientific method - some psychological aspects". Dr D.J. Daniels	
15h30	Tea		
19h30	"The value of visual communication in the teaching of science and mathematics". Mr J. Hooley		

TUESDAY/....

TUESDAY, 10 JULY

08H00:	Book display, apparatus display, teaching aids display		
10h00:	Tea		
10h30	"Fundamental aspects of school mathematics". Mr P. Pillay	"Teaching of physics at high school level". Part I. Prof. H. Helm	"Floral mor= phology". Mrs E.F. Hennesse
12h30:	Lunch		
14h00:	"Vectors". Prof. A.P. Malan	"Enlivening in-organic chemistry teaching". Dr D.J. Daniels	"Orientations and creative teachin in zoology". Mr A.S. Thander
15h30:	Tea		

WEDNESDAY, 11 JULY

09h00	"Our green heritage - an audio-visual display"	
09h30		"The need to protect the environment". Mr T.C. Robertson
10h00:	Tea	
11h00	"The role of mappings and groups in a modern geometry curriculum for the junior secondary school". Prof. H.G. Steiner	"Techniques for evaluation of science teaching" Prof. A.E. Lee

12h30/.....

12h30	Lunch		
14h00	"The number concept and number systems". Prof. A.P. Malan	"Teaching of physics at high school level". Part 2. Prof. H. Helm	"The B.S.C.S. laboratory block programme". Prof. A.E. Lee
15h30:	Tea		
19h30	Social		
THURSDAY,	12 JULY		
09h00	"The vector and linear approach to geometry". Prof. H.G. Steiner	"Projects and case studies in chemistry teaching". Dr D.J. Daniels	"The learning Carrel lesson". Prof. A.E. Lee
10h30	Tea		
11h00	"Modern elementary algebra: A reconstruction of present time algebra for the secondary school level". Prof. H.G. Steiner	"Chemistry curriculum development". Dr D.J. Daniels	"Individualized learning in science curricula". Prof. A.E. Lee
12h00	Lunch		
13h30	Excursion		

FRIDAY/.....

FRIDAY, 13 JULY

08h00	Meeting of Science Society of S.A.I.T.A.		
09h00:	"Combinotomics and probability in the elementary school". Prof. H.G. Steiner	"Gas syringe experiments" Mr P.E. Spargo	"A demonstration of B.S.C.S. single topic inquiry films". Prof. A.E. Lee
10h30:	Tea		
11h00	"Engineering". Prof. R.P.S. Horn		
11h45	ADMINISTRATION		

APPENDIX XXVIII

THE UNIVERSITY OF LEEDS INSTITUTE OF EDUCATION

COURSE FOR HEADS OF SCIENCE DEPARTMENTS
(An H.M.I./A.T.O. Course)

'RECORD OF THE JOB'

The responsibilities of a Head of Science are not clearly defined. In some schools the post does not exist. In others it is little more than a nominal title. In some however it is a post of considerable importance with the holder of the post contributing much to overall policy of the school as well as to the efficient management of the science laboratories and curriculum.

One way in which this course can be of value is in attempting to clarify the work of a Head of Science as it is at present. To help in this we are supplying each course member with a desk diary in which we are asking him/her to record those aspects of their work which directly relate to their responsibilities as 'Head of Science'. We would also like them to record those aspects of work in the school which were not brought to their attention but in which they feel they should have been involved. Course members who are in schools without a Head of Science are asked to keep a similar diary indicating where they feel the existence of a Head of Science might have been valuable in any aspect of work within the school.

Time will be given at the end of the course for analysing these records with a view of what the post of Head of Science entails.

B.R. CHAPMAN

JGM/BRC/KH/2748/70

APPENDIX XXIX

THE UNIVERSITY OF LEEDS INSTITUTE OF EDUCATION

COURSE FOR HEADS OF SCIENCE DEPARTMENTS - 1972

THE HEADTEACHER AND THE HEAD OF SCIENCE (4 January)
GROUP DISCUSSION

Discussion questions

1) Is the Head of Science consulted about general educational issues within the school? If so, is this simply in terms of implementation of a previously, or autocratically, decided policy or is it in terms of involvement in the development, as well as the implementation of that policy? (e.g. Non-streaming R.O.S.L.A., etc.)

2) How far does the Head of Science go in developing processes of consultation within the Science Department itself? What relationships exist between the Head of Science and the Heads of the individual science subjects?

3) To what extent does the Headteacher delegate responsibilities to the Head of Science? (e.g. finance, staffing, timetabling, science curriculum, etc.)

4) What organisation exists for inter-departmental co-operation and discussion? How often do Heads of Department meet together with the Head? What matters are discussed at these meetings?

5) Large schools are increasingly creating major posts such as Heads of Lower Middle and Upper School. What relationships exist between these people and Departmental Heads?

JGM/BC/KH/2796/71

APPENDIX XXX

THE UNIVERSITY OF LEEDS INSTITUTE OF EDUCATION

COURSE FOR HEADS OF SCIENCE DEPARTMENTS

This course will be composed of three parts:

	OPENING COURSE :	Monday 3 January, Tuesday, 4 January, Wednesday 5 January 1972
(2.0 - 7.30 p.m.)	SEQUENCE OF 10 WEEKLY MEETINGS	Thursdays, 13, 20, 27 January, 3, 10, 17, 24 February, 2, 9, 16 March, 1972.
	CLOSING COURSE:	Monday 27 March, Tuesday 28 March, Wednesday 29 March 1972

and will be held at the Centre for Science Education, School of Education, University of Leeds.

The course has been arranged by request following a very successful course held last session under H.M.I./A.T.O. auspices. It is intended for heads and potential heads of science departments in schools of the 11-18 and 13-18 age range. Its aims are to cover those aspects of school organisation, management, administration and curricula which are becoming increasingly important in the running of a science department.

The course will take the form of lectures, seminars, group exercises and visits.

Due to the practical nature of the course only a limited number of applicants can be accepted.

The following topics are likely to be discussed:

The rolé of the Head of Science Department
Laboratory organisation and management
The rolé of laboratory technicians
Laboratory planning storage
Curriculum developments

Management/....

Management of a science department
Impact of non-streaming
Examining and Evaluation
Developments in Educational Technology
General Studies courses
Equipping a Science Department
Middle School/Upper School liaison
Use of Television in School Science
The newly-qualified teacher
The teacher in training
Relationship between Heads of Science Department and L.E.A.
Careers guidance in science and applied science
Safety
Factors affecting choice of science subjects by pupils

The course will be directed by B.R. Chapman, B.Sc., Department of Education, University of Leeds, who will be joined by visiting tutors from Schools, Colleges, other Universities and H.M. Inspectorate.

The course fee is £25.00.

Membership of the course will be selected after consultation with Local Education Authorities and it is therefore hoped that L.E.As. will pay the course fee direct to the Institute.

Any teacher who would like to attend the course and is employed by an L.E.A. within the Institute area is invited to make application on the assumption that finance will be available. Others who wish to enrol on the course will need to make their own arrangements to pay the course fee.

APPENDIX XXXI

THE UNIVERSITY OF LEEDS INSTITUTE OF EDUCATION

SCIENCE, TECHNOLOGY AND SOCIETY
(An A.T.O./D.E.S. Course)

Increasingly attention in schools is being focussed on the area of interaction between science, technology and society. This course will aim to examine -

(i) some of the relations of science and technology to each other and to society;

(ii) the implications of the interactions between science, technology and society for the objectives of education in secondary schools;

(iii) the possibility of small groups of teachers collaborating in the production of teaching materials to support work in this field.

Whilst the course will be of particular interest to teachers of science to pupils in the 14-18 age range, teachers of say history, economics and geography with special interest in the relationships between science, technology and society will be very welcome. It is envisaged that a good deal of time during the course will be spent by groups of teachers developing teaching materials.

PART I : 26, 27, 28 September 1972

PART II : Wednesdays - 4, 11, 18, 25 October, 8, 15, 22, 29 November, 6, 13 December.

PART III : 3, 4, 5 January 1973

The course which will be held at the University of Leeds is non-residential. Assistance in obtaining accommodation will be given in Parts I and III of the course to those teachers living some distance from Leeds.

The course will be directed by D. Layton, Deputy Head, Department of Education, University of Leeds, in col= laboration with Dr K. Hutton, H.M.I.

Outline/....

Outline Programme

PART I : Objectives; statements on the nature of the relationships between science, technology and society; teaching methods including a consideration of the implications of science education moving into the area of controversial issues; case studies involving illustrative materials which are relevant to current syllabuses.

PART II : A variety of contributions by guest speakers with different experiences of teaching in the field; activities and projects by members of the course involving compilation of data and production of resource and other teaching materials.

PART III : Relevant curriculum development projects including Schools Council integrated science project (S.C.I.S.P.); the management of materials and resources.

JGM/KH/M270/72

ABBREVIATIONS

A level	Advanced level - Age 13 - 18 years
ASE	Association for Science Education
ATO	Area Training Organisation
BSCS	Biological Science Curriculum Studies
CBA	Chemical Bond Approach
CHEMS	Chemical Education Materials Study
CNAA	Council for National Academic Awards
CSE	Certificate of Secondary Education
GCE	General Certificate of Education
HPP	Harvard Physics Project
ILEA	Inner London Education Authority
LEA	Local Education Authority
LSTD	Lower Secondary Teachers' Diploma
NTD	Natal Teachers' Diploma
NTSD	Natal Teachers' Senior Diploma
O level	Ordinary level - Age: 11 - 13 years
PSSC	Physical Science Study Committee
SCIS	Science Curriculum Improvement Study
SCISP	Schools Council Integrated Science Programme
T2	Teachers' Second Class
T3	Teachers' Third Class
T4	Teachers' Fourth Class
T5	Teachers' Fifth Class
UED	University Education Diploma
UHDE	University Higher Diploma in Education.

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