DOCUMENT RESUME

ED 049 921 SE 011 025

TITLE	Science Teacher Education Project Information Bulletin Number 2.
INSTITUTION	Nuffield Science Teacher Education Project (England).
PUB DATE	70
NOTE	14p.
EDRS PRICE	EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS	*Curriculum Development, *Instruction, International Education, Program Descriptions, *Science Education, *Teacher Education
IDENTIFIERS	England, Nuffield Foundation, Science Teacher Education Project

ABSTRACT

Progress made by groups of tutors from departments and colleges of education in developing small curriculum units for training science teachers is described in this report of the Nuffield Foundation sponsored Science Teacher Education Project. All units under development involve student teachers in active study, for example in devising teaching materials, teaching in small teams, analyzing pupils' writings, and close, structured observation of teachers and pupils at work. Videotapes, sound recordings, and reproductions of pupils' work are an integral part of the materials being produced. The individuals involved in developing each topic group are listed, and a brief summary of their progress and plans given. Topic groups that have been established are concerned with aims and objectives of science teaching, methods and techniques/resources, teacher-pupil interactions, concept development, design of science courses, social context of science teaching, laboratory design and management, safety, and assessment and feedback. (Editors/AL)

SCIENCE TEACHER EDUCATION PROJECT

Information Bulletin

No. 2

Summer 1970

ABOUT THE PROJECT.

In December 1969, the Nuffield Foundation approved funds for a three-year curriculum development project on methods of training science teachers. After a period of extensive work on new curricula, it was fitting that a new decade should begin with investment in the teachers themselves.

These funds are being used to enable groups of teachers, most of whom are tutors in Departments and Colleges of Education, to develop small curriculum units on methods of teaching science. (Examples are given elsewhere)

In building up a bank of small course components rather than a complete packaged course, the intention is to provide maximum flexibility to users of the materials in [illegible]nstruction of their own courses. A major characteristic of a[illegible]he units is that they involve student-teachers in <u>active</u> study, for example, in devising teaching materials, teaching in small teams, analysing pupils' writings, or by close structured observation of films of teacher and pupils at work. Videotapes, sound recordings and reproductions of pupils' work are an integral part of the materials being produced.

<u>1970</u>

Contribution of suggestions for activities for students.

Topic groups devise curriculum units based on these.

Production of resource materials

<u>1970 SEPT</u>

TRIAL OF SAMPLE UNITS and of evaluation procedures

<u>1971 AUG</u>

<u>1971 SEPT.</u>

MAIN TRIAL with concurrent evaluation

<u>1972 AUG.</u>

<u>1972 DEC.</u> Publication of materials and evaluation data.

PROGRESS

Contributions.

Some 218 individual suggestions for activities for student-teachers have been received. It certainly appears that there is no shortage of inspiration in the profession! A few of these are in a form such that they can be made available for trial soon. Many more require extensive work on the reproduction and extension of resource material on which they are based, e.g., a better quality videotape of a laboratory incident to illustrate the same point, or a wider selection of examination scripts to bring out features of pupils' reasoning on a problem. For the time being the Topic Groups have more than enough ideas to work on, although contributions have been much more numerous for some topics than for others. Additional resource materials are the next priority.

The Topic Groups.

By July 1970 nine groups, as follows, were active.

Aims and Objectives.	Methods and Techniques of Teaching.
Teacher-Pupil Interaction.	The Development of Scientific Concepts
Assessment and Feedback.	The Design of Science Courses
Safety.	The Social Context of Science Teaching
	Laboratory Design and Management

A note about each of these appears in this Bulletin.

Trials.

The main trials will take place in the academic year 1971 - 72, but each Topic Group has prepared a few sample curriculum units for a Trial of Sample Units in the coming academic year. Correspondents and contributors are asked to note that this will be on a small scale, so that ways of getting effective feedback and evaluation can be explored. If less seems to be happening in the coming months, it does not mean that your contribution, or offer to take part in trials, has been forgotten!

The Film Review.

A review of film material likely to be of use in teacher training has begun, and it is planned to publish this in the form of a booklet which will have a detailed note on the content of each film and tutors' comments on ways of using it. The BBC and film libraries have co-operated in allowing free loan of films. Mike Graham, Administrative Assistant to the Project, prepares the content notes, and then sends the film to tutors who have expressed an interest in reviewing it, and they prepare the users notes (see acknowledgements page).

The emphasis is on films about teaching, rather than films about the content of science, especially those which show both pupils and teachers at work.

DIRECTIONS OF GROWTH.

Post-graduate, B.Ed., and Certificate of Education Students.

It is gratifying that after an initial predominance of interest from the University Departments of Education, the numbers of contributions from College tutors has been growing rapidly, and there are good prospects for bridging this particular communications gap. A dialogue on the needs of different student-teachers is aided by the growth of postgraduate courses in some colleges, where some tutors will be involved with both postgraduate training and certificate courses.

STEP is essentially concerned with methods of teaching science, not with main courses in science, and some correspondents from Colleges speak of problems over the allocation of time for science method work, especially for those pursuing B.Ed. courses. Responsibility in the choice of work suited to student-teachers of different ages and with different knowledge of their subject rests, of course, with individual tutors. Information about the most successful contexts of use of a particular unit will be gathered in evaluation procedures.

Areas not yet covered.

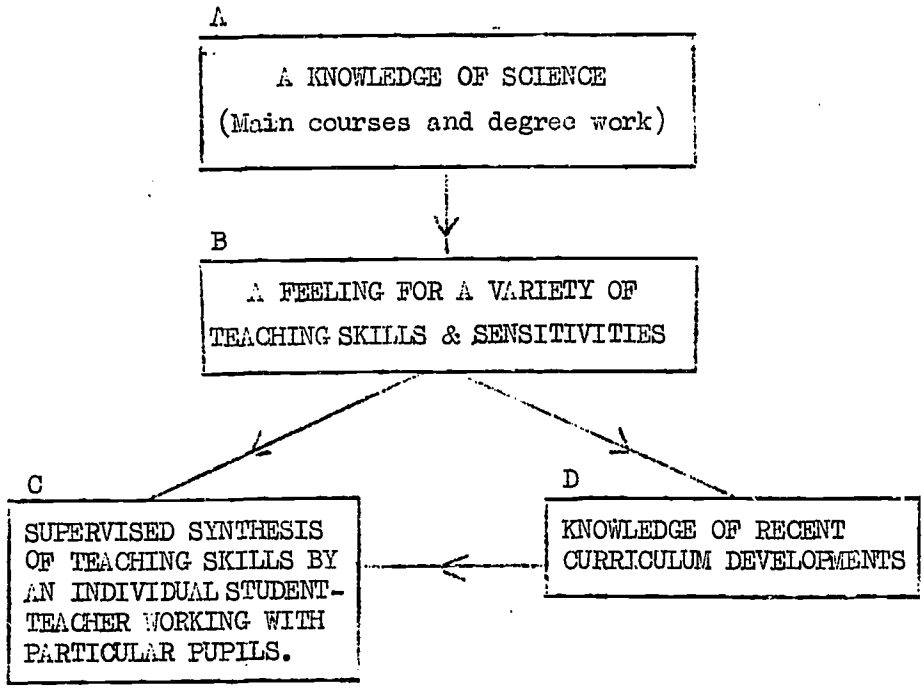
1. Discussions are taking place on the formation of a topic group on pupils of different ages and abilities, and another on Language and the Expression of Scientific Ideas.

2. Many enquiries and suggestions have also been received about the needs of intending primary teachers, and consultations on this will begin in the autumn.

3. The approach adopted in establishing the existing topic groups has been basically analytic - looking at various aspects of a science teacher's job separately, what he is aiming at, how he can use equipment, how he can organise a practical lesson, how he can prevent accidents, and so on. While it is convenient to look at all these skills separately and to have some training on each in isolation, the job of teaching ultimately involves a synthesis of all of them; the teacher has to be doing all these things at the same time, making a multitude of decisions about each one in a single lesson. Consideration is being given to ways of supplementing the analytic approach with training experiences which help student-teachers to do this in ways other than by "sinking or swimming" on teaching practice.

4. An important part of a science teacher's preparation is his knowledge of new curricula. He must know what is available to him and have some critical ability in appraising it, extracting, modifying,

and adapting ideas for his own use. The amount of work that could be done on this vastly exceeds what is feasible in initial training. Stimulating activities which communicate the flavour of particular courses and act as an incentive to reading are therefore of especial value. Several unusual ideas have been received in this connection, and the headquarters team of one project (Science 5/13) have already prepared an outline set of activities for student-teachers. The coverage of the project so far may be represented by the following set of relationships.



Emphasis in S.T.E.P. so far has been on B, with a strong interest in C and D.

RESOURCE MATERIALS NEEDED.

Some available already	Examples of further needs.
Videotape recordings of whole lessons (Films and one(!) loop)	Short tapes for discussion of particular features - e.g., the introduction of a problem, the briefing before a practical session, a question and answer interlude, pupils having difficulties with equipment, a teacher's demonstration technique, pupils' span of attention, etc.
Sound recordings of lessons	Sound recordings of a teacher introducing a problem, briefing for practical work, handling a question session, talking with pupils who are working on an experiment.
Still photographs of pupils at work	More of the same sort - e.g., aspects of laboratory design in relation to pupils using them, ways of distributing equipment, organisation of group work, pupils' faces in science lessons.
Copies of extracts from pupils' notebooks, and scripts (Xerox copies of original handwriting)	More of these to illustrate e.g., a) change in understanding and expression over 2 - 3 years. b) common misunderstandings. c) contrasting "diary-style" and "Aims - procedure - conclusions" type of records d) limitations of language at particular ages.
Still photographs of experiments <u>as seen by pupils</u>, for discussion of the teacher's role in aiding observation.	More of the same kind
Sound recordings of pupils' explanations.	Recordings, e.g., of pupils discussing how to wire a circuit, or what they see down a microscope, or what "Substance X" is, and why.
Case studies (of laboratory accidents)	More short accounts of particular classroom events, teachers' problems and successes, or pupils' achievements.

NOTES ON TOPIC GROUPS

AIMS AND OBJECTIVES.

R.C. Whitfield,	University of Cambridge (Leader)
D. Fox	Clifton College of Education
J. May	Chelsea College of Science and Technology
Mrs. J. Russell-Gebbett	University of Nottingham
Miss M.K. Sands	University of Nottingham.

This group is working on a variety of ways of helping student-teachers to think deeply about the short and long term purposes of teaching, and of teaching science. Some of the activities they are considering are school-based. These include observation of teaching in progress, to infer the range of aims that are manifest, and examining their own aims during teaching practice in a systematic manner. Starter materials for college-based discussions include a transcript of a discussion between members of a science department, copies of correspondence airing a disagreement, and accounts of classroom situations on which the student-teachers have to make choice of action, where choice can be related to aims.

The sample curriculum units already prepared include one on "Forms of Knowledge". This seeks to relate some possible aims of teaching science to aims of teaching other subjects in the curriculum of the secondary school. Another unit involves the student-teachers in a consideration of the affective repercussions of a teacher's actions, and his responsibilities in relation to the pupils' formation of values.

METHODS & TECHNIQUES/RESOURCES.

C.F. Stoneman	University of York (Leader)
C.G. Carré	Portsmouth College of Education
P.J. Hills	University of Surrey
R.L. Page	Bath University of Technology

The group is examining ways of developing the versatility of student-teachers in the selection of teaching methods and their skill in using resources available to them. There are contributions on Demonstrations, Class Practical Work, Homework, The Use of Television Broadcasts, Group Work, Worksheets, Questioning, Programmed Learning, and Project Work, as well as exercises on a variety of audio-visual aids.

In one unit, student-teachers compare two videotaped lessons on the same topic by the same teacher, one of which is markedly didactic and the other of which adopts an enquiry approach. Another introduces some features of programmed learning by means of a programme so that users are not just learning about it, but also experiencing it. A third sample unit involves groups of student-teachers in planning and

using experiments for class use, and a fourth is a study of what happens when pupils work in groups of different sizes.

The design and use of worksheets, preparation and use of film commentaries, criticism and redesign of visual aids, are other activities for which preliminary outlines have been contributed.

TEACHER-PUPIL INTERACTION

P. McPhail	University of Oxford (Leader)
R.W. Fairbrother	Chelsea College of Science and Technology
K.O. Turner	University of Cambridge
R.W. West	University of Sussex.

The overall aims for this topic area are to help student-teachers to become more sensitive to the needs of pupils, more able to see and to interpret cues which pupils give, more skilled in responding appropriately, and in initiating a productive relationship. It is hoped to provide videotape recordings to illustrate some aspects of pupil-teacher interaction, e.g., the influence of overt encouragement on pupils' response, or the recognition of small cues by an experienced teacher which the beginner may fail to observe. Videotapes offer the possibility of providing not merely illustrative material, but classroom exchanges in which the student-teacher has to seek his own understanding, with the help of the tutor, of what happened and why. This approach applies some of the ideas of present day social psychology within the context of the science teaching laboratory.

There are contributions on how a teacher can motivate pupils, on the observation of pupils' response to different teachers, on the comparison of pupil participation as a function of teaching style and on the teacher as seen through the pupils' eyes. Some tutors favour the use of Flanders' Scheme of Interaction Analysis, but it seems likely that for a short curriculum unit whis would have to be simplified. American writers have reported attempts to train student-teachers in understanding pupil behaviour by means of film which is stopped, and continued only after each student has volunteered his understanding of what is about to happen.

CONCEPT DEVELOPMENT.

F.R. Watson University of Keele (Leader)
J.R. Hall University of Newcastle-on-Tyne
A.J. Malpas Chelsea College of Science & Technology
D. Ryman University of Liverpool
W. Wilkinson University of Hull.

This group sees its function as helping student-teachers to help pupils to acquire scientific concepts and develop an analytical style of thought. Tentatively, they suggest that the teaching of the topic would lead student-teachers to an awareness of principles:

1. that pupils need to acquire concepts and this is a gradual process,
2. that pupils' understanding of concepts develops with age,
3. that it is possible to assess pupils' understanding, or their style of thought, by listening to their responses, especially the incorrect ones.

They hope that student teachers would gain a knowledge of methods of discerning interrelationships between concepts, of methods of assessing pupils' progress in forming concepts, and of methods of assisting such progress.

The activities they suggest for developing such awareness and knowledge are basically heuristic. For example, information is presented about the way in which pupils divide up materials given to them for classification, and the students are asked to seek the criteria the pupils used, and to compare the criteria used at different ages. Several curriculum units will use tape recordings of pupils talking and Xerox copies of written explanations. Another will require students to trace the inter-relationship of concepts in portions of published syllabuses, and another will lead them to examine their own strategy of thinking in solving problems in Physics, Chemistry and Biology. Some exercises will require students to apply their insights, for example in devising a test situation for a particular concept and using it during their teaching practice.

This topic is one in which it is hoped stronger links between "Method Work" and "Educational Psychology" will be forged.

THE DESIGN OF SCIENCE COURSES.

J.F. Eggleston	University of Leicester (Leader)
B.R. Chapman	University of Leeds
Miss B. Hollinshead	Manchester Polytechnic
M.J. Rowe	University of Swansea
F. Wright	Manchester Polytechnic

This group has concerned itself with three aspects of curriculum evolution: the strategic, tactical and developmental aspects.

Under the first heading they hope to provide student-teachers with insight into the factors which influence the form of science syllabuses, and their place in the whole school curriculum. This level could include a consideration of

1. The history of science syllabuses and science teaching, and how syllabus content has changed with the growth of scientific knowledge and changed societal functions of science.
2. A comparison of science as practiced by scientists and science as learnt in school.
3. The problem of 'Why teach science?' answered in terms of value judgements and related to the questions of what to teach, and to whom.
4. The concepts of "objectives" and "outcomes" of science teaching.
5. The criteria by which content is selected for a science syllabus.
6. The strategy of course planning, in relation to (i) the use of the model objectives - learning experiences - evaluation, (ii) psychological factors, e.g., planning for concept development, problems of sequencing, (iii) organisational factors, e.g., non-streaming.

At the tactical level they hope that student-teachers will develop skill in devising and implementing learning experiences, and in evaluating them - that is, in determining how far the learning experiences have contributed to the achievement of anticipated outcomes. It is hoped that the student-teachers can be helped to develop a repertoire of teaching styles. The curriculum units offered at this level will be partly college-based and partly school-based, so that a student teacher's early experience of planning and teaching - perhaps first of all of part of a lesson, working up to short sequences of lessons - takes place with maximal amount of discussion and feedback to himself.

Lastly, the group hopes to engage students in a study of the process of curriculum change - for example in British schools in the last decade, and of the constraints which limit change.

THE SOCIAL CONTEXT OF SCIENCE TEACHING.

R. Schofield	Brunel University (Leader)
Miss A.W. Carter	University of Reading
Miss L. Copp	Whitelands College of Education
I.F. Roberts	University of Keele

It is hoped that this topic will embrace a consideration of those influences exerted upon science teachers by society and the school organisation, so that student-teachers are not only aware of them, but able to consider the consequences for their own work. Some issues so far identified for consideration include:

Career choices, and present and future career opportunities.
Changes in the school system - e g., the raising of the school leaving age, the consequences of streaming or unstreaming, effects of comprehensive reorganisation.
The implications of sociolinguistics for science teaching to pupils of differing social backgrounds.
The influenoe of examinations.
Home and school relationships.
The implications of technology for schools.

Methods of introducing student-teachers to these issues in a participatory way include "in-basket" simulation exercises, and school-based follow-up studies of discussion sessions, and job analyses in local industrial concerns.

LABORATORY DESIGN AND MANAGEMENT.

W.F. Archenhold	University of Leeds
J. Barker	Chelsea College of Science and Technology
W.H. Lloyd	University of Leeds
O.M. Stepan	Department of Education and Science.

This group has been formed later than the others and the following are some of the exercises planned

- one on the distribution and collection of apparatus
- one on ordering materials and apparatus initiated by students' criticism of an order letter containing a number of errors
- one or more on the maintenance of animals and plants in the laboratory
- one on the relationship between teaching activities and laboratory design
- one on the role of laboratory steward based on a tape recording of an interview with a candidate for the job.

SAFETY.

E.W. Jenkins · University of Leeds (Leader)

K. Everett — University of Leeds Safety Officer
H. Perfect — Bulmershe College of Education.

This group is exploring the different ways in which student-teachers can be made aware of laboratory hazards, and skilled in preventing accidents, or dealing with them if they occur.

Several units planned so far are motivational, designed to shake complacency (e.g., one using photographs of injuries sustained by misuse of pipettes, and another based on a tape recording of a pupil's account of his accident), others are diagnostic of a student-teacher's awareness of hazards - e.g., a film loop in which potential dangers have to be spotted, and a set of quiz cards for individual study or group discussion.

More direct teaching will be involved in, for example, a unit on "The Kiss of Life".

ASSESSMENT AND FEEDBACK

J.H. Gray — University of Keele (Leader)

R. Hoste — National Foundation for Educational Research
I.W. Williams — University College, Swansea
W. Wills — Leeds and Carnegie College of Education.

Assessment procedures are intended to give teachers relevant and reliable information about pupils' performance. They serve, in addition, to give evidence about the effectiveness of the course materials and the teacher's own performance - in other words, they may be part of evaluation procedures, which are simply concerned with course materials and teacher efficiency.

Assessment procedures may also assist pupils to appreciate how far they have progressed. In any case, assessment procedures are an important part of a 'feedback' mechanism by which information about the effectiveness of a teaching system is fed back to the operators - the curriculum designers, the teachers and the pupils. This Topic contains experiences which help student-teachers to discover the range of assessment devices, the different purposes the devices may serve, and the techniques for administering them. They will include exercises in devising written questions and schemes of oral questioning, in criticising and re-writing sample questions, administering tests and analysing their results. While a number of the exercises are concerned with the design and marking of examinations, the policy of the group so far has been to match this with a consideration of informal modes of assessment.

ADDITIONAL ACKNOWLEDGEMENTS.

In addition to those already mentioned as members of Topic Groups, we should like to acknowledge contributions from the following individuals, who have sent materials or outlines of proposed curriculum units during the first six months of the Project. Contributions can continue up to the Summer in 1971, and the immediate need is for resource materials of all kinds (see article about this) rather than more suggested activities.

M.E. Archer
D. Bassett
A.R. Beatty
W. Biggs
M.G. Brown
R.A. Calder
P.C. Clark
A. Cornwall
R.W. Crossland
Mrs. P.S. Dean
F. Disney
D. Driscoll
D.H. Fox
M. Fossey
D.C. Gaskell
Mrs. Sheila Gosden
J.W. Hadwin
E.G. Hall
J.O. Head
R.B. Ingle
A.V. Jones
J.R. Lance
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T.K. Lockett
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M.B. Ormerod
H.T. Pascoe
Mrs. Brenda Prestt
P.A. Whittle
I.D.S. Robertson
P.A. Screen
M. Shayer
M.J. Shewell
J. Slade
J.W. Starr
D. Shadbolt
G. Tabbron
J.C. Taylor
P.J. Tansey
D.A. Tawney
K.S. Tetlow
H. Vickers

In connection with the Film Review thanks are due to D.J. Daniels, G.D.O. Evans, Mrs. J. Russell-Gebbett, K.O. Turner, G.R. Walker, F.R. Watson, and W.D. Wilkinson for their early work in this field, as well as to D. Allen, R.W. Crossland, Mrs. Sheila Gosden, J.W.Hadwin, R.B. Ingle, C. Neville, H.T. Pascoe, M.J. Tebbutt, P. Uzzell and P. Whittle for making themselves available to review and prepare users' notes.

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