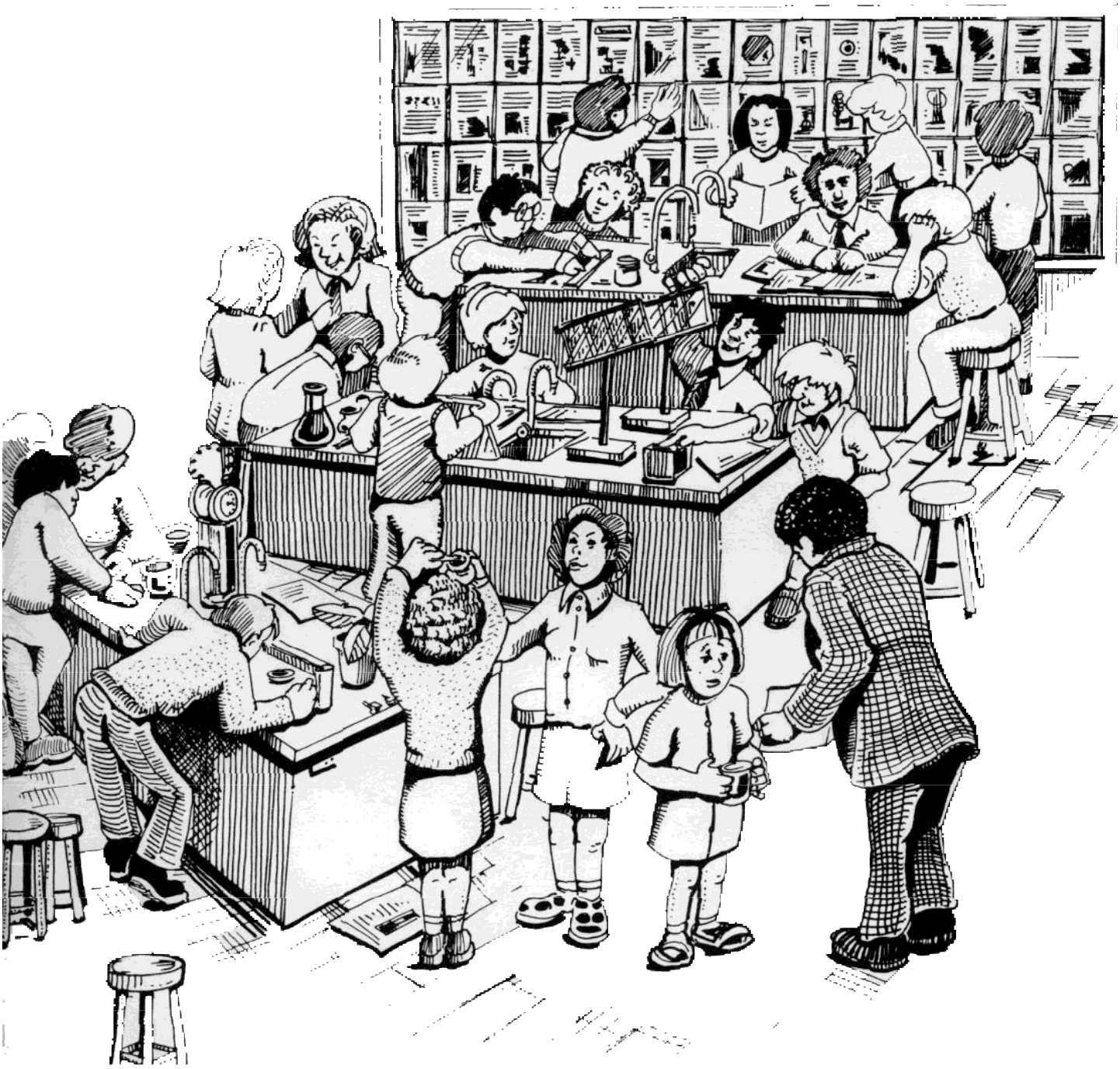
IMPROVING LEARNING FOR 11 to 14 YR. OLDS IN MIXED ABILITY SCIENCE GROUPS

Jack Whitehead Bath University School of Education



CONTENTS

INTRODUCTION

Many teachers are experiencing serious problems in their attempts to improve educational standards in mixed ability groups. This report shows how one group of teachers have tackled their problems and:

(1) created a network of in-service support (2) organised resources for enquiry learning (3) established a process o self evaluation.

In tackling their problems the teachers received one of the first local curriculum development grants from The Schools Council in, "The Swindon Area Mixed Ability Exercise in Science".

Whilst this report is addressed to teachers who are improving learning in mixed ability science groups, it is hoped that other teachers, educational researchers, and providers of in-service support will find, in sections 2 & 3, useful guidelines for action.

The report begins with statements from teachers in mixed ability science lessons, of their problems and possible solutions. These problems included the improvement of relations between teachers and pupils and the organisation of resources for enquiry learning. In response to these problems, the network of in-service support, described in section 4, was created. This network involved a Resource Collection and Evaluation Service from Bath University and financial assistance from Wiltshire L.E.A. and The Schools Council.

A central focus in the report is the process of self evaluation, by the teachers, of the relationship between what they intended to do and what they achieved in practice. The teachers were assisted, in this process of evaluation, by video tapes of their classroom practice and interview data on their own intentions and their pupils responses. This information was provided by the Science Centre of Bath University. You will see that improvements in learning occurred through the creative and critical powers of individual teachers and a high degree of cooperative activity. If you feel that it may be helpful to share your problems with the individual teachers, their names and location are given on the back cover. Do please contact them.

J. Whitehead Augu
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THE NATURE OF THE PROBLEM

Martin Hyman

Bryan Entwistle and Jack Whitehead.

Bryan Entwistle: Wootton Bassett

The subject matter is discouraging me from teaching in a way in which I believe because quite honestly a lot of what we teach, as you know, I don't particularly believe in, I don't think any of us do.

Paul Swanston: Dorcan School

I've a number of ideas I try to achieve. I try to base my relationship with my pupils on mutual trust and respect. From this I try to provide the opportunity to explore their own ideas and help them to feel confident enough to be able to face the insecurity and try their ideas out with my guidance and counselling. In the science lesson one often finds an intellectual and emotional barrier between pupils and teachers. I think this is due to science teachers feeling there is some form of method or technique special to science. The pupil must learn it and once having learnt it they must go through a pre-set exercise to demonstrate that they have learnt it.

Jack Whitehead: Bath University

You said that you liked working in groups and not when you were taught in the classes. Why was that?

Denise (12 years old)
Well, we just get bored sitting there and it's more difficult to understand.

By the time they come to us a lot of people have los their trust, confidence and eagerness to learn. We have to start trying to get it back and we succeed only partially. All the children, even the non-exam children are bound by the constraints of teachers who feel obliged to cove exam syllabuses. I think thi is where the confidence goes.

I know I initially failed here because people of different abilities cannot be learning the same thing the same level at the same speed. They must be able to go at different rates and select to some exte how far they go.

The report which follows is an account of how Wiltshire Science Teachers are beginning to overcome their problems with the support of Frank Hodgson (Senior Secondary Adviser), Tom Phillips (Wiltshire Curriculum Development Centre), Jack Whitehead (Bath University School of Education) an The Schools Council.

The account includes descriptions of how the teachers came together to work out ways of overcoming their problems, the difficulties they encountered in their relationships, the production of resources, the selection and arrangement of resources and the evaluation of their own and their pupils work. It also shows how some progress has been made and how the organisation of in-service support in the area gives reasonable cause for optimism that the improvements will continue.

TEACHERS PROBLEMS
AND
POSSIBLE SOLUTIONS

The teachers met to discuss their problems through an agreement between Tom Phillips and Jack Whitehead to offer teachers in the Swindon area a particular form of in-service support. This form of support rested upon teachers meeting to discuss apparently common problems and their commitment to work together to solve the problems. It was envisaged that the Wiltshire Curriculum Development Centre and Bath University Science Centre would contribute the material resources and evaluation service needed to create and sustain any valuable innovation which emerged.

From three meetings at the Swindon Centre, a group of six teachers from three comprehensive schools committed themselves to work together to design, produce, organise and evaluate individualised and small groups learning situations for their 11-14 year olds, the majority of whom were organised into mixed ability groups. Jack Whitehead was asked to co-ordinate the groups activities and provide assistance with evaluation. Jack agreed to collect information about classroom practices through participant observation, open interviews and video tapes, as well as giving some help initially with the production of resources.

In independent open interviews, the six teachers consistently cited problems in the following categories:

1) **Relationships between pupil and teacher**

To establish relationships of trust in which the teachers are seen to be working with the pupils and in which the pupils experience the freedom and security to ask questions.

Example of the problem: **PAUL SWANSTON**

I try to base my relationship with my pupils on mutual trust and respect. From this, I try to provide the opportunity to explore their own idea.

2) **Learning resources**

To select resources which are of personal interest to pupils in mixed ability groups and are also of social value.

To organise resources which allow the pupil to pursue their enquiries with a degree of independence from the teacher.

Examples of the problem:

a) **ROGER BARROW**

The first step in creating the learning situation 1 believe in, is to move to a more individual approach because then you can respond to the kids' questions, you can say 'go on and try it'.

b) PAUL SWANSTON

I think that I need some trolleys and trays and cabinets in the classrooms. If I was following a certain theme on the combined sciences, then I would like to have in my classroom all the core apparatus necessary for maybe a months work, so that the basic stuff is inside the room. There would be cards, workbooks etc. which would relieve the teacher of class teaching and I'm certain, well I know that I and many other teachers could train the children to work through a basic core of work, get their own apparatus, start off their own experiments and work along their own lines of enquiry, when and where that came in and at the end of the lesson, when the bell went, they could put it all back in some form of order.

3) **The nature of Science**

To create a situation in which the pupils scientific questions are not stifled by the prolonged imparting of scientific knowledge, as if it exists independently of the process through which it was created.

Example of the problem: BRYAN ENTWISTLE

I think we need our framework of scientific thought in order to be able to give them a method by which they can solve problems. We are, however, imposing our so called scientific method on them, we are stifling the creative instinct these kids may well have.

For a more detailed analysis of the teachers notion of the Nature of Science, see the Round 11 proposal to the Schools Council Appendix.

4) **The process of Evaluation**

To judge the learners progress in a way which gives the learner, information and criteria with which to judge his own work in relation to his past achievements, the subject he is studying and local regional and national norms.

Example of the problem: MAGGIE HANNON

Surely there must be a way to obtain an objective record of a pupils progress and the effect that a course of study is having upon him. It should be possible to build up a profile of each pupil 'in situ'. It should be so designed that a glance will reveal a valuable and as far as possible objective profile of the pupil.

THE OPERATION AND FUNDING OF THE PROJECT

THE GROUP

AT A MEETING IN MARCH 1974, THE TEACHERS AGREED THAT THE MOST URGENT PROBLEM WAS THE DESIGN AND PRODUCTION OF WORKSHEETS WHICH WOULD ALLOW THE PUPILS TO WORK AT DIFFERENT RATES WITH SOME DEGREE OF FREEDOM, CHOICE AND INDEPENDENCE

AN ACCEPTED ASSUMPTION, TO BE QUESTIONED LATER, WAS THAT THE STRUCTURE OF KNOWLEDGE IN THE WORK-SHEETS SHOULD FOLLOW THE PATTERN IN THE NUFFIELD COMBINED SCIENCE COURSE FOR THE FIRST TWO YEARS AND THE SCHOOLS COUNCIL INTEGRATED SCIENCE PROJECT FOR YEAR 3.

WORKBOOKS ON A RANGE OF TOPICS WERE PRODUCED BY INDIVIDUAL TEACHERS

JACK CONTACTED DR. TERRY BURDETT, SCIENCE ADVISOR TO THE COUNCIL WHO ADVISED ON THE PROCEDURES TO USE.

IT WAS NECESSARY TO FORMULATE A ROUND I PROPOSAL (SEE APPENDIX A) WHICH WAS DISCUSSED IN JUNE 1974 AND A ROUND II PROPOSAL (APPENDIX) SUBMITTED IN SEPTEMBER 1974 AND ACCEPTED IN JAN. 1975. THIS PROPOSAL WAS FORMULATED LIKE THIS - AN INITIAL DRAFT WAS DRAWN UP BY JACK WHO SENT COPIES TO THE TEACHERS FOR CRITICISM AND AMENDMENT

BY THE END OF APRIL 1974 IT WAS OBVIOUS TO THE GROUP THAT THE INCREASING NEED FOR PAPER, DUPLICATING EQUIPMENT, SECRETARIAL, TEACHER, AND LECTURERS TIME COULD NOT BE MET WITHIN INFORMAL METHODS. AS THE SCHOOLS COUNCIL HAD OFFERED TO SUPPORT LOCAL CURRICULUM PROJECTS .....

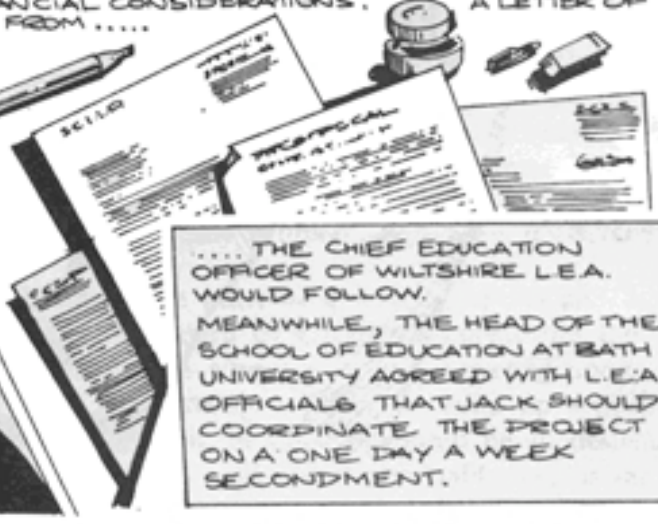
THE VIDEO TAPES WERE VIEWED EITHER IMMEDIATELY AFTER THE LESSON OR DURING A FULL MEETING OF THE WORKSHOP IN THE PARTICIPATING SCHOOLS

THE FIRST DRAFTS WERE MODIFIED AND CRITICISED AT FORTNIGHTLY INTERVALS

JACK HAD THE MODIFIED MATERIALS TYPED AND REPRODUCED.

HE VISITED SCHOOLS ONCE A FORTNIGHT TO OBSERVE THE CLASSROOMS, VIDEO TAPING AND INTERVIEWING TEACHERS AND A RANDOM SELECTION OF PUPILS

FRANK HODGSON, TOM PHILIPS AND JACK DREW UP THE FINAL PROPOSAL, WHICH WAS SUBMITTED BY JACK WITH FINANCIAL CONSIDERATIONS. A LETTER OF SUPPORT FROM .....



..... THE CHIEF EDUCATION OFFICER OF WILTSHIRE L.E.A. WOULD FOLLOW.

MEANWHILE, THE HEAD OF THE SCHOOL OF EDUCATION AT BATH UNIVERSITY AGREED WITH L.E.A. OFFICIALS THAT JACK SHOULD COORDINATE THE PROJECT ON A ONE DAY A WEEK SECONDMENT.

The Round If proposal, Appendix 2, describes the two phases in which the project was conceived. In phase I the teachers having mixed ability groups changed their classroom organisation for individual and small group teaching. This included the production of a variety of worksheets and workbooks with most of the problems "given" to the pupils. The workbook on Forces is an example of this form of resource.

In phase II the teachers hoped to avoid the problem of stifling the pupils questioning by producing and organising resources which would be responsive to the learners enquiries.

During this period of negotiation the group encountered the following problems, some of which reduced its effectiveness.

Trusting Relationships were disturbed

Roger: I don't think the relationship between the teachers is in any way difficult, I don't feel that. But I do feel that with the group we had, we would have said what we thought. And we would have known who was totally incapable of being convinced on a point and we wouldn't have wasted time trying. We knew who was capable of being persuaded to see a point and we spent time arguing. But we pulled no punches, and we didn't mess around, and we did have a pretty open honest sort of relationship. I think what happened was that once people from outside the teaching profession directly come in exception being yourself, because you were attempting to work with us and were very good as a sparking plug, if you see what I mean, to the mixture. But the mixture was right and this it has to be to ignite. What's happened now is that we're being watched. It's a bit like having a meeting with the head, you don't come clean, and are worried about whether if you speak your mind, it'll count two black marks or carry through for another three years - some of us feel like that and so we lose the honesty and the integrity that we had going before. Any time we have certain of the people there in on those meetings, we didn't shred any material, we had a philosophical discussion on educational principles and methods. We'd already had that discussion a long time ago, we'd already agreed that we didn't all see eye **to eye, but that there were** no one right or no one wrong answer, and there can't be.

Jack: Why *does this integrity go?*

Roger: Because you're afraid, you're looking over you shoulder all the time, you're wandering if I say that, will he think I'm a fool?

Jack: So *the trust has been disturbed and one o the reasons that you give is that we are being watched.*

Roger: *Being watched in preparation for being set upon a pedestal and I think that worried all o them, because we know full well that what we're doing is nothing revolutionary, we're doing our best in a particular situation, that's all. I understand why we are being watched.*

Jack: *Why?*

Roger: *Well, they're being watched in turn .....*

Jack: Do you *mean being judged?*

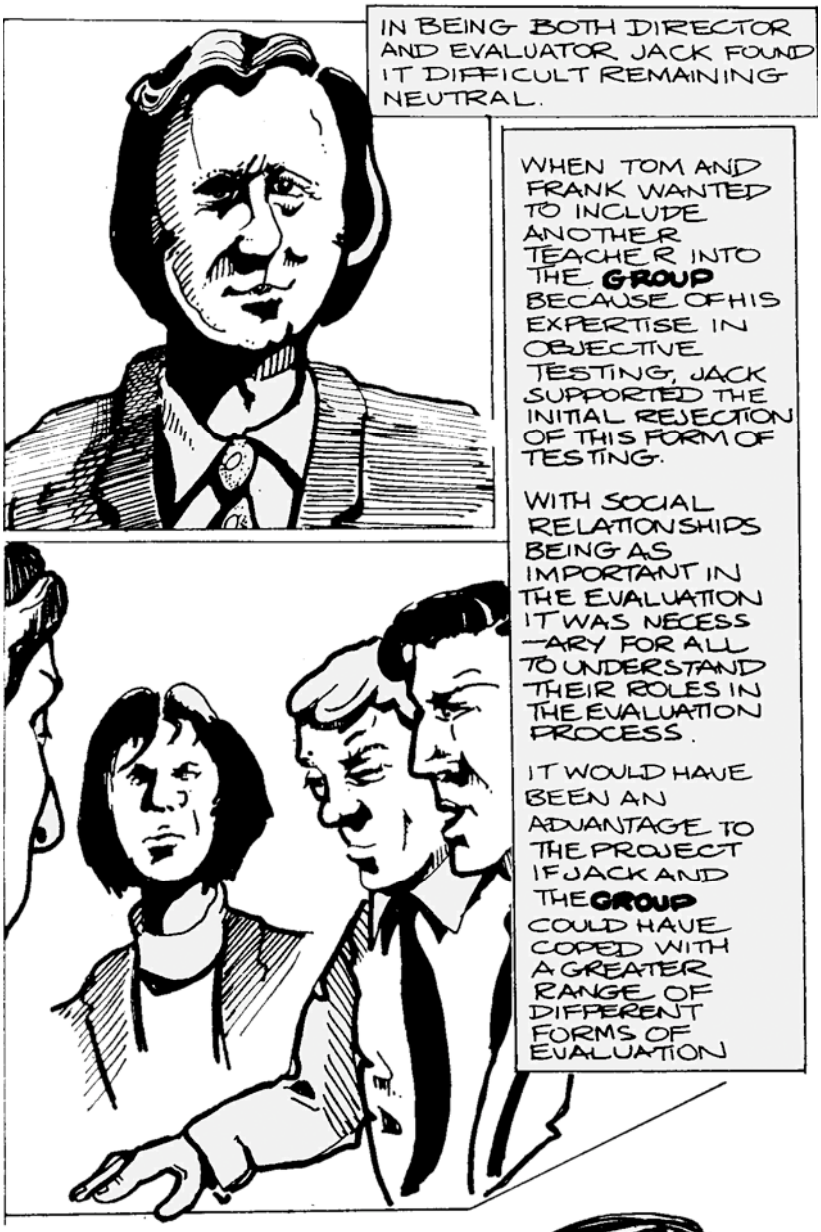
Roger: *Yes we have been told that people all over the country are judging Wiltshire this project, Tom and Frank, and to a certain extent yourself As a result we must be careful that the whole thing doesn't get out of hand.*

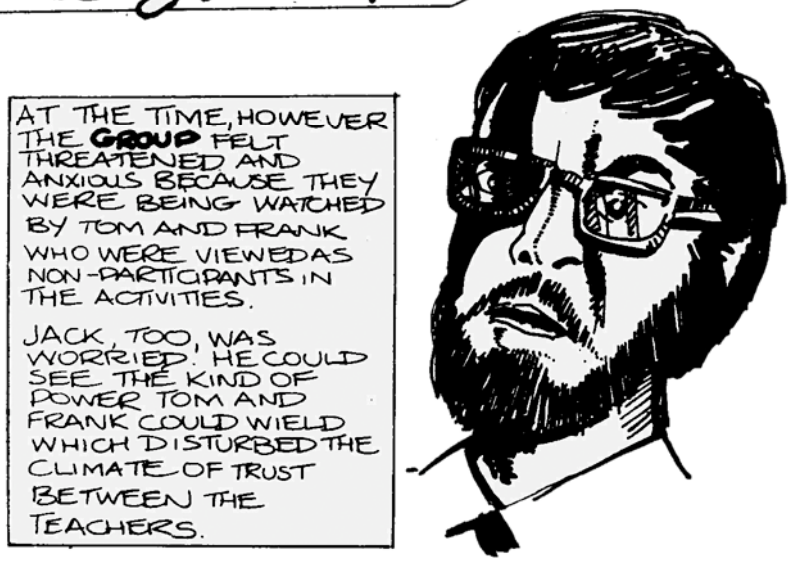
Obtaining Resources

The support from the Schools Councils was taking so long to formalise that only the efforts o Tom and Frank in supplying necessary paper resources allowed the groups to function. After the initial support with secretarial assistance fror the Science Centre at Bath the teachers were able to have their materials typed and duplicated within their schools. Tony Cole of Walcot School was especially fortunate in this respect as his technician had typing expertise which she was willing to use for the science department.

Jack had collected a bank of resources at the Science Centre in Bath from members of ILIS which were used extensively by the Groups. Eric Green, the co-ordinator of ILIS came down to Salisbury to give his support to the group. Patric Homan Berry agreed to co-ordinate the Salisbur Group and Jack, in his capacity as Chairman of ILIS arranged Patrick's secondment for one day week whilst supplying material resources in the form of workbooks, paper and plastic wallets from the mixed ability project. Don Foster, Science Editor of Avon Resources for Learning Unit, and at present Newsletter Editor for ILIS provided small workbooks on air and electricity for use in mixed ability groups.

The Newsletter of ILIS has given Vivienne Bellamy, Tony Grant, Maggie Hannon and Roger Barrow the opportunity to convey their views to others.





TEACHERS LEAVING THE GROUP

As part of the Project two teachers were to be seconded for one day each week. Two teachers wh had produced resources and made an important contribution to the evaluation sessions were selecte by the group. Local Authority permission and Head Teacher approval were sought for Paul Swanston's and Roger Barrow's secondment. These were gran Unfortunately for the Group, both teachers were promoted before September 1975 and could no lon be connected with the Project. Roger became a He of a Science Department outside Wiltshire and Paul,Head of Lower School in Dorcan. Tony Cole moved from Walcot to Wootton Bassett School in September 1975, continuing his activities but remov Walcot participation in the Project.

FACTORS INCREASING THE GROUP'S EFFECTIVENESS

A crucial time for the group was between September and December 1974. The resources produced in the previous term were tried out in Dor Wootton Bassett and Walcot Schools. The improvements noted by the teachers in terms of the pupils' behaviour, organisation of resources and qu of learners' work convinced the teachers that it was worthwhile continuing.

In January 1975 the Schools Council formalised its support and other teachers in different schools beg to attend meetings and share their resources. A second group formed in Salisbury in April 1975 in th same way that the Swindon Group formed in Janua 1974. The initiative in forming both groups came fro members of Independent Learning in Science and a one of the aims of the project was to develop a netv of support for teachers who are trying to improve th science curriculum it may be useful to show how thi network is developing between ILIS, the Avon Resources for Learning Unit, RFLDU and the Scho Council.

The aims and organisation of ILIS and the Avon Resources for Learning Development Unit (RFLDU are given in the Appendices 5 & 6 A central concer which is shared by the Mixed Ability Project, ILIS ar RFLDU is the production and organisation of learni resources. Examples of the Resources produced by teachers in the mixed ability project will now be considered.

RESOURCES PRODUCED IN THE MIXED ABILITY PROJECT

By September 1975 a number of workbooks had been designed, reproduced and used in mixed ability groups in the following years and topics

First and Second Year

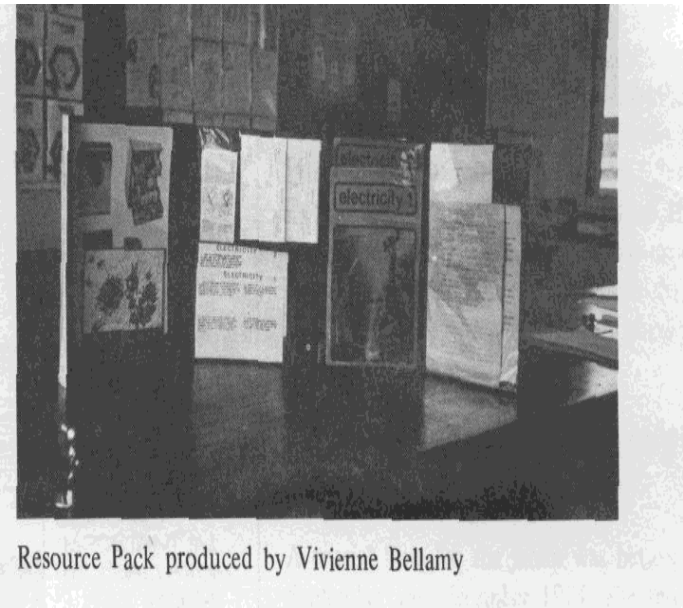
Topics

Classifying things Separating Mixtures Forces Heating Substances Electricity Examination of Hens' Eggs Flower Structure Earthworms Mammals

Third Year

Topics

Electronics and Ions Communities and Populations Motion Optics Classifying Building Blocks Atoms, Molecules Osmosis



Resource Pack produced by Vivienne Bellamy

of four teachers, Paul Hunt, Tony Cole, Maggie Hannon and Vivienne Bellamy to produce and organise enquiry learning situations will be considered.

The workbooks on Forces reproduced below is characteristic of the resources produced up to September 1975. In these workbooks, written instructions aided by diagrams require the pupil to do experiments following prescribed procedures. In the workbook on Forces of 19 activities and experiments, 17 have answers prespecified by the teacher. Of 50 questions, 41 are closed in the sense that the answer is prespecified by the question. No experiments are encouraged to emerge from questions posed by pupils. An interim evaluation report produced for the teachers in September '75 shows that the teachers are aware of the limitations of this form of learning resource. For example:

Maggie Hannon

"We are still saying that there is a logical sequence to the work and that we know what this sequence is. We might be kidding ourselves that we are getting away from presenting the kids with set formulae. We might simply be doing what was done to us, only a different way round."

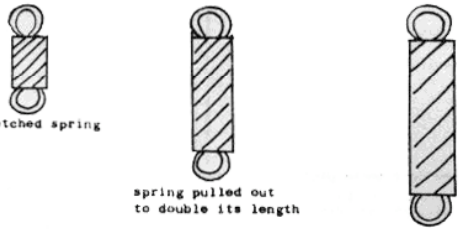
Following the workbook on Forces, the attempts

FORCES

We are going to start our work on forces by looking at "elastic" things.

In all your experiments, be careful not to break the apparatus by pushing or pulling too hard.

Pull a small spring as shown, to stretch it.



unstretched spring

spring pulled out to double its length

spring pulled out to three times its length

In which case do you have to pull hardest? .....

Now try the same thing with a rubber band. What result do you get?...

.....

Try squashing a big spring. Squash it flat, now squash it half way.

Which required the greatest push? .....

Did the springs and rubber bands go back into shape when you let go? ..

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Try squashing, twisting and gently pulling the sponge rubber. Describe what happens and what you feel. .....

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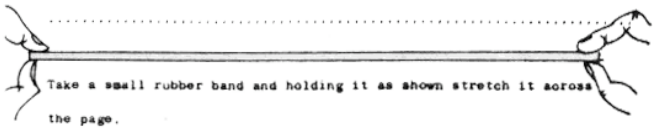

Take a small rubber band and holding it as shown stretch it across the page.

Now hold two bands in the same way and stretch them to the same length.

Then repeat the experiment with three rubber bands.

Stretch the thin rubber (valve) tubing. Describe what happens to it and what you see and feel. .....

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Twist the thick red rubber tubing, what happens to the square marked on it?

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Now bend it, what happens? .....

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Try the same experiments with an eraser (rubber), or the foam rubber.

What happens? .....

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.....

Make your own spring with copper wire. Explain why you think it is a good spring or a poor spring. .....

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All the materials we have used so far are called elastic, can you say why?

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Can you think of ways in which any of these experiments could be used to measure or store forces? .....

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.....

In what ways do you think any of the experiments could be made better?

.....

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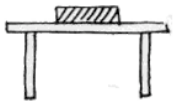
Cut some pictures from old magazines showing forces. Group pictures showing the same kind of force together, then stick them on to the paper provided to make a chart showing different forces at work.

Here is a brick standing on a table.



What would happen to the brick if the table top were made of very thin wood or paper? .....

.....

Why must the table top be made of thick wood? .....

.....

With a normal table, what force does the brick have on the table? .....

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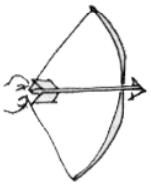
What force does the table have on the brick? .....

.....

Draw a picture of anything that makes use of the force in the wind.



Here is a bow and arrow with the bowstring pulled back. What will happen if the bowstring is released? .....

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Where did the force in the bowstring come from? ..

.....

If you happened to be in the way of the arrow would it hurt?

.....

Where does the force in the arrow come from? .....

.....

Why must the archer (bowman) hold the bow firmly whilst pulling back the bowstring? .....

1. Long ago a party of soldiers attacked a castle gate with a battering ram. They carried a huge log of wood under their arms and ran with it up to the gate so that the log crashed against the gate and broke it. Just before the log hit the gate the men stopped clutching the log and left it loose to slide in their grasp. Why? .....

.....

What would happen to a man who held on to it? .....

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Figure One

2.

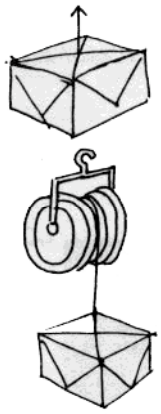
Figure Two

What happens here if you are not careful? .....

.....

What forces are at work in this drawing? .....

3. Which of these needs the most force?



Lifting a load straight up.

Or lifting a load with a pulley.

Set up the apparatus and see for yourself.

Which is easier? .....

Why? .....

Now that you have done the experiment can you answer the question as to which needs the biggest force? .....

.....

What problems did you have in finding an answer? .....

.....

4. What do we need in order to find the size of forces? .....

.....

Can you think of any forces you might want to measure or any places where it would be necessary to measure forces? .....

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Design your own force measuring machine. Draw a diagram of it below.

Ask your teacher if you can make it and try it out.

List below some of the different kinds of forces you found.

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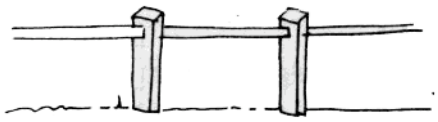
What forces are there in this fence?



A car travelling at 50 m.p.h. goes off the road into a wall. What happens to the car? .....

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What happens to the wall? .....

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The next day a large lorry runs into the same wall. Which of the two, the car or the lorry makes the largest hole in the wall? .....

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Can you give a reason for your answer? .....

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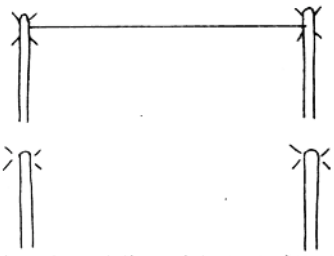
Look at the following pictures:

a) Here is a washing line on a still day.



Mark on this picture what happens to the l when some washing is hung on the line.

After the next three pictures say how many forces you think are working in the picture, and say what they are.

b) A stretched spring.

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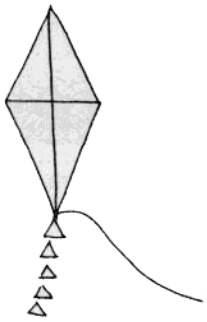
c) A kite flying.



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d) Someone unscrewing a jam jar lid.

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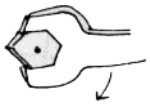
e) A spanner turning a nut.



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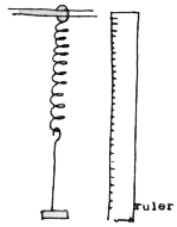
Now draw a picture of your own and mark in the forces.

The text shows the content and illustrations used in the worksheets. The worksheets were A4 in size.

Loading a Spring

Set up the apparatus as shown in the diagram.



Measure the length of the spring with no load on.

Add the load discs one at a time and measure the new length each time.

Record your results in the table below

Load	length of spring in cms.
0	cms.
1	
2	

Ask your teacher for some graph paper and plot a graph of load against spring length. Your teacher will help you if you have any difficulties.

Put your graph in your file facing this page.

What shape is the graph? .....

What happens to the length of the spring as more loads are added?

.....

What explanation can you think of for what happened? .....

.....

One day Isaac Newton was sat under an apple tree, in his orchard. Suddenly an apple hit his on the head. "A bit of luck that, I was feeling hungry", he thought, munching away. It would have been even better if it had landed on the grass or at least fallen gently. I wonder why things fall so hard, come to think of it, why do they always fall down to earth anyway?"

Isaac Newton was already a famous scientist and this chance accident made him realise that the earth pulled everything towards it and he called this force "gravity".

It was this force of gravity pulling on your loads which made your spring stretch.

Would the apple have fallen as hard, if Isaac Newton had been living on the moon? .....

Can you name any places where there is no "gravity" at all? .....

.....

If such a place exists, what would happen if you let go of your cup of tea? .....

Hard questions. Can you think of any places where the pull of gravity is more than on Earth, if so name them. .....

.....

What would happen if you fell over in such a place? .....

.....

Measuring Forces

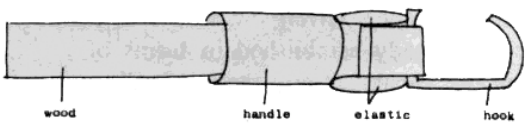
In the last experiment we used a ruler and a spring to measure the pull of the Earth on pieces of metal (loads). Scientists and Engineers often need to measure forces, so they know the strength of materials they need to use.

Force is measured in Newtons using a Newtonmeter.

Look at a Newtonmeter. They have a spring inside them, some are stronger than others so they can measure different sized forces. Be careful how you use the Newtonmeter. If you want to measure a force bigger than can be shown on your Newtonmeter, get another one, which will measure larger forces or you will break the spring by pulling too far.

Use Newtonmeters to measure the forces you need to do simple tests around the laboratory. Record your results in the chart below.

Test carried out	Force (in Newtons)
Force to stretch a spring	9N



This is a home-made push pull meter. Can you make one, like this, or one of your own design? If you make your own draw a diagram of it.

You could not use this push pull meter to measure a force.

Why not? .....

What is missing? .....

Can you find a way, with the help of a Newtonmeter, to help you use this push pull meter to measure forces.

Describe what you did, and say what forces you measured, and how big they were on the lines below.

.....

.....

.....

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From September to December 1975, six teachers in four schools discussed the problems of moving from phase I of the project into phase II, that is into enquiry learning. Two teachers decided to stay in phase I, as they felt that there was still a lot of work needed to increase the range of structured resource material with closed questions. The following four teachers in three schools agreed to try to move into phase II in January 1976.

TONY COLE (AND MAGGIE HANNON)
WOOUON BASSETT

"After Christmas (1976), we are hoping to put together five,topics in such a way that children can find their way through a particular topic and also answer questions, posed by themselves in these topics which may not actually be part of the subject material. Until they ask you a question you don't really know what you have communicated to the pupils. You may think you've had a good lesson because everythings gone to plan but you don't really know until they ask a question."

Maggie and Tony have organised a class of 24 pupils for enquiry learning from January '76. In March '76, they stated that there has been an improvement in the quality of the pupils relationships, activities and products.

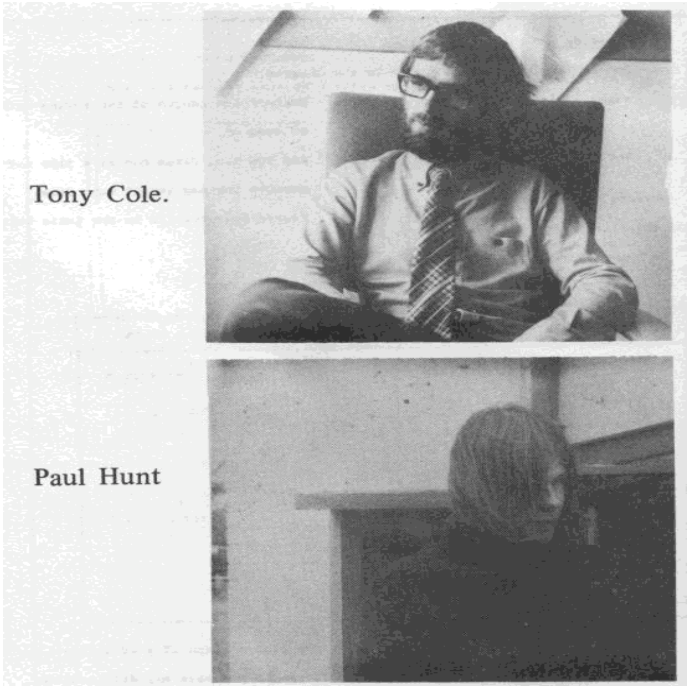
PAUL HUNT: DORCAN SCHOOL

"I am still bound by my image of myself as a science teacher. Given the scientific framework which is already established in terms of chemicals, apparatus and ways of going about things inside a room. I find it difficult to make the transition into opening up the situation in which the children feel secure to explore their own ideas."

Paul has allowed small groups of 3 or 4 pupils at a time to explore their ideas whilst the main body of the class were doing prescribed work. Paul has taped, transcribed and evaluated his dialogue with the four girls as they were exploring their own ideas. Part of this transcript has been included in the process of evaluation which follows, and shows enquiry learning in action in the classroom.

VIVIENNE BELLAMY: DUNWORTH SCHOOL

"If the children ask questions when, for example, they are heating things, I want them to be able to pursue their questions. At the moment, they wouldn't because of the way 1 structure their learning."



Vivienne produced ten folders of material for January '76, two on each of five topics from the Combined Science Course on: Forces and Movement, Patterns of Growth, Heating Things, Air and Electricity. The resources were arranged in plastic folders which opened into six sections with instruction cards, information sheets and experimental cards in different sections.

Monitoring effect of Resources
Video tapes made between January - April 1976 show pupils entering the classroom and organising their own work from the teachers selection and arrangement in the folders. The improvements noted by the teachers include:

*Fewer discipline problems
*More care in the presentation of work
*A greater quantity of work done
*A greater degree of co-operative activity
*More opportunities for pupils to try out their ideas and develop their own lines of enquiry
*More questioning from the pupils

In the above process of curriculum innovation, the teachers were continuously evaluating their own relations and the resources they produced with the aid of information collected through interviews and video tapes. The importance of the process of evaluation to the project will now be considered.

THE PROCESS OF EVALUATION

"This will be a co-operative activity between learners, teachers, lecturers, scientists and industrialists. The teachers will express their intentions verbally, in writing and with practical examples. The learners will be interviewed and video-taped whilst working to detect the state of their scientific activity. The view will be taken that language is inadequate to express a person engaged in scientific activity, it is the kind of phenomena which can only be shown. The evaluation sessions will be dialogues between the above people as they attempt to make available to each other their interpretations of the teachers' intentions and the learners' activities, and the assumptions on which they are based. Records will include written statements, transcripts of interviews and evaluation sessions and video tapes of the learners' activities."

Jack Whitehead and Maggie Hannon

The teachers, in open interviews with Mr. Jack Whitehead, expressed;

- their fundamental goals as educators, their intentions for their own classroom situations, the way in which these intentions could be realised with support from the project, how the pupils responded to: traditional learning situations, i.e. situations seen as problematic by the teacher, new forms of learning situation initiated within the project,
- their own reaction to the project.

The learners were also interviewed and expressed:

- their understanding of particular scientific activities,
- their reaction to different classroom situations initiated during the project.
- their own preferences for particular learning situations. In addition to written statements, transcripts of interviews and videotapes of pupils scientific activities, the teachers have manifested their intentions of the resources produced for their learners and in their particular classroom organization.

The basic value of the evaluation process was to gather information about the intentions, activities an interpretations of pupils, teachers, lecturers and advisers, to make this information freely available a to aid development of the means by which the intentions of the teachers might be realised and by which expressed problems might be overcome.

THE POSSIBILITY OF IMPROVEMENT THROUGH EVALUATION

The following two examples illustrate how the process of evaluation provides a basis for improvement:

ROGER BARROW: WOOTTON BASSETT
Statement of intentions:

Roger: *Well, I was concerned with the fact that most of my teaching was being pitched in the middle of the ability range and I wasn't really catering for individuals. I also had the problem o designing courses for teachers who are not specialists in particular fields. In the first instance feel we must produce good work schemes which increase the teachers and pupils confidence. Wh we have built up our understanding of this situati we can then move on to the second phase of responding to the learners questions.*

Jack: You *see the vital thing as getting the kids to ask questions?*

Roger: *I'm not sure everybody agrees. I feel that much of what has happened in Science Teachin has been a dull simulation, jumping through hoo at the appropriate moment at the command of th teacher or the examiner. I've come to realize ove period of time that we were chaining any creativeness and inventiveness in science. I kno someone has to work through all the permutation and combinations but I think we have got to ope out the possibilities for originality. I think so much of what we do in science, is forced on us by exa syllabuses and kills all expression of opinion or development of ideas.*

Jack: I *can see what you are getting at but I'm curious how you came to these ideas and how y are going to create the situation to make it possi for your pupils.*

Roger: I *came from a very rigid grammar school where I was very dissatisfied with what was happening. I went into the comprehensive system in the hope that I would find greater freedom and a greater concentration on the needs of the individual. The first step in creating the learning situation I believe in was to move over to this more individual approach because then you can respond to the kids and if they ask a question you can say, 'go on and try it'*

Jack: *Have I understood, when you are face to face with your pupils you are struggling in your relationship with them to help them be creative in the sense that they can ask questions and you must try and show them resources which can help in their enquiries.*

Roger: *Yes, that's right. The individual teacher is a vital part of the process. Recently we had four teachers on the same scheme. I suppose because I had a large hand in writing the scheme I somehow got a better relationship with my class. I don't know what it is but it's a different relationship to some of the others who were struggling with the materials.*

Contradictions between Intentions and Practice

Data of the following type was evaluated by Roger and a modification in the pupils responses occurred.

One of Rogers pupils was interviewed by Jack Whitehead:

Jack: *What kind of things did you do yourself?*

Paul: *Well, we got all the apparatus and put it up ourselves and poured in the mixtures ourselves and we did, Mr. Barrow, just helped us a little bit, if we were stuck.*

Jack: *Really, yes. Did you ask any questions about the way you were doing this?*

Paul: No.

Jack: You *didn't. You just did it?*

Paul: *Yes.*

Jack: *But where did you get your ideas from then, if it didn't come from you?*

Paul: *Well, Mr. Barrow had a little talk with us in* ***the*** *beginning and* ***then he got all our stuff out for*** *us and we put it up and we went to go and get it and then we did our experiments.*

Jack: I *see. As you were doing the experiments did you have any ideas of your own that you wanted to test?*

Paul: No.

Jack: I *see. And if you've got questions of your own, like when I put that in front of you, you said, you know, I've tried to separate it, is that because when you're given substances like this, you were told how to separate it or not?*

Paul: *Mr. Barrow helped us a little bit.*

Jack: *Yes.*

Paul: *And he told us if we were doing things wrong If we did we started it again.*

Jack: *Yes. The thing I want to try to find out is do you have any ideas of your own that you'd really like to think about and test out?*

Paul: No *not really.*

Jack: You *don't?*

Paul: No.

Jack: *What do you think scientists do? Do you think al their problems are always given to them or do you thin that some scientists really try to think out ideas of their own.*

Paul: *Yes.*

Jack: *Which one do you think?*

Paul: *That they try to think it out themselves. Trying to make things that can help people, medicines or something*

Roger interviewed one of his own pupils.

Roger and Tracey:

Roger: You *remember that, and you had to try to save water yourself didn't you? Yes?*

Tracey: *Yes.*

Roger: *Well, what did you do to stop it evaporating away?*

Tracey: *We put a dish on the top of a beaker with water in it, and put ice in it.*

Roger: *Oh, yes. Why did you get that idea?*

Tracey: *I'm not quite sure.*

Roger: *You're not quite sure. Did you see other people doing that?*

Tracey: *No.*

Roger: *Or did you work it out for yourself?*

Tracey: *No.*

Roger: How *did you get it then? You just don't remember.*

Tracey: You *told me.*

Roger: I *told you! Deary me. That's the second person who's said I told them, been splitting obviously. What was the ice doing then?*

The process of evaluation has highlighted to Roger Barrow the gap between his goals and his actual classroom practice. Roger began to encourage his pupils to express and pursue their own enquiries, with the following result.

Roger: Now *what I want to do is just ask you one or two questions about what we've been doing in science this term. First of all did you, what were you expecting when you discovered that you'd got science on your timetables? Did you have any idea what you would do?*

Boy: *No, not much. Well, some that we did in our other school was very different.*

Roger: I *see, what was different about it?*

Boy: *Well, it was more set, you know, they did more for you instead of now you have to do more for yourself*

Roger: You *feel you've had to do more for yourself?*

Boy: *Yes.*

Roger: *Have you enjoyed doing more for yourself'?*

Boy: *Yes. It's the independence of it ....*

Roger: *The independence of it you enjoy?*

Boy: *Yes. Discovering the actual thing with nobody telling you what's going to happen.*

Roger: You *really enjoyed that did you?*
Boy: *Yes, that's what I liked about it.*

Roger: You *really liked that? Oh, splendid.*

Finally Roger Barrow attempts, in dialogue to make sense of his experiences.

Jack: How *far do you think that the basic ideas that we are working with are unfeasible?*

Roger: *Well, I think the questions pupils ask fall into three categories, there are those who are asking a shallow, trivial question for the sake of asking a question, or because 'Sir' said they were to think about some questions on the topic; there are those who ask a question quite seriously but are totally lacking in the ability to follow through their question with any sort of mature thought about it because the questions they've asked require some kind of thought and therefore they need guidance. This is where they need a resource, something you can put into their hand, at least to start them. This is the biggest problem with any project, getting them going. Once you've started the lesson off***,*** *or particularly the project overall off***,** *then one can spend time in individual groups, one can then help them. Now the third group asks serious questions and are capable of following them through. Like Ian and Gary with that plastic stuff They asked the questions, they attempted to find the answers. They were capable of a very mature level of thinking and 'the way they faced up to the problems they met en route was exceedingly encouraging.*

The above example shows how the evaluation process has helped a teacher to appreciate the varying reactions of children to learning situations, and therefore to a modification of their behaviour in a direction which is most likely to lead to the practical realization of their intentions.

The following example shows how the evaluation process allows an in depth understanding of the learners problems. It also opens up possibilities for individual and small group tuition.

Paul H: *What have you been doing in the last few weeks?*

Gary: *Cubic centimetres and that.*

Paul H: Do you *understand them?*

Gary: *Not really.*

Paul H: *What do you find difficult about them?*

Gary: *When you have to write the number and*

then put the little two at the top. -

(Notation 2 sq. cm. can be written $2cm^2$).

Paul H: *Yeah, you're confused about that are* you?

Gary: I don't know what I do.

Paul H: *Can you work out the numbers? Do you know what the numbers mean?*

Gary: (Indistinguishable) - I *think I do anyway.*

I presented him with the first problem and he replied correctly "4 sq. cm." immediately. I asked him to write it down. Without hesitation he wrote "4 sq. cm.".

This is what happened then.

Paul H: *Lovely - that's right - now, do you know another way of writing it?*

Gary: (looking uncomfortable) No.

Paul H: Go *on have ago - see if you get it right. If you get it wrong I'll show you how to do it afterwards.*

Gary: (writing) 4 cm. He then hesitated -knowing it wasn't complete.

Paul H: *Yes, good that's right. Come on, one more thing to do.*

Gary: (completing it) 4 cm^2

Paul H: *Good - very good.*

It is becoming clear that individual and small group work as exemplified in the above evaluation process can lead to a dialogue which encourages the formulation of problems, questions and ideas which can be exploited by the provision of suitable resources. The resources can be designed with a thoughtful understanding of the real problems with which learners are faced and with a realistic appreciation of stimulus material responsive to their ideas and imaginations. The possibility of change has been shown to originate in the process of evaluation. The following extracts clearly demonstrated how learning has actually taken place in a small group situation within a classroom situation, where all children were working on a circus of experiments highly structured by worksheets.

The majority of the class could continue their activities with a minimum of supervision from the teacher. This allowed the teacher the opportunity of fulfilling the role of 'consultant, advisor or tutor'.

It allowed the process of self evaluation to occur in dialogue between teacher and small groups of learners.

Four second year girls were measuring the acidity or alkalinity of lead monoxide (a fine orange powder) by adding drops of indicator (a green liquid) into a mixture of the powder and water. One pair obtained an orangy-red liquid indicating an acid and the other pair obtained a blue liquid indicating an alkali. They went to the teacher, formulated the problem, "We got different colours", and received permission to continue work to solve their problem.

By the end of a double lesson they succeeded, after three failures involving highly creative work, to obtain the same blue colour indicating that lead monoxide is alkaline.

Teacher: *What was important about what you were doing? Tracer?*

Tracey: It's just that, well, when we got different answers, we couldn't see why, we got different answers and so we wanted to get them so that they were the same.

Judith: *We were excited... It would have been better if we'd had longer.*

Teacher: I *mean, why was what you did so valuable? What was its value to you?*

Judith: I *suppose it was our own little discovery.*

Denise: *We achieved something . . . we don't normally get so interested in lessons, but this time we just got interested because we wanted to find out the answer to it.*

Teacher: *Was it the answer, the so-called answer that was important or was it something else?*
Tracey: *Well, we was very pleased when we got the right answer, but I don't know . . . well, every other experiment that I do is normally a complete flop and, well, this one seemed to be going quite well and so I got really interested in it.*

Teacher: *But for someone coming into the room, your experiment would have seemed more of a flop than the normal. Do you understand that? They would have seen one of you with a blue colour and one of you with an orange colour and said 'well, something has gone wrong... do it again . . it's not right.' In fact, it would have seemed a complete flop.*

Tracey: *Well, it came out of a . . . well, it wasn't exactly a flop, but it was more or less, but the reason was . . . it started off with a flop and we got it to a good experiment. Well, I thought it was.*

Teacher: *What do you feel you created in this room?*

Sandra: *Noise!!*

Judith: I *suppose, you know, the atmosphere was, we were just getting more excited after it didn't work twice, so, you know, we just kinda, well when the teacher come into the room and saw it as a flop, I don't think I could have seen it as a flop, because it was, you know, just a discovery which you wanted to take further. So if they saw it as a flop then I can't see why.*

And subsequently: -

Judith: *Well, I suppose really it was that we were doing an experiment off our own bats, and it was working was the most important thing because it was our achievement and not prompted by the teacher and it wasn't what everybody else was doing, so it was different and so we enjoyed it more than we would have before.*

Teacher: *Are there any questions that you want to ask me?*

Judith: *Well, in the next lesson, can we carry on?*

Sandra: Yes, 'cos we didn't find out why. All we did was we finished the experiment, you know, just got the result the same, but we didn't find out why!!

Teacher: *Right! Yes. That's what you want to do. That would be good, you know, to find out what it was that made the lead monoxide go, on the one hand blue and on the other hand red.* The dialogue shows how the evaluation process has encouraged the formulation of a new question a sudden realization that another problem had arisen to which they were personally committed.

This personal commitment to the solution of a question which they had formulated produces a huge leap in their understanding of the concepts of acids and bases.

They continue their investigation:

Teacher: *Denise, can you tell me about the experiment you are doing today?*

Denise: Well, I get two test tubes, but I don't fill them up with the same amount of water and I measure up the same amount of lead monoxide, one spatula ful, and 7 drops of indicator. Tracey uses dirty test tubes, Sandra uses exactly the same amount of water and indicator but different amounts of indicator but the same amount of water and lead monoxide.

They say that the results might have been wrong the first week, for one of four reasons:

They used different amounts of water.

They used different amounts of lead monoxide.

They used different amounts of indicator.

They used dirty tubes.

The experiments they devise use a sophisticated technique called 'a controlled experiment' where one variable (i.e. amount of water) is altered while all other factors are kept constant. This concept is notoriously difficult for a major proportion of children at this age when taught in the more conventional ways.

They obtained their results.

Teacher: *Now you've said "It's nothing to do with the amount of water, it's nothing to do with the amount of lead monoxide, or with dirty tubes, or the amount of indicator. In fact it doesn't seem to be to do with anything that you've tested.*

Sandra: *No.*

Teacher: *Now what do you think was different about the experiment that you did last week which makes it different to the experiment you did this week?*

Tracey: *Well I suppose what we could try, Sir, is that we could have say, different amounts of water in the test tubes and different amounts of*

lead monoxide and dirty test tubes and see whether it was all four of them.

They are saying "It wasn't one factor on its own that made the difference but it could have been caused by all these factors acting together".

Teacher: Yes, that is certainly true. It could have been. What about this idea. The lead monoxide should turn indicator a blue colour, but last week you had one tube that went red. Could it have been a dirty test tube which had had acid in it?

Tracey: *Wouldn't it go neutral, because a certain amount of acid and a certain amount of alkali in there . . . shouldn't it turn neutral, but we didn't. We got a very strong acid and one got a very strong alkali.*

Teacher: You *think about that.*

Sandra: I *don't get what you mean.*

Tracey: I *thought about it before I asked you!*

Teacher: *Well, think about it again. Sandra, you don't understand what we are driving at, do you?*

Sandra: No.

Teacher: *The mistake might have occurred last week because you had a dirty test tube and it had acid in it already. Now what would happen if you did all this in a test which was dirty to begin with, with a bit of acid. What might happen?*

Sandra: *What . . . what, you mean if we did an ordinary experiment and it turned acid and then we tipped it out without washing it, do you mean?*

Teacher: *Mm.*

Judith: *Well, then it would turn acid wouldn't it.*

Tracey: *Well not, it wouldn't. If you have got lead monoxide and that's, well we found out it was a very strong alkali. A strong alkali and a strong acid is going to make neutral isn't it?*

Teacher: *Well it depends.*

Sandra: *You've got to have virtually the same* haven't *you.*

Tracey *Yes it's a balance isn't it.*

Teacher: *Mm.*

Sandra: *Tracey said "if you had a strong acid and a strong alkali it would make a neutral, but how is Tracey going to know how much acid is in there to ad?1 the same amount of alkali?*

Teacher: *Good point.*

Judith: If *we use a syringe, then we could put exactly the same in, so we know that it's balancing, or we know if it's stronger or weaker.*

Sandra: *But we don't know how much acid is in there.*

A minute ago Sandra didn't understand the problem the other girls were raising. She has now grasped the idea of 'acids cancelling out alkalis' and of her own accord is appreciating the idea of balancing out different quantities of acids and alkalis whose 'strength' is unknown. A giant leap.

THE VALUE OF THE EVALUATION PROCESS

The process of evaluation:

Stimulates interest.
Encourages questions which can be followed up.
Provides a concrete base on which relationships can be formed and sustained.
Consolidates past learning.
Encourages formulation of ideas.
Encourages the pupils to become active learners.

In section B of this report "Teachers Problems and possible Solutions" 4 main areas of concern were given.

Relationships.
Learning Resources.
The Nature of Science.
The Process of Evaluation.

The evaluation process has consistently shown itself appropriate to the solution of 3 of these problems, namely:

Relationships:

Evidence has accumulated to the effect that

effective and valuable relationships are formed between teachers and pupils.

Certainly many teachers note a marked reduction in discipline problems and a greater degree of co-operative activity.

Pupils do experience greater freedom and security and feel encouraged to explore their own ideas.

The Nature of Scientific Enquiry:

Evidence has been cited supporting the notion that it is possible to create a learning situation in which the pupils become familiar with working according to the scientific method.

These attitudes of controlled rigorous observation and the use of logic are shown to exist in harmony with the imagination and originality which the learners bring to bear upon their problems.

The Process of Evaluation:

The judging of the pupils progress in a relationship of trust and security has been both informative and conducive to learning for all parties involved.

Such a form of communication can become self sustaining because the dialogue encourages the asking of questions, the confidence to solve the problems and the commitment to provide information and criteria to judge the learning which takes place.

There remains the one outstanding problem of producing resources which are of personal interest and of social value. How far the process of evaluation has increased the effectiveness of resources selection, design and production is unsure. Most teachers, however, have begun to express a commitment toward one form of resource organisation or another. These forms are manifold and include:

Class sets of highly structured materials -usually of low reprographic quality. Individual packs of highly structured materials of a high quality. Individual packs of non-structured materials of high quality with suggestions for pupil activity.
They exist together in our classrooms and are not mutually exclusive. Such a mix may provide a transition from structured class lessons toward an individualised enquiry approach by a means least stressful for the teacher.

The process of evaluation is thus justified:

As a general research strategy for the collection of information. As an aid to improving learning through dialogue. As an integral part of the development of the curriculum. As a model of democratic evaluation. (see p.22).

The Implications of the above process of innovation and evaluation will now be considered in relation to

a) models of curriculum innovation
b) models of evaluation
c) In-service Education
d) Educational Research

For any model to adequately characterise the human process of curriculum innovation, it should account for part of the process in terms of the values, intentions and actions of the individuals in the process. In the mixed ability project the processes of innovation and evaluation will now be considered and related to the values, intentions and actions of the individual participating in the project.

IMPLICATIONS OF THE PROJECT

MODELS OFCURRICULUM INNOVATION

At least four models of curriculum innovation can be distinguished in recent projects. These models have been defined in terms of: Diffusion, Research Development and Dissemination, Problem Solving and Creativity. These characteristics are given in appendix 3. In the mixed ability project the innovation was characterised as a living process which synthesised the four models in the following way.

The Diffusion Model:

In the process of innovation some information on resources and organisation have percolated through to the teachers through the National Press, The Schools Councils Dialogue and Educational Suppliers newsletters and catalogues. This information made the teachers aware that others were experiencing similar problems.

The Research Development and Dissemination Model:

From a concern to solve their problems a small group of teachers had gathered themselves together, supported by an adviser, warden and lecturer, and negotiated funds and time from The Schools Council and L.E.A. to develop their curriculum.

The Problem Solving Model:

In the formation and operation of the Workshop Group a central theme for analysis and continuous questioning was why the curriculum was in need of improvement. Through seeing that the changes were relevant and important to their situation the teachers attempted to improve the curriculum.

The Creativity Model:

The operation and funding of the working group has been described in a previous section. This was an example of how teachers, a warden, lecturer arid adviser attempted to create the circumstances and provide the support which would enable effective innovation to be generated, sustained and carried forward in the schools by the teachers directly concerned with the problem.

It is difficult using the above models to define the process of curriculum innovation in the mixed ability project. A new view of the curriculum was implicit in the way the teachers selected and arranged the resources. The teachers selected topic areas and arranged resources which contained the conceptual frameworks of the disciplines within the scientific form of knowledge as one set of possible interpretations amongst many others. The key notion was that the curriculum was viewed in terms of the conceptual framework which emerged from the questions educator and pupil agree are likely to be in the pupil's personal and social interest to pursue. This view of the curriculum differed from previously held views that the curriculum of a school is a body of knowledge independent of the pupil and there to be mastered.

The Approach to Innovation in the Mixed Ability Project

The above change in view occurred in the interactions of the teachers in their classrooms. The following four values and five activities could be distinguished in the lives of the teachers through participant observation in the classrooms.

Four Values

1. Concern with improving learning situations for pupils.
2. Commitment to work with others, in a climate of trust and critical dialogue, to solve shared problems.
3. Faith in each others capacities to evaluate their own activities relations and products.
4. Determination to gather and evaluate information on the areas of concern from people in local regional and national institutions.

Five Activities

1. Organise meetings for teachers with similar problems.
2. Encourage the formulation of teachers problems.
3. Work with the teachers to solve the problems.
4. Gather and evaluate, with teachers, information on the changing situation.
5. Disseminate information to other interested individuals.

MODELS OF EVALUATION

Implications for the Structure of Evaluation

Six models of evaluation can be distinguished in the educational literature. Three attempt to characterise evaluation in terms of democratic, bureaucratic and autocratic forms of social control (Appendix 4). Three characterise the

process in terms of norm, criteria and illuminative forms of psychological testing procedures.

Norm referenced assessments are used by the GCE boards. They are concerned with obtaining standardised objective measures of achievement in order to provide information to the selection agencies which influence opportunities for jobs and higher education.

Criteria referenced assessments are used by CSE boards are designed to detect mastery of a set of intellectual skills, ability and knowledge. They are usually based on a set of behavioural and cognitive objectives and may contain an attitude scale.

Illuminative procedures have rarely been used in this country's structure of evaluation. They are designed to help the learners improve the quality of their products by providing information and criteria on which the quality may be judged.

The democratic evaluation study (Appendix 4) is an emerging model, not yet substantially realised but one which embodies some recent theoretical and practical trends. The criteria which distinguish this form of evaluation are:

1)The evaluator acts as a broker in exchanges of information between groups who want knowledge of each other.
(2)The evaluators main task is the collection of definition of and reactions to the programme.
(3) Key concepts are confidentiability, negotiation, accessibility and the right to know.

The form of social control used in the above process of evaluation fulfils criteria 1 and 2 and the key concept the right to know.

The structure of Evaluation which is emerging from the Mixed Ability Project.

1) A democratic form of control in the evaluation process.

In the process of evaluation the key issue was the creation of a climate of trust in which the teachers and learners experienced the freedom and security to express their intentions and interpretations. Jack gathered information about the intentions, activities and interpretations of learners and teachers who agreed that this information should be freely available. The techniques of data gathering included video tape and open unstructured interviews.

2) The Illuminative Evaluation Procedure

This procedure rested upon the climate of trust being established between a network of teachers, lecturers and advisers. The primary purpose of establishing this network was to improve the quality of the learners' relations, activities and products. This was achieved through a series of evaluation reports compiled from the data given in the body of this report. An expression of faith between participants in each others capacity to evaluate these reports in terms of improving ones own practice was essential to this procedure.

3) Criteria Referenced Assessment.

It is suggested that this form of assessment should be related to the intrinsic qualities of the subject. For science, the following 4 categories are suggested which, with a 5 point scale and a matrix of work done, will provide important feedback on progress to teachers and parents and future employers.

1. Creativity

e.g. having ideas
asking questions
finding patterns
forming hypotheses
forming problems

2. Experimentation

Observation Recording Manipulation

3. Evaluation

Self criticism
Response to criticism of others

4. Communication

Talking | Writing | Other media

It is suggested that the 4 categories be equally weighted.

4) Norm-referenced assessments

The Universities are most anxious that some agreed and applied criteria be established for norm-referenced assessments. This could be done efficiently and cheaply by isolating the key concepts within the forms of knowledge (agreed by the Universities as important) and applying the well-tried techniques of developing standardised objective measures for examination.

It is suggested that the balance of financial resources should shift from emphasising norm and criteria referenced assessments to an emphasis on illuminative evaluation procedures which are

EDUCATIONAL RESEARCH

Implications for Educational Research

There is no serious dispute that educational research is seen as an attempt to construct a set of logical or empirical relations between a set of variables and measured student outcomes.

The mixed ability research project has raised serious questions about the appropriateness of this definition for answering questions of the form: How are educational standards improved within secondary schools?

An alternative view of educational research has be presented. In this view, research is an approach tc solution of problems encountered in practice, and construction of plausible and useful interpretations educational phenomena which are directly related the lives, language and relations of those involved the process.

The present methods of educational research transform human relations in logical or empirical relations. They also represent the immediately live experience and behaviour of a human being in numerical scales or category systems. In the dom view of educational research, explanations of educational processes, which involve networks of human relations, are given as sets of determinant relations between variables in the process and measured student outcomes. A valid explanation c phenomena, must, however, relate directly to the nature of the phenomena under investigation, whi in this case, a network of human relations.

The limitations in the above methods can be experienced directly in reflection on ones own nat as a human being. In my nature as a person 1 experience myself as completely different from a dependent or independent variable in a set of determinate relations. My experience of reason, freedom, creativity, moral and social responsibility cannot be represented in numerical scales or cate systems.

1 encounter educational phenomena as conscious awareness which are sources of meaning. It is precisely as teachers have immediately lived and experienced their relations in classrooms, in their quality of being educational phenomena that creat reveal or at least carry meaning, that provides the for the alternative view of educational research presented here.

A scientific enquiry begins with the creation of a possible world, a world which we invent, criticise a modify as we live so that it ends as nearly as we c make it a story of real life.

The account in this research report started with th immediately experienced problems of teachers in classrooms. It continued by following the teachers through their project to improve their own situation The data on the lives, language and relations of th teachers and their pupil has been presented as ar interpretive commentary on a living process, a sto about real life which began with the creation of a possible world in the teachers' intentions.

Implications for In-service Education

A central function of in-service education is to improve educational standards within schools. There are, however, few case studies which show how particular forms of in-service support have influenced improvements in classroom practice. The study presented here describes how the in-service support from Bath University Science Centre influenced improvements in learning for 11-14 year olds in mixed ability science groups.

This form of in-service support was based upon the following 4 assumptions.

Teachers could isolate the problems they experienced when they were not living their intentions in practice.

Scientific thinking could be resolved into two episodes, the imaginative and critical which alternate and interact. The generative acts were outside logic and involved the asking of questions, forming hypotheses, or having ideas.

Teachers needed easy access to resources which would help solve their problems.

Teachers could evaluate the contradictions between intentions and practice when presented with objective evidence. Evaluate, that is in terms of the relations involved in the transformation of intentions into practice.

From exploring these assumptions a network of in-service support has been created which involves contributions from Bath University, Wiltshire LEA, The Schools Council, Avon Resources for Learning Development Unit, Independent Learning in Science, The Association for Science Education and The Department of Education and Science.

This form of support has emerged from the assumptions related to teachers isolating their own problems, enquiry learning, the self-evaluation of intentions and practice and easy access to resources. These resources include the objective evidence on which the teachers can evaluate the contradiction between their intentions and classroom practice

The in-service education above was not offered as a blueprint for improvements in classroom practice. Improvements have occurred through the creative power of individual teachers to transform their own situation.

The implications in the above project are that teacher trainers and others have a social responsibility to remove constraints which may prevent teachers creating and being critical of their own local curriculum developments.

APPENDICES

APPENDIX 1

a) ROUND I PROPOSAL
June 1974
RESEARCH AND DEVELOPMENT PROGRAMME

1 Description of the purposes of the project
This is **an attempt at local** level to respond to the needs of teachers faced with the problems of teaching science to 11-14 year olds of wide ability ranges, individually and in small groups. Teachers from five schools are attempting to solve their problems by forming workshop groups to reorganise existing resources from the Nuffield and Schools Council Projects and creating additional resources to meet specific needs.

The outcome of this general attempt to look at what the children and teachers are doing in science will be a co-ordinator's report, which will describe and evaluate the curriculum developments.

2 Originated by Teachers working as a group at Swindon Curriculum Study Centre, Swindon

3 To be conducted by A Group of Teachers co-ordinated by Mr Jack Whitehead, Bath University School of Education.

4 Approximate duration and desirable starting date
2 years - September 1974. (Changed in January 1975 to 1 year, and to finish in August 1976.)

5 Approximate Total Cost
£7,000 (Changed in January P1975 to £6,000)

6 Discussed/Approved by the following Committees

7 Numbers of any relevant papers

8 Existing relevant Council Projects

APPENDIX 2

b) ROUND II PROPOSAL
December 1974

MIXED ABILITY PROJECT

I Origin
The proposal originated from a group of science teachers who formed a workshop group to solve their problems of organising a learning situation for 11-14 year olds, in mixed ability groups, to engage in scientific activity.

Background
In November 1973 a request was made by Jack Whitehead of the University of Bath for £1,000 to support teachers who were producing independent learning schemes for children of all ages and abilities. The Science Adviser to the Council, Dr. Burdett, replied that the procedural lines for local development proposals would be clarified in the new year.

Early in January 1974 a course was organised at the Swindon Curriculum Development Centre for teachers who had problems with their third year science teaching. The course dealt with the teachers' intentions, forms of assessment and the range of science resources available, for teachers and 11-16 year olds, from the Nuffield Foundation and Schools Council Projects. Following this course teachers in five comprehensive schools decided to form a workshop group to design, produce, organise and evaluate an individualised learning situation for 11-14 year olds in mixed ability groups. In the light of Schools Council's concern with local curriculum developments, the teachers decided in April 1974 to request financial aid from the Council. The Round I proposal was submitted with the approval and support of the Chief Education Officer and in June the proposal was placed in the B category.

The L E A has recognised that the work of the project is well under way and are anxious to ensure that it is not hindered during any waiting period which may occur. Limited funds have been made available for the project and these fundsare administered by the Curriculum Development Centre.

RESEARCH DEVELOPMENT AND DISSEMINATION

The Research Development and Dissemination model assumes that one must gather together a small number of people who are actively improving their curriculum. They must be given funds and time to be able to develop this curriculum and then actively engage in the dissemination process.

The Present Situation
The teachers concerned in the project possess a wealth of experience in the use of modern source materials in science, developed for the 11-14 age range. They and many of their colleagues in the locality are involved in the teaching of mixed ability groups in science. They have progressed through a number of stages, beginning with the implementation of the modern schemes as they stand, NCS and SCISP, proceeding to adaptations of these schemes for the mixed ability situation and have now reached the significant stage of writing material of their own, using the feedback of the experience of earlier stages.

The project has reached the point when normal school resources cannot meet the heavy demands of a development programme of this kind; when support from a Centre of Higher Education must be on a regular and systematic basis; when reprographic facilities must be enhanced and when skilled evaluation methods are needed.

The initiation of the project by this local group coincides happily with the wishes of the L E A and Schools Council to provide support for school generated curriculum development and thus support was granted.

AIMS

11 The Aims of the Project fall under two headings: -

1 **Educational Aims**

The main concern of the teachers is to provide for their pupils meaningful and enjoyable scientific situations which are relevant in the best educational sense. They feel that the best learning situations occur when pupils are encouraged to devise solutions to their own questions.

The educational aims of the project correspond precisely with those of individualised learning in general, namely:

1 to place the pupil in an active learning situation;

2 to allow the pupil to operate in an atmosphere of success and reward, derived from his own operations;

3 to enrich the natural development processes of children;

4 to promote a situation of pleasing and motivating interpersonal relationships involving pupils and teachers;

and, in addition

5 to use the particular qualities of science, its empiricism, its discipline and its imaginative thinking to complete the whole education of children.

The mixed ability situation is often seen as one which creates insoluble problems and yet is a situation which draws attention to learning methods which might well have been used in any class grouping and which have not only been neglected in traditional teaching to a great extent but are also highly efficient and productive.

2 Strategic Aims

1 To establish a network of mutual support between teachers, lecturers, advisers, scientists and industrialists.

This aim has been achieved in fact, in Wiltshire, where a contract is already in being between Wiltshire L E A and the University of Bath, to enable lecturers to promote individualised learning in Wiltshire schools. In the project locality, there are extensive connections between schools and local industry and the locality has very strong associations with technological education. There is already very effective co-ordination from the Curriculum Development Centre which has considerable administrative potential.
This particular project is seen as a specimen development, based in schools, but embodying the kind of relationships envisaged in the concept of a Professional Centre.

2 To establish a resources retrieval system.

The concept of group development implies growth and proliferation. The resources produced are a tangible means of demonstrating the value of group development in both the processes and the end product.

Objectives in terms of proposed outcomes

1 The design, production, organisation and evaluation of resources in the learning situation, which are responsive to individuals' enquiries in mixed ability groups.

2 The formulation, expression and criticism of learners' questions about physical phenomena.

The importance of this outcome rests upon the view that the generative act of scientific reasoning is the asking of a question, the creation of an idea or the formulation of an hypothesis. It is assumed that this process is outside logic but that once an opinion is formed and expressed it can be exposed to criticism. This criticism involves the empirical testing of the logical consequences of the beliefs usually through experimentation.

3 A network of relationships between teachers, lecturers, advisors, scientists and industrialists which are responsive to solving the teachers' problems in the provision of dialogue and material resources.

This outcome has partly been achieved between teachers, lecturers and advisors in Wiltshire and is manifested in the contract negotiated between the Wiltshire Authority and the University of Bath to enable lecturers to promote, individualised learning in several Wiltshire schools. Scientists and industrialists are also being requested to comment on the content and relevance of the materials and will help to evaluate the teachers' intentions and learners' scientific activities.
These outcomes are being achieved in two phases. In phase I the teachers facing mixed ability groups have changed their classroom organisation for individual and small group teaching. This has included the production of a variety of worksheets with most of the problems "given" to the pupils.
The outcome of phase II will be the learning situation described in 1, 2 and 3 above and will include a resource retrieval system which, with the teacher, will be responsive to the learners' enquiries.

III The Proposed Pattern of Organisation and Operation

The pattern of organisation is centred on the activity of teachers in the workshop group, designing, producing, organising and evaluating the individualised learning schemes for their pupils. These activities are being co-ordinated by a lecturer from the University of Bath. This co-ordination involves the development of closer relationships between advisers, lecturers, scientists and industrialists for the criticism and evaluation of pupils' scientific activity. Meetings are being held at fortnightly intervals in the schools for an on-going dialogue on fundamental goals and criticism of resource materials. The latter are modified and reproduced at the schools or local teachers centres.

IV Evaluation

This will be a co-operative activity between learners, teachers, lecturers, scientists and industrialists. The teachers will express their intentions verbally, in writing and with practical examples. The learners will be interviewed and video-taped whilst working to detect the state of their scientific activity. The view will be taken that language is inadequate to express a person engaged in scientific activity, it is the kind of phenomena which can only be shown. The evaluation sessions will be dialogues between the above people as they attempt to make available to each other their interpretations of the teachers' intentions and the learners' activities, and the assumptions on which they are based. Records will include written statements, transcripts of interviews and evaluation sessions and video tapes of the learner's activities.

APPENDIX 3

MODELS OF CURRICULUM INNOVATION

Three models of curriculum innovation, the Social Interaction or Diffusion, the Research Development and Dissemination and Problem Solving model have been characterised as follows.

DIFFUSION

The diffusion model rests on the assumption that improved curricula will be seen as self evident by teachers and their advisers and will percolate through the system with little intention on the part of advisers, teachers or Schools Council to disseminate the curriculum developments.

The Motivation of the Groups

The range of teachers from whom this proposal emanated are convinced of the value of the source material in modern science teaching schemes. At the same time they recognise that these schemes, with one exception, are science centred in structural and organisational terms. They wish to relate the science to the child, to teach individuals and to enrich their experience, whilst maintaining the integrity of the discipline of science. They realise that group development is necessary as well as desirable. They are aware of shortcomings in expertise and in resources and have thus sought professional and financial support.

PROBLEM SOLVING

The problem solving model emphasises the need to change teachers' attitudes. The primary problem is seen not so much in terms of producing material resources but as changing teachers to begin to see why the curricula is being improved. It is believed that if teachers see that the changes are relevant and important to their situation then they will attempt to improve the curricula.

CREATIVITY

The model suggested by U N E S C 0 is characterised in terms of the "Creativity of the School". By this is meant the power of a school to evaluate, accept or reject and institutionalize innovation. The task is to create the circumstances and provide the support which will enable effective innovation to be generated, sustained, and carried forward in the institution by the people directly concerned with the problem.

APPENDIX 4

MODELS OF EVALUATION

BUREAUCRATIC EVALUATION

Bureaucratic evaluation is an unconditional service to those government agencies which have major control over the allocation of educational resources. The evaluator accepts the values of those who hold office, and offers information which will help them to accomplish their policy objectives. He acts as a management consultant, and his criterion of success is client satisfaction. His techniques of study must be credible to the policy-makers and not lay them open to public criticism. He has no independence, no control over the use that is made of his information, and no court of appeal. The report is owned by the bureaucracy and lodged in its files. The key concepts of bureaucratic evaluation are 'service', 'utility' and 'efficiency'. Its key justificatory concept is 'the reality of power'.

AUTOCRATIC EVALUATION

Autocratic evaluation is a conditional service to those government agencies which have major control over the allocation of educational resources. It offers external validation of policy in exchange for compliance with its recommendations. Its values are derived from the evaluator's perception of the constitutional and moral obligation of the bureaucracy. He focuses upon issues of educational merit, and acts as expert adviser. His techniques of study must yield scientific proofs, because his power base in the academic research community. His contractual arrangements guarantee noninterference by the client, and he retains ownership of the study. His report is lodged in the files of the bureaucracy, but is also published in academic journals. If his recommendations are rejected, policy is not validated. His court of appeal.is the research community, and high levels in the bureaucracy. The key concepts of the autocratic evaluator are 'principle' and 'objectivity'. His key justificatory concept is 'the responsibility of office'.

DEMOCRATIC EVALUATION

Democratic evaluation is an information service to the whole community about the characteristics of an educational programme. Sponsorship of the evaluation study does not in itself confer a special claim upon this service. The democratic evaluator recognizes value pluralism and seeks to represent a range of interests in his issue formulation. The basic value is an informed citizenry, and the evaluator acts as broker in exchanges of information between groups who want knowledge of each other. His techniques of data-gathering and presentation must be accessible to non-specialist audiences. His main activity is the collection of definitions of, and reactions to, the programme. He offers confidentiality to informants and gives them control over his use of the information they provide. The report is non-recommendatory, and the evaluator has no concept of information misuse. He engages in periodic negotiation of his relationships with sponsors and programme participants. The criterion of success is the range of audiences served. The report aspires to 'best-seller' status. The key

concepts of democratic evaluation and 'confidentiality', 'negotiation' and 'accessibility'. The key justificatory concept is 'the right to know'.

APPENDIX 5

A **FIVE-YEAR SUPPORT PROGRAMME FOR INDEPENDENT LEARNING IN SCIENCE (I.L.I.S.)**

INTRODUCTION

This proposal represents a development of the current ILIS model of localised curriculum development, based on a felt need by teachers to set up independent learning as a viable alternative to traditional class teaching. The growth of independent learning in science has occurred because of the realisation that independent learning is an effective response to the needs of the individual, whatever the method of grouping students. The fact that it is a clear and meaningful alternative in mixed ability groups has accelerated this growth. The proposal is intended to aid the development and extension of methods of independent learning per se, the teachers seeking methods and materials suitable for work with mixed ability classes.

HISTORY AND AIMS

In April 1973, a conference was held at Countesthorpe College on "Individual and Small Group Methods in the Teaching of Science", School and University teachers, lecturers from Colleges of Education and representatives from the Inspectorate, Industry and Commerce took part and the outcome was the setting up of the organisation ILIS.

Its present membership, nearing 400 reflects the interests at that conference and the involvement of about the same number of schools. The membership continues to grow and interest from overseas is considerable. There is a central Executive Group comprising of a Chairman, Co-ordinator, two Newsletter Editors and a Treasurer.

Initially, Leicestershire Education Committee provided the Co-ordinator, Mr. E.L. Green, with part-time secretarial help, and further assisted the work of the organisation by providing him with a year's part-time secondment 1975-76.

The-Schools Council granted the ILIS organisation £5900 for the year 1975-76 to provide for some teacher secondment, secretarial assistance to the Co-ordinator and general financial support to enable the organisation to continue its work.

AIM I To provide co-ordination of thought and enterprise in establishing methods of independent learning in science, the main interest at present being in the secondary school, but growing involvement wit similar work at the primary and tertiary levels is apparent.

AIM II To provide for co-ordinated development to prepare and disseminate ideas and resources, primarily through workshops and resource centres.

PATTERN OF CURRENT WORK

The two aims stated above determine the pattern of work of the CENTRAL ORGANISATION of ILIS and the WORKSHOP! RESOURCE CENTRES which it seeks to create.

CENTRAL ORGANISATION,

The work of the organisation so far has clearly demonstrated the need for a service to science teachers which enables them to understand and plan for schemes of independent learning.
The central co-ordinating organisation is responsible for dissemination of information, establishing and developing contacts between interested teachers, advisers, inspectors, commercial and industrial interests, and publishers, as well as taking initiative in extending the work of ILIS through exhibitions, conferences, and negonating grants to the organisation, and by visiting individual and small groups of science teachers with the intention of enabling them to set up local workshops/resource centres. Most of this work is the responsibility of the COORDINATOR, but the other officers of the ILIS organisation play an important part in this process. (An interim report on this work for the year 1975/76 has been supplied to the Science Adviser and Finance Officer of the Schools Council, and will be followed in January 1977 by a final report on that work).

The work of the Co-ordinator is supplemented by the following publications.

THE NEWSLETTER. This publication has now become an important journal of independent learning in science. It is published each term with a print of 600 copies. It is intended for members but some copies are sent to teachers and others expressing an interest in the work of ILIS. The current editors are Mr. Don Foster and Mrs. Vivien Bellamy.

THE DIRECTORY. This is supplied to members only and gives details of all those known to ILIS who are involved in independent learning schemes in science. It enables teachers to make contact with others doing the same work as themselves, leading in some cases to the establishment of a workshop/resource centre. This document is prepared by the Co-ordinator and up-dated annually.

THE CATALOGUE. This is supplied to members only and gives details of independent learning materials currently available. This document is prepared by the Co-ordinator and up-dated annually. "I.L.I.S." This is a descriptive leaflet outlining the purposes of the organisation and giving details of its structure.

WORKSHOP/RESOURCE CENTRES

From the start of the ILIS organisation its members have sought to establish such centres which will provide:

A MEETING GROUND for teachers on a localised basis, so that they can discuss and facilitate independent learning in the science departments of their schools.

A RESOURCE BANK of materials for independent learning, together with facilities for copying the materials pertinent to the work in the schools from which the teachers come.

A WORKSHOP for the development of new materials relevant to the needs of the teachers in the locality, produced and evaluated by them. There is little wish to develop new content or courses, the main emphasis being on taking such developments made over the past ten years or so and devising methods and materials which make those developments suitable for independent learning.

A SUITABLE STAFF for this work to be coordinated and developed. There is a need here for secondment of some of the local teachers to provide the necessary staffing. Such requirements will vary from centre to centre.

THE RELATIONSHIP OF THE CENTRAL ORGANISATION TO THE LOCAL CENTRES

The relationship is one which exists to promote a process, clearly stated in the Schools Council Workin Paper No.10 (1967), of which the essential elements are as follows:

The careful examination, drawing on all available sources of knowledge and informed judgement, of the objectives of teaching ..... The object is to help as many teachers as possible to define, co-operatively, and from personal conviction, these objectives.

The development and trial use in schools, of those methods and materials which are judged most likely t achieve the objectives which teachers agree upon. (Taken from para 1 Working Paper No. 10)

The relationship also gives expression to the "two basic principles on which, in the Council's view, progress on curriculum development should be built: first, that the motive power should come primarily fror local groups of teachers accessible one to another; secondly, that there should be effective and close collaboration between teachers and all those who are able to offer co-operation". (Taken from para 27 Working Paper No.10.)

This relationship has also given expression to the Schools Council basis for curriculum development as given in paragraphs 6, 7 and 11 of Working Paper 10 The first basis on which development rests in the ILIS model is a keen interest on the part of teachers in curricular progress. Teachers, more and more are meeting to discuss curriculum problems and local education authorities are doing all that is practicable t encourage such groups, and in particular help them with accommodation, apparatus and secretarial assistance as may be necessary

We are encouraging local education authorities, eithe singly or in collaboration with neighbouring authorities to consider ways of responding to the expressed wish of teachers to come together to conduct for themselves curriculum development in order to help them to sharpen their judgements on objectives, improve their experimental procedures and play a full part in assessing the results of development work.

The essence in the ILIS programme, of curricular review and development is new thinking by the teachers themselves, as well as the appraisal of the thinking of others. This means that we create regular opportunities to meet together, both nationally and locally, and that we look upon the initiation of thought, as well as the trial and assessment of new ideas and procedures drawn from other sources, as an integral part of our professional service to society.

Within this relationship the function of the local ILIS groups is that described in paragraphs 16, 17 and 18 of Working Paper 10.

The most important is to focus local interest and to give teachers a setting within which new objectives can be discussed and defined, and new ideas on content and methods can be aired. The comments and criticism of local teachers shows very clearly whether an idea which works well in one school can succeed in another. Teachers working in these local ILIS groups seek a wider forum by invoking the help of the local authority or institute of education.

The schools in the area of the local group are usually among those who give new materials their trial. The local centre of interest will contribute to the evaluation of materials, providing feedback comments criticisms and suggestions for improvement. In this respect, the role gives nationally and locally initiated work a solid foundation in widespread teacher experience and judgement.

The local ILIS groups are kept informed about research and development in progress elsewhere. This is the primary function of the ILIS Newsletter and the work of the Co-ordinator.

ACHIEVEMENTS TO DATE

The foregoing relationship between the central organisation of **ILIS** and the members in local groups has resulted in a number of major projects. It is thought that without the stimulus of the work of the central organisation these groups would either not have come into being at all or would have been very limited in achievement.

GROUPS FUNDED DIRECTLY BY THE ILIS CENTRAL ORGANISATION. The funding in each of these cases consists in financing the part-time secondment of three teachers, one in each group**.**

Mr. Peter Herbert. Elliott School, ILEA, for the 'Quest Project'. The project involved the Elliott School and the Christopher Wren School in the ILEA, the writers of the materials used being Peter Herbert, Head of Science at Elliott, John Merrigna Head of Science at Christopher Wren and John Lewis ILEA advisory teacher. 'Quest' provides materials for first and second year pupils working in mixed ability groups in science.

Mr. Patrick Homan-Berry established a Salisbury workship/resource centre for independent learning in science. The work has lead to the development of a major proposal to the Schools Council which is presently being considered.

Mr. Peter Ashworth who is establishing a local workshop/resource centre in Cornwall with some 50 local science teachers involved. This work will begin in October 1976, as it was not possible for him to arrange the secondment for the current year. Extension of the ILIS project to cover this is awaiting ratification by the Schools Council.

£2500 of the £5900 granted by the Schools Council to ILIS was set aside for the above secondments.

GROUPS FORMED BY DIRECT ASSOCIATION WITH THE WORK OF ILIS. The following groups are completely autonomous, having received no financial aid from the ILIS central organisation, but nevertheless inspired and assisted by the contact with the organisation.

Workshop on Medium Term Independent Learning in Physics for Northern Ireland G C E 0 level Syllabus. Organised by David J. McCullough at Belfast Teachers' Centre who with the N.I.Schools Curriculum Committee are providing the funding.

Workshop on Computer Assisted Management of Learning in Physics. Dr. Martin Brown of Methodist College, Belfast is the organiser. The National Development Programme in Computer Assisted learning has established at the Education Centre, New University of Ulster, a development project in the Computer assisted Management of Learning in Secondary and Tertiary Education. As one element of the project, during the period 1975-79 the physics department of the Methodist College will introduce a system of computer assisted management of their A-level physics course.

Workshop "11- 14 Mixed Ability Project in Science", at the Swindon Curriculum Development Centre. Organiser, Mr Jack Whitehead, Chairman of ILIS 1974-1976. This workshop was funded by the Schools Council.

PROJECTED GROUPS FORMED BY DIRECT ASSOCIATION WITH ILIS. It is intended that a number of ILIS Workshops will make a direct approach to the Schools Council for funding through the Science Adviser. The following are in the process of making such an approach.

ILIS Workshop/ Resource Centre in Stockport from September 1977. This proposal has been initiated by Mr Andrew Firman, Mr John Onslow and Mr John Thompson of the Reddish Vale Science Department, and has the support of Mr H. Peters, headmaster of the school, as well as R. West, Education Adviser, and Mr B.L. Harmon the Director of Education for the Metropolitan Borough of Stockport.

'Trent Science Education Unit', concerned with the development of teacher skills for individualised learning in science. Proposed by J.K. Tollyfield, A. Jones and D. Briggs of the Trent Polytechnic - Clifton, Nottingham. It was intended at one stage that ILIS would negotiate on behalf of these members but after consideration at the ILIS Members General Meeting at Bath University on June 12th 1976, it was decided that negotiation should be decided following consultation with the School Council Science Adviser.

SPECIFIC AIMS OF THIS PROPOSAL

It is considered that the funding of the central organisation of ILIS is vital to the continuation of the pattern of curriculum development as outlined. It is hoped that the intimate connection of the work of the central organisation to that of the local workshops is apparent, and its importance understood.

Broadly it is hoped to further strengthen the work of the ILIS organisation. This would be done by:

allowing for the employment over a fiveyear period of a full-time Co-ordinator,

allowing for the employment over the same period of a full-time secretary to the Co-ordinator,

making financial provision for:

rental and other general expenses of establishing a national centre for ILIS, a national ILIS resource bank, together with a catalogue of materials, and facilities for copying such materials as members require, continuing the production of publications such as those described

COSTING OF THE PROPOSAL

SETTING UP THE NATIONAL CENTRE.
Negotiations on this matter are tentative at the moment but are ongoing with Bath University and Leicestershire Education Committee. Clearly the final costs will depend on the location.

For furniture, telephone installation, addressing machine, office materials, electrical fittings etc.

ANNUAL COSTS OF THE NATIONAL CENTRE

Salary of Co-ordinator	£7281-£7905
Secretary to Co-ordinator	£3000
Postage	£500
Telephone	£300
Travelling Expenses	£500
Stationery and printing costs	£600
Rental for accommodation	£500
Contingencies	£300
TOTAL ANNUAL COST	£13,300
on average	

APPENDIX 6

THE RESOURCES FOR LEARNING DEVELOPMENT UNIT AS PART OF THE NETWORK OF IN-SERVICE SUPPORT

County of Avon

Director Philip Waterhouse
Redcross Street
Bristol BS2 0BA
Telephone 0272/**559491**

Resources for Learning Development Unit

The problems of teaching science to mixed ability groups expressed by the teachers in this report are by no means unique. The phrase 'mixed ability' included in the title of a course or conference ensures massive support. An evening conference in Bristol recently attracted over 170 science teachers. It is hardly surprising, therefore, that considerable use has been made of the network of in-service support that is developing in this area. One part of the network is the Resources for Learning Development Unit based in Bristol and sponsored by the D.E.S. and the County of Avon.

The science project of RFLDU got under way in September 1975 after a conference of science teachers had, in May 1975, determined the broad framework for the project and elected an editorial board to assimilate and express the wishes of science teachers in the area.

RFLDU is a teachers' cooperative, planned, managed and operated by teachers for teachers. The aim of the Unit is to evaluate the claims of independent resource based learning. To achieve this aim the Unit supports teachers in setting up independent learning situations in their laboratories primarily by making available to them a wider selection of resources than they could hope to produce individually. The resources (including worksheets, study guides, cassette tapes, film strips and background readers) are intended for use by 11–13 year old pupils of a wide range of abilities and are mainly written by practising teachers in the County. The resources are not intended to form a course but rather are designed for use with any of the existing courses presently being followed and in the style of independent learning situation determined by the teacher.

Clearly it will not be possible, in the two year production life of the project, to produce all the resources that will be necessary to equip laboratories for independent learning nor will all the materials produced by RFLDU be equally suitable to the wide variety of learning situations created by science teachers. Fortunately, in this area, teachers have a number of other sources to turn to for resource material; the Mixed Ability Project and I.L.I.S. workshop groups in Swindon, Salisbury and Cheltenham.

Teachers who wish to operate an independent learning system need more than help with the provision of resources. The reasons for wanting to move to this type of system, the aims that the system is intended to achieve and the constraints that will operate on it vary from teacher to teacher. Any support that is offered to teachers must be *sympathetic* support. Not only must resources be made available but help must be given to individual teachers in selecting and arranging the resources so that they can be used by pupils to reflect the aims of the teacher and the constraints placed upon him. It is for this reason that the network of in-service support in this area has developed. Materials made available by RFLDU have been used by teachers involved in the mixed ability project whilst members of that project have been able to give personal, and sympathetic support to science teachers wishing to use resource material. Similarly members of ILIS have been able to provide both types of support.

The success of a network of in-service support depends, to a large extent, on the relationship which exists between the people involved in the different parts of the network. If the relationship is a close one ideas which are generated in one part are quickly passed on to others. Jack Whitehead and Vivienne Bellamy, as part of the Mixed Ability Project, have investigated ways of packaging resources in such a way that genuine inquiry learning can take place. Because their ideas were quickly passed on, other teachers have been able to see the system in operation and make use of it for themselves. Similarly, because of the close cooperation, it has been possible to organise conferences for teachers in which the work of the different support services has been on view at the same time.

The Resources for Learning Development Unit can offer considerable support for teachers who wish to improve the learning situation for their pupils. However, the support it can offer is greatly enhanced because of the close relationship that exists between it and other parts of the network of in service support that is developing in this area.

Don Foster
Science Editor

3)a) **REPORT ON THE SCIENCE CONFERENCE HELD ON 6th MAY 1975**

INTRODUCTION

The Director outlined the essential characteristics of the organisation. Basically the Resources for Learning Development Unit is a teachers' co-operative, planned, managed and operated by teachers for teachers. In practical terms the Unit is aiming to produce an organisation to promote independent resource-based learning in Avon secondary schools - not to do away with the teacher, but to help them by making available to them a wider selection of resources than they could hope to produce individually for themselves. All the Unit staff come straight from schools so the practical approach to the classroom situation is uppermost in their minds. And accordingly material produced must be the material needed by Science teachers in the area. The purpose of the meeting is therefore not only to provide information on the Unit for those interested teachers attending, but also to elect from them an Editorial Board to assimilate and express the wishes of Science teachers in the area, and as their representatives to formulate the basic policies on which materials will be produced. The Editor's function is to implement those policies which come through to him from the Editorial Board. Meanwhile teacher/authors, critical readers and testers from amongst those interested are all essential to the success of the operation.

The Unit has a budget of £8,000 p.a. per subject and by co-operation we are able to offer much more for the money and effort expended than could be achieved by dividing this money equally between all the schools in the County. There is a charge to schools purchasing the materials produced, but it is subsidized by the Local Authority so is small compared with the actual production costs.

POINTS RAISED DURING QUESTION! ANSWER SESSIONS

1. What can the Unit offer which is not already catered for by other courses?

The Unit is not proposing to produce another text book course, or dictate an authoritarian style of teaching, but to produce a bank of materials for teachers to use in an independent learning situation as desired - a provision of the opportunity to evolve their own style, content and use of materials where the need arises. We were set up on the Nuffield Foundation's recommendation with the support of the D.E.S. and the Local Authority as an experimental unit, experimenting in the co-operative production of resourcebased learning materials - these appearing to them to be the solution to most teachers' problems in the large, mixed-ability classroom situation. However, it is not what the Unit suggests that will dictate the nature of the materials produced, their scope or their content, but what teachers express the need for. Materials produced in other subjects have tended to be in addition to styles of teaching and courses already in use, but the decision on their scope and content is that of the Editorial Board in the subject.

2. **How long will it take for pupils** to work **through the whole bank?**

Since the difficulties involved in trying to produce a successful whole course in one year are obvious, and there are anyway so many good science courses already in use, this material is probably better thought of as auxiliary, enrichment or extension material which can be incorporated with courses already in use, as individual teachers choose. But it is up to the Science teachers involved, via the Editorial Board, to decide just how much material is needed and in what areas.

3. What ability range is aimed at?

The mixed-ability situation in many Avon Schools means that a vast range of ability has to be catered for by many teachers. Some conference members felt that there was a lack of work for low ability ranges in Science at present. It was up to the Editorial Board with consultation with Conference members to decide whether to cater for the whole range, on two or three ability levels, or merely to rely on supplementary help such as tapes to support units produced, for the lower ability children.

4. Are we restricted to printed materials?

No - there is an excellent facility for printed material. However, there is also an audio studio for taped instructions and information, and tape duplication at very reasonable prices, and a designer on the permanent staff for advising and arranging graphic illustration and photography, film strips, educational games, etc. TV and films have so far been considered

too expensive to tackle. We can however bulk buy published materials for use in individual units at a good educational discount, where we know we can use the materials widely.

5. Who produces the material?

The Editorial Board members, following the policies expressed by conference members, decide with the Editor on the type and range of material to be produced. The Editors in the three subjects already in progress this year began the writing, on set topics suggested, themselves but teacher/authors (including BEd students, heads, college lecturers, advisers, etc) now contribute the bulk of the work, either individually or writing in working groups where they benefit from one anothers experience, suggestions, criticism etc. Much of the 1st Year bank in these three subjects in fact consists of redesigned worksheets already used by teachers in local schools for independent learning - most valuable as they are already tried and tested. A small payment is made to teacher/authors offering assistance in writing or contributing their own work. The Editorial Boards so far have been grateful for all contributions which they have incorporated into the bank if they have been able to see a place for it.

6. Must one buy the whole bank of materials?

It is possible to buy individual units, but the Local Authority subsidy is not so good in this case, as we are trying to promote the use of this type of material, and whole banks in schools provide a much better basis for a successful experiment.

7. Cost of Materials to Schools

The whole bank of materials in each subject presently costs £48 per bank, which includes multiple (around 6) copies of about 40 topics and all the relevant extras such as tapes, film strips, etc. e.g. approximately 200 resource packages for £48. A 10% replacement factor is included in the costing, so that materials can be serviced or replaced, or revised if necessary, once in schools. The Unit is very conscious of costs to schools and is negotiating bulk buying of suitable asette players at under £11 each.

8. Editorial Board Commitment

The commitment is to one or two afterschool meetings per term on average. In the first place the Editorial Boards are concerned with devising the headings under which resources are to be produced. Gradually they may wish to become involved in the writing itself, or in direction of the writing of materials by individuals or working groups in their areas. Eventually there will be a need to devise ways to help teachers keen on using the material to introduce them into the classroom situation. We are very conscious of the heavy commitment of teachers' time already however,and their principle role is to support and guide the Editor. None of the Social Studies Board for instance have in fact done any actual writing, while all of the Maths Board have chosen to.

PRELIMINARY POINTS RAISED BY CONFERENCE MEMBERS FOR ATTENTION BY THE EDITORIAL BOARD

a) Science for remedial children with basic language difficulties is neglected and needs particular attention in compiling a bank of resource based materials.

b) There is a need for background readers supporting standard courses already in use.

c) In mixed ability situations where low ability children need supervision in practical work, there is a need for enrichment material for higher ability children.

d) It must be possible to evaluate the ability level and the workability of the materials -they must therefore be tested thoroughly before being produced.

e) The Editorial Board were going to have to solve the problems of where the greatest needs for resource-based learning materials lay - whether solely with high and low ability children or with a large amount of good materials at varied levels which would enable the teacher to cope with individual members of the class while others worked independently, regardless of which standard course was in use.

The Director suggested that with the Conference's approval questionnaires would be sent to everyone concerned, and information gained from them by the Editorial Board would then hopefully provide a very complete picture of the state of play in the subject throughout the County - the schemes of work already operated, the sort of resources needed and the main problems teachers have to contend with. This would

provide a very sound basis for their policies with regard to material produced, and useful information to act as. a guide to them for the first few months of next year.

The Director emphasised that the Unit would keep all Conference members in touch with the Unit's development on the Science side, and hoped that they would get in touch whenever they wished.

EDITORIAL BOARD MEMBERS ELECTED FROM THE CONFERENCE

Woodspring Area
Brian Griffiths - Nausea School
Russel Lewis - Broadoak School

Bath & Wansdyke Area
Graham Whitfield - Culverhay School
Michael Greenslade - Norton Hill School

North Bristol Area
Nina Sulley - Henbury School
Nigel Darby - Lawrence Weston School

South Bristol Area
Lena Rust - Hartcliffe School
Ralph Giles - Bedminster Down School

Northavon Area
Terry Barker - King Edmunds School
Jeremy Gunter - Marlwood School (Castle School in September)

East Bristol & Kingswood Area
Graham Mathews - St George School
George Everard - Speedwell School

APPENDIX 7

OUTLINE FOR AN ATO/DES COURSE ENTITLED "THE IMPROVEMENT OF LEARNING IN MIXED ABILITY GROUPS FOR 11-14 YEARS IN SCIENCE".

AIMS OF THE COURSE

To illustrate the variety of approaches being used by teachers of mixed ability groups.

To analyse the Resources produced by the Avon Resources for Learning Unit.

To study the forms of organisation adopted by Wiltshire teachers in mixed ability groups.

To provide support to teachers in taking decisions on how to match content, style of resources, methods of organisation and evaluation to their particular pupils to produce the most effective learning.

CLIENTELE

Science Teachers.

SUGGESTED PROGRAMME

The course will start and end with a weekend conference with 14 meetings in 12 months. The 14 meetings will be made up of (a) 2 in-service days fixed by the L.E.A., (b) 8 x 31/2 hour late afternoon, early evening sessions, (c) 4 x 31/2 evaluation meetings.

Apart from the weekend conference, the meetings will take place in individual schools and local teachers centres, to support the teacher in the classroom and cut down travelling expenses. Separate arrangements will be made for Avon and Wiltshire teachers to reduce travelling costs.

OPENING CONFERENCE

A Friday December 1976 6.30-9.30	The problems of organising mixed ability groups in Science for 11-14 year olds.
Teachers Panel	Don Foster: Avon Resources for Learning Unit. Vivien Bellamy: Dunworth School, Tisbury. Tony Cole: Wootton Bassett School. Paul Hunt: Dorcan School
Display of Resources	The ILIS and ASE collection
Saturday 10-11	Resource Based Learning: Philip Waterhouse.
11.30-12.30	The Organisation of Mixed Ability Groups: Jack Whitehead.
14.00-15.30	Discussion Groups organised for teachers with similar problems in easy travelling distance.
16.00-17.30	The formation of Workshop groups. Aims Programme

19.30-21.30 Commitment to Action. Programme of activities for the Spring Term to be produced including venues and dates.

THE 14 WORKSHOP AND EVALUATION SESSIONS - 58 HOURS

To promote local curriculum development, the following venues are suggested:

THE TWO LEA IN- SERVICE DAYS - 2x 8 hours

Wiltshire teachers: Swindon Curriculum Development Centre.
Avon teachers: Resources for Learning Development Unit.

THE 8 x 31/2 HOURS WORKSHOP MEETINGS

Individual Schools of members of the Workshop group.

THE 4 x 31/2 HOUR EVALUATION SESSION

Wiltshire teachers: Swindon Curriculum Developments Centre.
Avon teachers: Resources for Learning Development Unit.

THE CONTENT

IN-SERVICE DAYS:

Lecture by senior LEA advisor on the authorities organisation and resources to meet the teachers problems.

Lecture by a teacher on the problems emerging from the classroom.

Display of resources and apparatus.

WORKSHOP MEETINGS

Starting with the resources being used within the schools, the workshops will focus upon improving the quality of their organisation and content. Existing resources from The Schools Council and other sources will be used to create new resources or to modify the existing ones. Some of these resources will be produced with the University Facilities and funded by the DES. Some of the Resources will be reproduced in the individual schools and LEA reprographic Units. The main focus of workshop will be the criticism and improvement of the resources in use. Resources, when tried, will be further criticised and modified as necessary.

EVALUATION SESSIONS 4 x 3 hour meetings
As part of the process of evaluation the lecturers will make available their own intentions and encourage the expression of the teachers intentions in taped conversations. These conversations will be transcribed and copies given to members of the groups.

Once a term the lecturer will video tape and interview several pupils in two schools to detect the form of organisation of the resources, the learners interpretation of the changes and a description of what the pupils have produced. This description may include the results of norm and criterion referenced assessments.

One meeting each term will be devoted to a discussion of the similarities, differences and contradictions which invariably emerge when intentions are compared with the information collected from within the classroom.

THE FINAL CONFERENCE
Saturday
December 1977
10-12.30 Display of pupils work.

Teachers Panel to evaluate the course

2-4.30 Future Strategy

Total Time about 80 hours

Support: Specific support has been given by the Science adviser for Wiltshire, Dr. P. Biggs, the Science Editor of Avon Resources for Learning Unit, teachers in the Wiltshire and Avon Schools.
Fees: The cost of lecturers fees, travelling expenses and resources will not exceed £600.

The following teachers are improving their science curricula for their pupils and would welcome. contact with you.

Tony Grant	Durrington School Durrington Salisbury tel. 0980/52467	
David James	Dorcan School	Head of Science
Paul Hunt	St. Pauls Drive Swindon. tel. 0793/25231	A special thanks for help with the process of evaluation
Paul Swanston		Head of Lower School
John Sheard	Wootton Bassett School	Head of Science
Bryan Entwistle.	Lime Kiln.	
Margaret Hannon	Wootton Bassett 0793 370/2121	
Tony Cole	(Margaret and Tony have probably the most experience of organising learning in mixed ability science groups).	
Colin Dodds	Sheldon School Hardenhuish Lane Chippenham 96/51216	Head of Science
Don Foster	Avon Resources for Learning Development Unit Redcross Street Bristol. tel. 559491	Science Editor
Vivienne Bellamy	Dunworth School Weaveland Road Tisbury 074 787/480	
Martyn Hyman	Hreod Burna School 14-18 Comprehensive Akers Way Swindon 0793/21335	Martin is one of the Hreod Burna Science Team who have organised independent learning for mode 111 Science Groups
Tom Philips	Wiltshire Curriculum Development Centre Sanford Street Swindon	Tom is coordinating in-service provision in Wiltshire
Dr. Peter Biggs	Science Adviser County Hall Trowb ridge	
Frank Hodgson	Senior Adviser (Secondary) County Hall Trowbridge	
Jack Whitehead	Bath University School of Education Claverton Down Bath 0225 6941	I.L.I.S. The ASE/ILIS resource collection of independent learning resources can be obtained on loan from the Bath Centre.

THE PROJECT ON THE SWINDON AREA MIXED ABILITY EXERCISE WAS LOCATED AT: THE WILTSHIRE CURRICULUM DEVELOPMENT CENTRE SWINDON.

This Research Report on a Schools Council Local Curriculum Development Project shows:

The creation of a network of in-service support for teachers

The organisation of Resources for enquiry learning

A self evaluation of the differences between teachers intentions and classroom practice.

This report was published at The Wiltshire Curriculum Development Centre Swindon
Warden. Mr. T. Philips

Illustrations, layout and design by Aaron Evans.

Printed by Kingston Press, Bath.