

problems. Only after this do they help the people construct for themselves what it is that they require. This may take more time than would be involved in a more directive approach, since changes in belief are usually involved as well as new information, but it avoids wasted effort and wasted resources. Further, the recipients are not left in a state of dependence on the aid given. We see this approach as having many similarities to the approach needed to change teachers' ideas about teaching and to change pupils' ideas in science.

Our experience with the Learning in Science Project, which was the starting point of this book, has been that many teachers need to be sensitised to what often happens in existing science lessons, and how children's ideas are being influenced, or not influenced, by schooling. Once teachers have convinced themselves that the existing conceptions of children are important — since such conceptions will inevitably be incorporated in future learning — their teaching frequently does alter, sometimes in small ways at first, to take greater account of children's present ideas. In this regard we see the main task of science teacher-educators, including senior teachers and curriculum-developers, as helping teachers:

- to confront the realities of classroom learning,
- to understand the importance of children's existing ideas,
- to understand children's ideas and,
- to realise how children's ideas compare with the views of scientists.

Most young children are, thank goodness, inherently curious. As we have seen they are only too willing to formulate theories about why the world is as it is. Our job as science teachers is to devise situations which sharpen up their ability to test those theories, which help them to assemble systematically the facts of the case before jumping to conclusions, and which highlight the consistencies and inconsistencies in their own explanations. Our job as science teacher-educators and curriculum-developers is to help teachers find increasingly more effective ways of tackling such problems.

Like all good aid projects, it is definitely a self-help and co-operative operation!

Appendix A

Finding Out What Children Think¹

Beverly Bell, Roger Osborne and Ross Tasker

Throughout this book we have emphasised how important it is to find out what children think about a topic *before* we start teaching it. Sometimes there are research findings to guide us, often none. Even where research has something to tell us, it is always about other children, not our own. While many findings in science education research appear to be generalisable, across age-levels, across various curricula and across cultures (for example, children's ideas on causation), others are not. Thus, wherever possible, we should check our assumptions about children's prior knowledge with the situation in our own schools.

Interviewing children

Finding out what children *really* believe is not at all easy. Children spend a considerable portion of their childhood learning how to please their elders, and they are adept at fastening on small cues as to what is expected of them. In a teaching role, which even non-teachers adopt from time to time we are prone to use leading questions, to reject a 'wrong' answer by raising our eyebrows or rephrasing the question, and to praise the 'right' answer when we get it. Verbal and non-verbal cues such as these can quickly influence the authenticity of children's responses whether in a group or in a one-to-one situation. Effective probing of children's real ideas requires a conscious value-free approach which it is not at all easy for teachers to maintain — but maintain it we must if we are to get the information we need.

Whether we decide to proceed by interviewing individuals or by talking to small groups of children — and there are advantages and disadvantages in both these approaches — we have found it helpful to explain openly and clearly what we hope to achieve. For example:

Next week we are going to start a new series of lessons about various kinds of rocks. Before we do so, I want to make sure that we are all talking about the same thing. What do you mean when you talk about a 'rock'?...

¹ This appendix has been adapted from Bell and Osborne (1981) and Tasker and Osborne (1981).

Children often talk so quickly that it is impossible to write down even a skeletal account of their responses so we invariably use an audio tape-recorder if at all possible. We turn the recorder on *after* the interview has begun, explaining that we wouldn't otherwise be able to remember everything that they said. We also tell them that we will remove anything from the tape that they are unhappy about, if they wish, thereby suggesting that we do not see it as a big issue. The recorder needs to be placed close to the child (children) as the adult's voice is almost always stronger than the children's and in any case we can fairly easily guess what we said even if it is not very distinct. We always try to sit *alongside*, rather than opposite, a child or group.

We have found the interviewing of individuals a surprisingly difficult business and we have learnt not to be too depressed especially with our first attempts. Even after more than 500 interviews as part of the original Learning in Science Project we were still not completely satisfied with some of our efforts. As Ravenette (1977) has suggested, the skill of the interviewer is to know when to ask a question and what question to ask. In the Interview-about-Instances (I.A.I.) approach, as with most interviews, the aim is to get the interviewee to talk. The interviewer chooses the topic, but what the interviewee says is most informative if it does not need to be extracted laboriously by a long series of interviewer questions followed by mono-syllabic answers. The aim of the interview is to get pupils to express their ideas in their own words. The interview is not an interrogation. The aim is to ask questions which show a genuine interest in the responses the interviewee makes and encourages children to respond further. Questions need to be easy to answer rather than difficult, neutral rather than leading, but on the other hand penetrating rather than superficial.

It is important to monitor one's own interviewing performances, as it is almost impossible otherwise to avoid the intrusion of such cues to children as we referred to earlier. Some problem areas, based on our own experience, and comments made by Simons (1981), are:

1 An interviewer needs continually to reiterate his or her stated interest in the child's meanings, and not go looking for an answer which will be assessed with respect to some external criterion. For example, consider:

Interviewer: *Do you know why the person might be able to see the candle?*

Interviewer: *Do you know how the eyes work?*

Interviewer: *Do you know what happens to the sunlight on the moon?*

These questions would have been much better if they had been phrased differently. For example:

Interviewer: *Why do you think the person might be able to see the candle?*

Interviewer: Can you explain to me the way you think the eyes work?

Interviewer: *What do you think happens to the sunlight on the moon?*

An interviewer's tone of voice, expression, emphasis and intonation are important considerations, as they need to be encouraging but not suggestive of expecting any particular answer. Often a nod, smile or 'a-hum' can be given to maintain communication and put the child at ease. However, care must be taken not to convey messages to the child other than those intended.

Teachers and ex-teachers have a particular problem when it comes to the neutrality within the I.A.I. technique. When teachers interact with students individually, they often almost unconsciously lead them through a series of questions which are aimed at developing a new student conception. This is the exact opposite of the I.A.I. procedure. *It is not the interviewer's conceptions that we are trying to get into the child's head but the child's conception that we are trying to get into the interviewer's head.*

This complete turn around requires the teacher to make a major change in orientation which some find very difficult to do initially, either lapsing back to a teaching mode or at least to a mode which is simply checking to see if the interviewee has the 'right' answer. Such a lapse is critically damaging to the tone of the interview. The interviewer is now seen by pupils as not really interested in their personal view. He or she is seen by the child as a teacher in disguise, giving an oral examination. On the other hand, if the interviewer can, both by word emphasis and mannerism, convey to the pupil that he or she is really interested in the person's view, whatever the view happens to be, then pupils respond and grow in confidence as the interview proceeds.

2 One of the advantages of the I.A.I. method is that the interview is a mixture of *closed questions*, for example 'In your meaning of the words electric current-- is there a current in the battery?' (which are simple to answer) and *open questions*, 'Why do you say that?' (which are penetrating). A balance of closed and open questions, of simple and difficult questions, of superficial and penetrating questions, of neutral and very specific questions, is most important. In this way it is possible to maintain pupil confidence but at the same time establish clearly the way the pupil thinks about the topic under discussion.

Follow-up questions are particularly crucial, but must not 'lead' the respondent. For example 'What happens to the light?' is a better question than 'Does the light stay around the candle?' The latter question has already made assumptions about the way the child views the situation. It also encourages a simple yes or no response. Such interview data is really of no value as evidence to support the proposition that a child has a particular point of view. He or she merely agreed or disagreed with the interviewer's view, which is quite a different matter.

3 The interview technique enables the reasons behind a student's initial answer to be explored by including supplementary and exploratory questions. Listen carefully to the answers given and follow them up until you are quite confident that you fully understand the response. For example:

Interviewer: *Does the mirror make light?*

Student : *You can get your reflection. If you shine a torch in it, it'll make light.*

Interviewer: *What's a reflection?*

Student : *Something you look at and it does whatever you do.*

4 A useful technique, particularly when one gets an unanticipated answer, is to repeat the answer back to the child, as if mulling it over. This has a dual purpose: (a) it checks that the child's response is audibly recorded on the tape, and (b) it allows both the child and the interviewer time to think about the answer.

An interviewer needs time to formulate a question to follow up a student response. Unanticipated responses are the high point of an I.A.I. interview and the interviewer can't afford not to follow them up. For example:

Interviewer: *Does the rainbow make light?*

Student : *People say that God made it.*

Repeating the response, for example 'People say that God made it?', in a thoughtful tone of voice, also gives the child the opportunity to elaborate if she so wishes.

If this technique were used continually, then obviously the whole interview would become very stilted. On the other hand, when a response is repeated, it is *critical* that it is repeated exactly. Here is an example of poor interviewing:

Interviewer: *What is steam make of?*

Student : *It is kinda like water?*

Interviewer: *It is water.*

Student : *Yes.*

The pupil didn't say 'It is water' and there is *no* justification for the interviewer's definite statement in response. In I.A.I. we need children's own responses — not agreement, or disagreement, with an interviewer's comment.

5 This technique of repeating the response leads us to the more general issue of 'wait-time' — that is the time the interviewer waits for a response from the pupil. A successful interviewer has to be patient. Pupils need time to formulate a response. Do not butt in, if for no other reason than that the interviewer

must appear interested in *everything* the pupil has to say. On the other hand, it is possible to wait too long when no response is forthcoming. Experience helps one to judge how long a pupil requires to think a question through. Sometimes a little encouragement is required. For example:

Interviewer: *I just want to get your meaning. Remember, there are no right or wrong answers.*

Interviewer: *Let me try and put that question another way.*

Interviewer: *Well, let's leave that now. We might come back to it later.*

It is also important to realise that some children or indeed, most children from some cultures — will sometimes respond initially with a 'yes' simply to indicate that they understand the question. The interviewer must then wait for the *answer* to the question.

6 Some students express doubt and hesitation. This should then be explored by the interviewer. For example:

Student : *I don't know.*

Interviewer: *You are not sure?*

Student : *No.*

Interviewer: *Can you tell me what you are not sure about?*

Often when a student says 'I don't know' he or she has lapsed back into assuming that the interviewer is looking for the 'right' answer. Frequently just repeating the question by re-emphasising '*in your meaning of the word...*' is sufficient to overcome the problem.

7 Sometimes students will misinterpret or misunderstand a question. This is interesting in itself and the interviewer may wish to explore this. On the other hand the interview technique also enables the interviewer to clarify the question and clear up any misinterpretations.

Interviewer: *What happens to the light that it makes?*

Student : *You use it to see with.*

Interviewer: *Does it move anywhere, or does it stay around the candle?*

Student : *Stays around the candle.*

8 As stated earlier the most important response is often the unanticipated one for it indicates the child is thinking about things in quite a different way to the interviewer. Such responses need to be handled with delicacy as the aim is to appreciate the child's thoughts without distorting them with inappropriate questions.

If you do not understand a student's answer, do not ignore it but try to get at just what it is that the student is attempting to tell you. For example:

Interviewer: *I am not quite sure I understand what you are trying to tell me. Could you tell it to me another way?*

Inevitably, some unusual responses are not seen as such in the interview setting. The reading of the transcripts often highlights a point not obvious in the interview itself. For example:

Interviewer: *Could you describe how it is that the person can actually see the sun?*

Student : *The same way as he could see the candle, except for, he couldn't go far enough away from the sun so he wouldn't see it. And when he's... unless the earth rotated quite fast he might.*

In this case the interviewer did not chase up on the comment about the earth's rotation. An appropriate question might have been:

Unless the earth rotated quite fast he might — can you explain what you mean by that?

Clarifying responses is awkward where a student gives a long reply, and one does not want to interrupt in case it disturbs the student's line of thought. The interviewer must try to remember the various probe questions which he or she will inevitably formulate during the long response, and introduce these probing questions into the interview when the student has stopped responding.

If lapses in questioning do occur, all the interviewer can do is to be sensitive to them and attempt to concentrate harder on the student's answers in the next interviews. Such concentration is extremely demanding, and for this reason not more than two interviews should be undertaken without a reasonable break. Good listening and questioning require hard and fast thinking!

9 Another reason why an interview is so demanding is that the interviewer needs to be sensitive to contradictory responses. These need to be explored fully, at every opportunity. For example:

Interviewer: *Is the grass living?*

Student : *No, because it hasn't got a brain, doesn't eat.*

Interviewer: (Later) *Is a tree living?*

Student : *Yes, it moves and feeds on particles in the air and needs water, it needs fertiliser.*

Interviewer: *You said the grass wasn't living and yet you say the tree is.*

Student : *Oh, if (the grass) is just like a tree, needs water and it moves by growing.*

Interviewer: *So why did you say that it was not living (before)?*

Student : *Because it wasn't like us.*

Naturally the interviewer has to keep in mind a student's earlier responses so that contradictions with respect to an earlier part of the interview can be picked up. This is another reason why not too many interviews should be attempted consecutively. It becomes increasingly difficult to remember if an earlier contradictory statement was made by the current interviewee or a previous one.

10 The interview technique also allows the opportunity for students to query the wording and meaning of a question. For example:

Interviewer: *Does a heater make light?*

Student : *What kind of heater? One of those with orange bars?*

Interviewer: *Is the book living?*

Student : (Pause) *I don't know what you mean.*

Interviewer: *Well, we'll start with another one. Is the boy living?*

Student : *Yes.*

Be patient and supportive of this kind of questioning. It encourages students to see the interview as something different to the normal test situation.

11 The interview technique can be used with very young children. Since questioning is usually oral those with a limited vocabulary and perhaps reading difficulties should not experience any problems. In their replies children also give their responses orally and by gesture or facial expression. However, it should be pointed out that young children may interpret the pictures literally.

Interviewer: *Is the bird living?*

Student : *Yes, living: if he was dead, he'd be lying on the ground and most probably be eaten by now.*

In the interview situation this kind of problem has to be expected from time to time. In this particular situation the dead/alive perspective was able to be replaced by careful questioning, directed towards the living/non-living distinction. Young students may also focus on unanticipated details in the diagrams.

Interviewer: *In your meaning of the word, is a cow an animal?*

Student : *It has four legs and not two like a bird. It is an animal.*

Interviewer: *Is there anything else about the cow that tells you it's an animal?*

Student : *Those things (pupil points to the udder) under there for feeding.*

Again the additional response may be interesting in itself.

12 Occasionally, despite all efforts to make the interview informal and non-threatening, a child will lose confidence rather than gain it as the interview proceeds. The child's responses tend to become mono-syllabic and the silences longer. It is best to discontinue the interview in such cases.

With the shy, withdrawn child there is undoubtedly a major problem with the I.A.I. technique. Our knowledge of learners' concepts and cognitive systems, using the technique, comes from what a child says or does. However, one who does not talk in an interview can not be categorised as knowing nothing. We have to accept this problem, and can but assume that the views of such children are not scientifically different from their more talkative peers. Subsequent survey techniques following interview work can check this to some extent.

13 It is essential to read the question on each interview card to the student, or in some other way to verbally identify the card you and the interviewee are discussing for a useful audio-tape record. When transcribing and analysing data an interviewer statement such as, 'Now, what do you think about this card/question?' is not helpful when you are not sure which card was actually being discussed at that time. This can be a particular trap for the unwary when an earlier card is reviewed to clarify an apparent contradiction in responses, because then the cards are being discussed out of their normal sequence. 'Let's compare your answers to these two cards', is inadequate. One needs to state something like 'Let's discuss these two cards — the one with the seagull on it and the one with the whale on it.' Again, where a child refers to a card but doesn't mention it by name the interviewer needs to make quite clear that it is verbally identified for the purposes of the audio-tape record. For example:

Student : *If you go back to this card.*

Interviewer: *The one with the whale on it?*

Student : *Yes.*

Interviewer: *Hm Hm.*

Student : *Well, I think that is not an animal...*

14 While the one-to-one situation enables an interviewer to get some sort of response to every question asked, he or she must be sensitive to the possibility that a child may give just any answer, simply to avoid a silence. Subsequent questioning can investigate the depth of thinking upon which the answer is based. This is not a common problem, we believe, but the interviewer needs to be mindful of the possibility.

15 Sometimes a structured question or card will be intentionally passed over by the interviewer. This may be necessary if the pupil shows signs of exasperation at being asked *what obviously to him or her is exactly the same question to which the reply is always the same*. However, one can never assume that, if the card had been shown, the pupil would have definitely responded in the way predicted. Thus omission of a card or cards may make the comparative analysis of the data from different pupils very difficult.

To summarise

The interview-about-instances technique places a very heavy responsibility on the interviewer. She or he has to be skilled in the art of questioning and also knowledgeable in the content area under discussion to be able to assess pupils' responses immediately and make decisions about further questioning. Fortunately, most of us improve with practice. During a set of interviews on one particular topic, too, the interviewing becomes easier and more effective, since fewer answers are given which are completely unanticipated. Furthermore, in transcribing earlier sessions the interviewer learns from his or her mistakes.

For these reasons, if for no other, it is most desirable to transcribe tapes as soon as possible after an interview. This also has the advantage that the interviewer is more likely to remember what was said where the tape is indistinct. The interviewer should always listen to each tape, and transcribe it personally wherever possible, but be warned, it is a time-consuming task.

Finally, most novice interviewers find it helpful to get a more experienced interviewer to sit in with them during the third or fourth interview. That is, after they have first gained a little confidence! If the novice does one interview, and then the more experienced person does the next interview, this raises many useful discussion points. Alternatively, or in addition, it can be most helpful to get an experienced interviewer to read the novice's transcripts and point out leading questions, responses that should have been explored further and so on. No interview, however experienced the interviewer, is so good that it couldn't be improved, so there is no need to be embarrassed by your first mistakes!

We may have made it appear that effective interviewing is an impossible task, especially for the busy teacher. We hope you will not be discouraged, however; the important thing is to try for yourself to find out what children really think. After a few interviews, refer back to our check-list (Figure A1); it may be more meaningful, and hopefully helpful, at that stage.

Collecting information in classrooms

A great deal can be learnt about children's thinking — and attitudes — by observing their interaction with the teacher and amongst themselves during ordinary classroom activities. This kind of information-gathering should not be left to outside researchers: it should be facilitated for teachers within their own schools.

Figure A1 Checklist for Interviewers

Do's	Don'ts
1 Try to establish clearly how and what the <i>pupil</i> thinks. Emphasise it is the <i>pupil's</i> ideas that are important and are being explored.	Do not give any indication to the pupil of your meaning(s) for the word or appear to judge the pupil's response in terms of your meaning(s).
2 Provide a balance between open and closed questions and between simple and penetrating questions. In so doing, maintain and develop pupil confidence.	Do not ask leading questions. Do not ask the type of question where it is easy for the pupil to simply agree with whatever you say.
3 Listen carefully to the pupil's responses and follow up points which are not clear.	Do not rush on, e.g. to the next card, before thinking about the pupil's last response.
4 Where necessary to gain interviewer thinking time, or for the clarity of the audio-record, repeat the pupil response.	Do not respond with a modified version of the pupil response; repeat exactly what was said.
5 Give the pupil plenty of time to formulate a reply.	Do not rush but on the other hand do not exacerbate embarrassing silences.
6 Where pupils express doubt and hesitation encourage them to share their thinking.	Do not allow pupils to think that this is a test situation and there is a right answer required.
7 Be sensitive to possible misinterpretations of, or misunderstanding about, the initial question. Where appropriate explore this, and then clarify.	Do not make any assumptions about the way the pupil is thinking.
8 Be sensitive to the unanticipated response, and explore it carefully and with sensitivity.	Do not ignore responses you don't understand. Rather follow them up until you do understand.
9 Be sensitive to self-contradictory statements by the pupil.	Try not to forget earlier responses in the same interview.
10 Be supportive of a pupil querying the question you have asked, and in this and other ways, develop an informal atmosphere.	Do not let the interview become an interrogation rather than a friendly chat.

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|---|--|
| 11 Read the question out loud to pupils. | Do not rely on pupils' reading ability. |
| 12 Where all efforts to develop pupil confidence fail, abort the interview. | Do not proceed with an interview where the pupil becomes irrevocably withdrawn. |
| 13 Verbally identify for the audio-record, the pupil's name, age and each card as it is introduced into the discussion. | Do not return to earlier cards without verbal identification for the audio-record. |
| 14 Be sensitive to the possibility that pupils will give an answer simply to fill a silence. | Do not accept an answer without exploring the reasoning behind it. |
| 15 Appreciate that a card omitted will result in missing data. | Make no assumption about the way a pupil would respond to a particular card. |

A necessary pre-condition, of course, is that it is the students who are being observed — not the teacher. Teachers who expose their classes to this kind of observation must be assured that their performance as *teachers* is in no way being judged, although it is inevitable that what they say to their students, individually or as a class, will affect the thinking and responses of those students. Our experience has been that most teachers, while a bit hesitant until they are sure of the goodwill and non-judgemental approach of the observer, actually welcome the chance to find out what is really going on in children's minds as they participate in a lesson. Not once have we had an adverse reaction to the information so gathered — factually recorded, but no more so than one expects in other colleague interchanges.

Perhaps the easiest way to suggest how such observations should be handled is to describe how we proceeded in the Learning in Science Project. Our aim throughout was to focus on what the learners thought and did, with as little perturbation to the situation as possible.

- 1 As outside observers we always aimed to make ourselves as inconspicuous as possible, both in appearance and behaviour. We dressed informally, but not too much so, and we found it best *not* to be assumed by pupils to be an inspector (supervisor), visiting teacher, or even a teacher-in-training.
- 2 We started our observations with the class at the beginning of a lesson. The settling-in period which normally occurs at a change of lessons provided the ideal opportunity to enter the class and to locate ourselves within it without drawing much attention to ourselves.
- 3 As far as possible, we assumed the status of a pupil. This was done in a variety of ways. We preferred the teacher not to introduce us. If we felt the

needed to introduce ourselves to an individual student, we used our first names only. We tended to sit in the body of the class, usually asking students where there was a spare seat. We sought student permission to associate with them while they worked or while we talked to them about their work. In working with students we always referred to the teacher formally.

The following exemplifies what we would regard as a successful integration into a class at the beginning of a lesson. In this case the student directly in front of the researcher was curious about why the researcher was there.

Student : *Hello.*

Researcher: *Hallo.*

Student : *Are you a checker? (Inspector)*

Researcher: *No.*

Student : *Are you a student teacher? (Teacher trainee)*

Researcher: *No.*

Student : *Why are you here?*

Researcher: *Oh, I just want to learn about science and Mr... (teacher) said I could come today.*

Student : *Oh... then you better come up and sit by me.*

4 We avoided public interaction with the teacher. To be seen talking informally and quietly to the teacher could have identified us as one of them as far as the students were concerned. When interaction was unavoidable it was done openly so that students could hear.

5 We placed any observation instruments, for example tape recorder or notebook, on the table from the beginning but handled them in a matter-of-fact way. We kept note-taking to a minimum. Our audio recorders were small, portable and encased. We found it best to use the recorder freely but to ensure that it was never the focus of attention. Once it was switched on we then ignored it as far as possible. When asked by students 'Why have you got a tape recorder?' we found the best response was to say that we were there to learn about science and did not want to miss anything. This was readily accepted, in our experience, perhaps because it complemented the kinds of questions we asked.

6 As far as possible we fitted our movements and actions to the stream of class behaviour and conformed to teacher directions. (That sometimes meant sitting down when the class was asked to do so.)

7 We were interested in student actions in an unobtrusive way. We tended not to question students too soon. Our experience was that, if we intervened with questions too early, it influenced subsequent behaviour. When talking with students we used the students' own idiom as far as possible.

8 When we asked questions we framed them in such a way as to elicit the views of the student. As we pointed out above, teachers almost unconsciously ask questions in a particular way to establish whether or not students hold specific views, and then to lead them to a new view. We found that it was all too easy for a researcher who has been a teacher to continue, or revert to, this style of questioning. In addition, if a student asked a question which would normally be directed to the teacher, we did not answer but rather implied that it was a question for the teacher to answer! We emphasised the view that we were there to find out about learning, about what students were doing and thinking. The following is an example of an effective probing of children's ideas.

Researcher: *What's happening when the crystal dissolves?*

Student 1 : *Dissolves and keeps going.*

Researcher: *Is the crystal still there?*

Student 2 : *Yep.*

Student 3 : *Yeah — just though.*

Researcher: *Just though?*

Student 4 : *Yeah... the colour's come out of it.*

Researcher: *The colour has come out of it?*

Student 4 : *Yeah... dissolved out of it.*

One cannot take for granted what children are actually doing, just from observing them. It is often necessary to probe actions as well as thinking.

Researcher: *How did you find all these (features)?*

Student : *Some of them, I looked up the back at the index and the others I just looked at the countries.*

Researcher: *What did you do first? Look in the index or at...?*

Student : *At the pages.*

Researcher: *Is that quicker or what?*

Student : *Yeah, that's quicker — a lot quicker than using the index.*

Researcher: *What's hard about using the index?*

Student : *I don't understand the North and the West.*

It is all too easy to slip into a teaching role and this soon becomes obvious, albeit subconsciously, to students. Such interviews yield little information, contrary to the main purpose of the exercise.

- Researcher: *Which is the part you don't understand? This?*
 Student : *Yeah, these amounts are different in the test tubes.*
 Researcher: *So what does the whole sentence say? From here?*
 Student : *The amounts in the test tube all weigh the same but the amounts are different in the test tubes.*
 Researcher: *What do you mean by amounts? (Silence)*
 (The researcher now begins the slide into teacher.)
 Researcher: *How much iron sand did you need (to weigh the specified amount)?*
 Student : *A little bit.*
 Researcher: *Where did it come up to?*
 (The researcher is now firmly committed to teaching what amount means.)
 Student : *About there.*
 Researcher: *All right, now how far up did the sawdust come?*
 Student : *Right up to the top.*
 Researcher: *What about the water?*
 Student : *The middle.*
 Researcher: *Right, so the amounts are different... the volumes are different.*

Finally, many of the comments about the structured interview discussed earlier apply equally well to the informal interview in the classroom setting. Figure A2 provides a checklist of some do's and don'ts based on our experiences. The overriding aim in working in classrooms is, in our view, to be unobtrusive and to achieve acceptance by students at an almost adult-to-adult level. Naturally it is difficult for us to be certain just how students considered us, but our experience has been that, by adopting the procedures we have outlined, we were assigned a suitable role in the classroom — something like a potential adult student trying the subject out to see if he/she liked it! At least the off-task comments and actions made in our presence suggested that students saw no need to change their behaviour as a result of our presence.

Figure A2 Checklist for Classroom Observers

	Do's	Don'ts
1	Dress informally.	Do not dress in a way which will suggest that you are an authority figure.
2	Start your observing at the beginning of a lesson.	Do not arrive late for a lesson.
3	Assume the status of a student but treat students on an adult-to-adult level.	Do not in any way act as a teacher or interact with students on a teacher-to-student level.
4	Interact solely with the students.	Do not interact with the teacher in the presence of students.
5	Use observation instruments quite openly, in a matter-of-fact way.	Do not turn the tape-recorder on and off or in any other way fiddle with the instrumentation during the lesson.
6	Fit in with the movements and actions of the class.	Do not be obtrusive, acting in a different manner to the students.
7	Interact with students at the minimum level necessary to obtain the required information.	Do not interact with students in a way which will alter the behaviour you wish to observe.
8	Use questions which elicit students' views, whatever those views might be.	Do not use teacher-type questions and hence assume a teaching role.