

## **Case Study 20: Cognitive Acceleration through Science Education (CASE)**

**Monifieth High School, Angus**

**This case study describes how one school has used and developed an intervention programme aimed at developing thinking skills in the context of science.**

CASE is an intervention programme taught through science. The subject that is taught does not matter; it is the thinking that is important.

This is a two-year programme consisting of 32 activities – not necessarily experiments. The timing of this programme is important and is most effective if used over P7–S2. The lessons are delivered at the rate of one every two weeks, over two years.

CASE promotes the acceleration from concrete to formal (higher) levels of thinking. Research has shown that high-grade exams require formal thinking but only 30 per cent of pupils have achieved it.

CASE works by presenting pupils with observations that challenge their preconceptions. In attempting to assimilate these observations, reasoning patterns that are more mature and of a higher order are established. Pupils respond to open-ended problems with increased confidence and creativity.

### **Why use it?**

In 1998 I attended an INSET course called 'Thinking Science' – not knowing anything about the programme. At the end of that day I came away feeling that here was something worth trying.

We were shown evidence from schools in England that showed schools where CASE was experienced showed a significant improvement in attainment in GCSEs. This improvement was not only in science but also in English and maths.

After many discussions, much persuasion and changes of staff in the school it was decided to try and incorporate CASE into our S1/S2 course starting with S1 in August 2001. It seemed a good idea to put some of the activities on trial with a class.

At present I have two S1 classes so I decided to carry out the activities with one of them. Both classes are mixed ability and require no additional support. This trial would show any immediate problems and may also be advantageous to the pupils concerned.

The activities in CASE concentrate on particular scientific skills, which are:

- control of variables

- proportionality
- compensation and equilibrium
- correlation probability
- classification
- formal models.

The first of these, 'control of variables', was the focus for this project.

Each lesson has five phases:

1. concrete preparation
2. cognitive conflict
3. construction
4. metacognition
5. bridging.

*Concrete preparation* involves the teacher setting the scene, introducing new equipment and vocabulary, etc.

*Cognitive conflict* is created by an unexpected result or observation that does not fit into preconceptions.

*Construction* is resolving cognitive conflicts through discussion either in small groups or whole class.

*Metacognition* is thinking and talking about thinking – asking pupils to explain their thinking and not allowing them to evade an answer. As teachers we expect an answer immediately but it has been shown a more realistic time for processing and answering is about 15 seconds so in CASE we wait for an answer.

*Bridging* involves applying new thinking to new contexts.

It is these last two that are the most important in leading to progression of thinking.

## **Initiating CASE**

Before you start using CASE it is important to know your class, as the grouping is particularly important. Able pupils are grouped with the less able and unlike a normal science lesson the groups are larger and are changed in different lessons.

Once the decision had been taken to start CASE, I had to give a lot of thought to the groups not just in terms of ability but also who may not communicate effectively with each other.

When these lessons were introduced, I told the pupils that the answers they got were not important and they would not be assessed on the work. This took a while to sink in, so they are allowed to put the worksheets in the bin on the way out of the room but some of them are retrieved to look at what they write.

The CASE lessons take place during period 1 on a Monday when the pupils are less tired and more attentive than in the afternoons.

## **Positive outcomes**

There have been many positive outcomes for the pupils and for me.

The pupil benefits are that:

- they are more confident in attempting to answer questions
- they appear to enjoy these lessons
- they found writing up investigations was easier to complete
- they are more willing to make predictions about experiments and to try to explain their findings
- they appear to have achieved better results in the S1 exam especially in the problem solving.

We plotted the knowledge percentage of our S1 and the CASE class achieved better results than the non-CASE class.

In the problem solving we completed a checklist. The tick shows questions where pupils have achieved full marks and questions 4 and 14b show a performance of level D or E. It was seen that the CASE class have achieved better overall results.

These results are not as reliable as they could be. A pre-test should have been given to both classes that would have shown the stage of thinking each pupil had reached. A comparison could then have been made of the results of particular individuals. It would also have helped me to form the groups; as it was, professional judgement was used.

I feel these results show that the CASE class is more confident at writing down its own thoughts and are less worried about giving a wrong answer.

The positive outcomes for me are that:

- it made me think about the questions asked – they are more open now
- more time is given to process and answer questions than was given previously
- preparation time for each activity is now known
- all the equipment needed for the first few lessons has been tested
- it has had the major advantage of giving me back some of my lost enthusiasm for teaching
- I will be able to give practical advice and support to my colleagues next year.

## **For the future**

As a department we are introducing CASE to all S1 from August 2001 and we have had INSET training recently that will help me in the future. The trainer

was able to give good advice on how to keep up the pace of the lesson – you should work at the speed of the most able.

He also told us how to modify activities to fit into a 50- or 55-minute period without losing the most important areas of metacognition and bridging.

One of the hardest areas found at the beginning was asking the correct questions for metacognition and bridging. This area is being addressed and Kings College is producing a set of questions to help teachers with this.

A CASE bulletin board is being set up on the Learning and Teaching Scotland website where questions can be asked and information exchanged with other practitioners.

## **Evaluation**

I asked the pupils to complete an evaluation sheet (Appendix 1). All of the pupils enjoyed the activities and many admitted to finding the most difficult area was answering the questions. Eleven out of 18 pupils stated that they were helped because it made them think. One pupil stated that she felt 'eager' at the end of the lessons.

I feel that this was a worthwhile project and it has influenced my teaching style. I have become much more aware of questioning techniques and more enthusiastic about my job. Although these lessons are very tiring they are very rewarding.

CASE seems to do what it promises and I will certainly be continuing to use this programme in the future.

# Thinking Science

## Pupil evaluation sheet

### Name

1. Did you enjoy these activities?
2. How did you feel at the end of these lessons?
3. Which part of the lesson was the most difficult?
4. Which part was the most easily completed?
5. Would you like to do more of these?
6. Do you feel they have helped you and why?
7. If they did not help – why not.