



CASE STUDY REPORT

Boiler suits and buns: Using modelling in science to develop independent learning

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This study was originally published in 2010 as part of the 'What Works Well' initiative, part of the National Strategies for Education in England.

Abstract

Background: The purpose of the study was to find ways to get pupils more engaged in their learning in Science by incorporating the effective use of models into schemes of learning.

Aims: The main aim of the development work was to encourage pupils to develop positive attitudes towards Science, improve attainment, and empower teachers to develop ideas and practices to improve teaching and learning.

Methods: The participants in this development work included head of school improvement, middle leader, national strategies consultant, subject leader, teacher, and pupils. The methods used included pairs of teachers sharing complementary strengths, circulating draft plans for comment, sharing effective practice, and using CPD materials and research. Pupils were also engaged in developing ground rules and using models in lessons.

Findings: The main findings of this case study are that the use of models in Science lessons has increased pupil engagement, improved attainment, and empowered pupils to become involved in their learning. It has also supported the development of self and peer assessment, active learning strategies, and group talk.

Implications: The findings of this case study suggest that the effective use of models in Science lessons can lead to increased engagement, improved attainment, and a more positive attitude towards Science. It also suggests that collaboration and feedback are essential elements for successful development.

This abstract was generated by Camtree using a large language model (LLM) and added to the original report in 2023.

Keywords: Secondary education; Science

Introduction

What were your reasons for doing this type of development work?

The development work described in this case study was undertaken for three reasons:

- To encourage pupils to develop positive attitudes towards Science to support engagement in lessons and effective learning.
- To improve pupil attainment in Science, initially at Level 6 and beyond at Key Stage 3 and subsequently at Key Stage 4.
- To encourage teachers in the Science team to be confident about developing ideas and practices to improve teaching and learning.

Who might find this case study useful?

- Head of school improvement
- Middle leader
- National Strategies consultant
- Subject leader
- Teacher

Description

What specific curriculum area, subject or aspect did you intend to have impact on?

- Science

How did you intend to impact on pupil learning?

The intention of the development was to find ways of getting pupils more involved with their learning in Science. The decision was made to explore the use of models. It was felt that by incorporating the effective use of models into schemes of learning it would make pupils' experience of learning in Science more consistent. It was also felt that if pupils had the opportunity to use models and were able to manipulate them and develop models of their own they would be more engaged in their learning and that the effective use of models would lead to the use of a wider range of lesson activities.

What were your success criteria?

- Pupils scoring higher marks on tracking and summative assessments
- Pupils with a positive attitude and disposition towards Science
- Pupils feeling able to explore ideas and take the risk of responses being wrong
- Teachers being able to adapt any model to use with any teaching group

What information or data did you use to measure progress towards your success criteria?

- Observation outcomes
- Periodic teacher assessment
- Pupils' work
- Test results

Describe the CPD approaches you used

The development work on the scheme of learning was undertaken by pairs of teachers, who were nominated by the subject leaders to combine complementary strengths and build in quality assurance. The revisions were designed to identify and share a range of active teaching strategies. Many teachers were making some use of models in their lessons so progress could be made by identifying good practice. They were often using approaches they'd developed themselves, so there was the opportunity for the sharing of effective practice and strengthening collaboration and a sense of shared enterprise in the team. Draft plans were circulated for comment; staff were encouraged to feedback on ideas and make suggestions having tried out the scheme. They were encouraged to "drop in" to each others' lessons and the (joint) subject leaders modelled this approach. At each team meeting effective practice was shared and at a whole school CPD event a group of Science teachers led an input, exemplifying how the team worked to develop and implement active learning approaches. It was considered important for the meetings to have a positive ethos and to focus on what was working well.

Who provided you with support?

- External agency
- Middle leader
- Senior management
- Subject leader

How were you supported?

The LA Science Consultant supported the developments by providing feedback on classroom practice, encouraging the sharing of effective practice and referencing the work with parallel developments in other schools. The 'Progressing to Level 6 & Beyond' materials were used and good practice shared at the local network meetings. At these meetings teachers from schools brought along examples of effective practice and discussed how they had implemented change.

Impact

What has been the overall impact on pupil learning?

- Pupils are more engaged with lessons and therefore with the overall process of learning.
- Lessons are enjoyable as well as challenging.
- It is significantly more likely that pupils will talk to each other about positive experiences that they have had in lessons.
- Lessons are much more likely to be 'high challenge - low stress'; pupils feel more able to offer their own ideas and less worried about whether they are 'correct'.

There are now an increasing number of opportunities for pupils to use, modify and devise models in science lessons in order to develop key concepts and processes. Pupils feel more able to ask questions, suggest changes and offer ideas. Learning activities are more varied in style and pupils feel empowered to become involved and respond. Critical to making this possible and practical has been developing an appropriate climate for learning; one of the ways in which this has been achieved is by engaging pupils in developing 'ground rules', which they then have ownership of.

Thoughts you think are relevant to overall impact on learning

Setting an appropriate climate for learning is central to developments such as this. Pupils have to be confident that their ideas will be valued and considered. At the same time the structures have to be in place to support effective group work so that questions such as "Have we explained this well?", "Does this get the point across?" and "Would it be better if we ..." can arise, be explored and dealt with.

It's also important for the lesson structure to support an effective sharing of ideas. Pupils will make a better job of developing models if they know that they'll be shared and evaluated. A clear and well managed time scale is also important.

Quotes you think are relevant to overall impact on learning

I liked running around outside with a tail on!

- by a pupil involved with a group activity on food chains.

I like being a Science geek!

- by a pupil who had previously taken no interest in science.

Quantitative evidence of impact on pupil learning

- Test results

Qualitative evidence of impact on pupil learning

- Learning walks / study visits
- Observation outcomes
- Pupils' work

Describe the evidence of impact on pupil learning

- Lesson observations showed how participation and engagement had increased.
- Pupil questionnaires showed how attitudes and satisfaction had increased.
- Interim test scores showed how attainment had improved.

One of the principle ways of tracking pupil progress is by means of topic test. It was arranged that in each of the tests there would be two or more questions that involved the use of modelling. Question level analysis then indicated pupil performance in that aspect. As the sample sheet from Y9 shows, pupils generally cope well with questions on summative tests that involve modelling, these marks make a positive contribution to the pupil's overall level of attainment and that pupils are, as a result, performing well against their predicted grades.

This particular group is one whose rate of progress prior to this year had, in some cases, not been as good as expected. As the sheet shows, by the end of the year none of the pupils had underperformed, many had exceeded their predicted grades by one level and some by two.

What has been the impact on teaching?

Teachers now use a range of models to support the development of ideas in lessons. They do so by drawing on plans and sets of resources which make the practice easier. The models often involve the teachers in using active learning strategies and in asking a range of questions, such as "Is this a good model?" "What's good about it?" and "How can it be improved?"

Pupils are likely to suggest modifications to models and may be challenged to devise and present models of their

own; this may involve them in group work, discussions, practical work and making presentations. Teachers use the opportunities to challenge pupils to reflect upon and evaluate models and in so doing support their movement to higher order thinking skills.

Pupils comment on the strengths and areas for development of their own models and those of their peers; hence the development of self and peer assessment has been supported. The developed use of models has supported a variety of other aspects, such as group talk and effective writing.

Quotes you think are relevant to the impact on teaching

Teachers in the department may express the view that we, as leaders, have made a real difference. In fact, they've made the difference, and we make a point of saying that.

Subject leader

We always try to find a way forward with pupils. If one approach doesn't work, it was the approach that was wrong.

Subject leader

Evidence of impact on teaching

- Evidence from observation and monitoring
- Teacher perceptions

Describe the evidence of impact on teaching

- Level of enthusiasm in lessons as evidenced by "drop ins".
- Pupil responses to questionnaires.
- The sharing of effective practice, as evidenced by collaborative lesson plans.
- Confidence of pupils in suggesting ideas and responding to questions, as evidenced by lesson observations.

What has been the impact on school organisation and leadership?

Leadership in the department has developed by teachers feeling able to develop effective practice by drawing on their own ideas and expertise and collaborating to develop and validate these. Effective practice is enshrined in schemes of learning so that it becomes an entitlement for pupils but teachers also feel empowered to draw upon and adapt approaches to personalise the curriculum for pupils; leadership has successfully supported this approach by modelling it themselves and recognising it across the team.

Improvements have been led by focusing upon the pupils' experience of learning as the prime determinant of the quality of work. By so doing the subject leadership has influenced the view that teachers have of themselves, their work and their impact. The senior leadership has recognised the significant impact this has had and has been instrumental in validating this across the school to support the approach.

Evidence of impact on school organisation and leadership

A greater emphasis upon effective teaching and learning has led to a more effective use of Teaching Assistants.

Summary

What is the crucial thing that made the difference?

Making development a collaborative venture and not an imposition.

What CPD session and resources were particularly useful?

Team meetings where staff worked in planned pairs to identify current practice and develop opportunities in the schemes of learning. Providing a clear rationale for changing practice, so that team members knew not only what was expected but why. Providing quality feedback to teachers, recognising developments that have occurred and the impact of these.

If another individual or school was attempting to replicate this work, where would they start and what would the essential elements be?

- Where would they start? Identify current strengths in their team. Encourage effective practice in a variety of ways. Develop partnerships with lead practitioners in other schools – become an ambassador for the team.
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- What would be the essential elements to include? Develop effective behaviour management strategies. Develop a variety of learning activities so that pupils are engaged. Provide pupils with an overview of the “learning journey” so that they can see how lessons serve to develop an overview of an aspect of science.
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What further developments are you planning to do (or would you like to see others do)?

- Develop the effectiveness of the schemes of learning for higher attaining pupils.
- Develop the approach more in Key Stage 4, so that it informs the type of curriculum pathway, and the provision within those pathways.
- Strengthen opportunities for pupils to devise and develop their own models.

Supplementary Materials

This report is accompanied in the library by the following supplementary material:

- Genetic engineering lesson plan
- Genetic engineering lesson presentation
- Pupils developing a particle model to explain why heating a mixture of liquids will cause some of them to evaporate first
- Pupils planning their presentation of plasmid modification
- Pupils preparing a model showing how atoms (the coloured balloons) are rearranged when a chemical reaction occurs
- Pupils using donuts and strawberry laces to model plasmid modifications
- The modified plasmid
- Sample Year 9 pupil progress tracking sheet

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About 'What Works Well'

This case study was originally published as part of the 'What Works Well' section of the National Strategies for Education in England. The National Strategies were professional programmes aiming for improvements in the quality of learning and teaching in schools in England. 'What Works Well' involved teaching practitioners from all phases and areas of education sharing accounts of real developments which had improved learning and teaching, and made a difference to pupil progress. 'What Works Well' case studies were designed to support practice transfer and include sufficient detail and resources to enable others to implement the effective practice described. They were reviewed by experts prior to publication as 'User Generated Content' (UGC) under a licence which encouraged reuse and derivative works, but which precluded commercial use.

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