Developing process skills within the maths curriculum

CASE STUDY REPORT

Developing process skills within the maths curriculum

Christine Dawson and Vanessa Wears

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 analyze the reasons for a decrease in GCSE results in mathematics and develop strategies to improve the results for the following year.

Aims: The main aim of this development work was to improve GCSE results in mathematics by teaching students strategies to solve more open ended questions.

Methods: The participants included a middle leader, senior leadership team, subject leader, teacher, external agency, local authority staff, and senior management. They provided support through review, action planning, staff development, monitoring, and evaluating. The methods used included department training, team teaching, questionnaires, lesson observation, learning walks, and pupil work scrutiny to help pupils develop problem-solving skills and improve GCSE results.

Findings: The main findings of this case study are that regular review meetings with a strategic steering group, AQA exam board question level analysis, and the use of starter activities, "create a question" and problem solving using a graphic organiser have had a positive impact on pupil learning, teaching, and school organisation and leadership.

Implications: The findings of this case study suggest that teaching strategies such as starter activities, "create a question" and problem solving using a graphic organiser can help students to better understand and answer process type questions. This can lead to improved GCSE results and increased confidence in tackling open-ended questions.

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

Keywords: Secondary education; Mathematics

Introduction

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

During the academic Year 2008-9 Queensbury School changed from AQA Linear Specification to the Modular to cater for the needs of underachieving boys within the department. After Module 1 and 3 the Year 11 cohort achieved 60% grade C+. The Year group target was 53% and the previous modular results suggested the students were on track to achieve this. In August 2009 the results achieved fell to 47%. This equates to 31 students failing to retain a C+ after the final module is incorporated and the department under-performing at C+ by 14 pupils. This was disappointing and the Maths department had to reflect upon what had happened and what they needed to do to prevent a similar outcome in results for the next year. An analysis of the Module 5 paper revealed two main issues: The cohort struggled with the functional elements of the GCSE questions and they performed particularly badly in certain topics.

Who might find this case study useful?

- Middle leader
- Senior leadership team (SLT)
- Subject leader
- Teacher

Description

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

- Mathematics

How did you intend to impact on pupil learning?

Through teaching students strategies to solve more open ended questions, they would be able to confidently answer process type questions (A02 “choose and use” and A03 “scratch your head”) in the GCSE exam.

Review the Transformation unit of work.

What were your success criteria?

Improved GCSE results in maths to meet prediction.

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

- CVA data
- Data comparison of cohorts
- Pupils' work

Describe the CPD approaches you used

a) NS Regional Advisor provided department training using the AQA additional questions in conjunction with three strategies: starter activities to introduce students to problem solving, “create a question” and problem solving using a graphic organiser.

b) Team teaching using Flip cameras enabled teachers to reflect (post lesson) on pupils understanding of concepts; pupils were able to comment on the strategies used and this could be reflected in future lessons.

c) Staff opinions and experiences of the trial were collated through questionnaires, fed back into the process and were invaluable in the success of the trial.

What CPD materials, research or expertise have you drawn on?

AQA exam board question level analysis for their targeted cohort

PowerPoint (Appendix 1: Staff development presentation) for staff development meeting

Throughout the project this (informal) steering group met termly:

Subject Leader

Steering Group

Who provided you with support?

- External agency
- Local authority staff
- Senior management

How were you supported?

Review - NS Regional Advisor reflected with Subject Leader on the issues surrounding the disappointing exam results.

Action planning and staff development - Following Subject Leader identification of issue, NS Regional Advisor led department training using the AQA additional questions in conjunction with three strategies: starter activities to introduce students to problem solving, “create a question”, problem solving using a graphic organiser. These approaches were to be integrated into the Y 11 teaching.

Monitoring and evaluating - Follow up meetings with Steering Group to monitor progress, review next steps and maintain focus and momentum on the developments.

Developing classroom practice –

- Team teaching to evidence pupil voice.
- Use of the flip camera to enable post lesson reflection on developing classroom practice.
- The project was a regular discussion item on the department meeting agenda to maintain focus and momentum.

Impact

What has been the overall impact on pupil learning?

- Pupils increased confidence in tackling process type questions
- Pupils have explicit strategies which they employ effectively to tackle less structured questions

Thoughts you think are relevant to overall impact on learning

We think, that in the future, if these skills in interpretation are applied in real and increasingly purposeful contexts, then learners will develop functional skills.

Quotes you think are relevant to overall impact on learning

'I have to understand the information given to be able to create a question and so this approach makes me think carefully about what I already know.'

‘Using the writing frame for the more difficult questions helps me to break it down.’

'It looks more simple when you break it down like this instead of just giving you a sheet of paper with a question on it.'

'Well, I'll be able to, instead of having a piece of paper there I'll be able to picture the questions that the examiner could ask me in my head, and then use other questions to give me hints for the actual answer.'

'It helps your mind focus and work more independently, and I like that.'

Quantitative evidence of impact on pupil learning

- CVA data
- Data comparison of cohorts
- Test results

Qualitative evidence of impact on pupil learning

- Logs or interviews

Describe the evidence of impact on pupil learning

See the uploaded 'Impact on pupil learning' and 'Progress data' documents for quantitative evidence.

Pupils skills in interpreting what was being asked of them significantly improved – this is evidenced by the attached pupil transcript of pupil interview.

What has been the impact on teaching?

- Teachers employ explicit strategies to enable pupils to develop their problem-solving skills
- A refocus on mathematics vocabulary to allow students to access the examination questions
- Less teacher led learning and more pupil led learning
- Transformations is now taught consistently and more creatively across the department

Quotes you think are relevant to the impact on teaching

'I found it really useful having a systematic approach that helped students towards solving problems!'

'Create a question was a really useful tool as a revision aid, and students of all abilities could "Crack open" the questions.'

'My lower attaining boys enjoyed the competitive element of posing their own questions and being challenged to set the hardest one!'

Evidence of impact on teaching

- Evidence from observation and monitoring
- Evidence from planning
- Teacher perceptions

Describe the evidence of impact on teaching

- Lesson observation evidences the use of the strategies in all year groups and more pupil led learning.
- Resources are regularly featured in the lesson plans demonstrating the approaches are now part of embedded practice.
- Learning walks and pupil work scrutiny reflects pupils using the 'create a question' and 'problem solving' graphic organiser.

- During teaching and learning review in January two Year 11 teachers were observed teaching the new Transformations unit of work and received a “Good” as their teaching element.

What has been the impact on school organisation and leadership?

Impact on other schools:

The subject leader gave a report of the developments to the LA SLDM in the summer term 2010 and shared the resources more widely. The input included the SLs reflections on the ease of classroom use of the resources for teachers, short video clips evidencing pupil engagement and recording their comments, pupil work records and summary of the teacher questionnaire. Anecdotal evidence of pupils recalling the use of the ‘create a question’ approach prior to their module 5 exam and encouraging others to make up an easy question within the context and then go back to the exam question was particularly convincing. The systematic approach outlined to accomplish the success of this project was also well received and understood by the subject leaders (see essential elements for other schools in summary). The ‘can do’ attitude of the subject leader gave the delegates a clear message that the barriers to learning must be tackled without excuse and that this was about the adults changing their behaviours in the classroom.

Evidence of impact on school organisation and leadership

The subject leader presented the work being carried out in this case study at the LA SLDM so that other schools could share in the learning.

Summary

What is the crucial thing that made the difference?

Regular review meetings with strategic steering group (Mathematics line manager, mathematics subject leader, LA consultant, Mathematics RA) to monitor progress, review next steps and maintain focus and momentum on the developments.

What key resources would people who want to learn from your experience need access to?

All key resources attached throughout case study (also attached here)

What CPD session and resources were particularly useful?

AQA exam board question level analysis for their targeted cohort

Powerpoint (Appendix 1: Staff development presentation) for staff development meeting

Writing Frame: Problem-Solving (Appendix 6: Problem solving questions)

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

- Baseline assessment to help identify the specific barriers to progress, underperforming groups and curricular targets.
- At the planning stage focus upon short term impact measures (teacher and pupils responses to developments, targeted assessments) and longer term impact measures (GCSE pupil outcomes) recorded on a time line.
- Identify small steps in classroom practice with clear time frames to make it manageable for teachers. Include the review date for classroom developments and the evidence to help evaluate impact.

- A clear end point to fully evaluate the impact of the project.
- Comparative exam question analysis on identified curriculum areas for intermittent monitoring of progress.

Supplementary Materials

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

- Appendix 1: Staff development presentation
- Appendix 2: Staff questionnaire
- Appendix 3: What next?
- Appendix 5: Create a question questions
- Appendix 6: Problem solving questions
- AQA problem solving qs - reference
- Impact on pupil learning
- Appendix 4: Progress data
- Create a question student voice transcript

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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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