Mathematics curriculum discontinuity on secondary transfer

Aim of the project

Existing research evidence identifies a decline in pupils' mathematics performance, or lack of progress, on transfer to secondary school. The extent of this decline varies but affects as much as 40% of the pupil population, when assessed using common tests before and after transfer. Explanations for the decline are complex but tend to centre on inadequate curriculum continuity, and unsatisfactory progression in teaching and learning.

The project was designed to measure the extent to which this lack of progress following transfer was a consequence of 'redundancy' in the Y7 mathematics curriculum: time being spent teaching what is already known!

The project then developed a suite of diagnostic tests which allowed classroom teachers to adapt their teaching to the varying needs of their Y7 pupils.

Context

The study was conducted in one secondary school for boys, with three Y7 intakes of 112, involving seven teachers. It took place over a period of three years, commencing in 1999.

Summary of main findings

- The study revealed that levels of 'redundancy' in the delivery of otherwise successful Year 7 lessons (a measure of the discrepancy between teaching approach and pupil need) are demonstrated to be as high as 35%.

- Diagnostic pre-tests were shown to have significant potential in planning classroom approaches for pupils after school transfer, when associated with purpose-made marking grids.

- As a result of eliminating a substantial proportion of the 'redundancy', it was possible to augment the Y7 programme of study with material previously reserved for Y8.

- This effect has allowed about a month of teaching time to be reclaimed in Key Stage 3 for extension activities, relating to reasoning and 'proof'.

- Although the level of 'redundancy' was so high, pupils appeared to have been socialised into accepting the teacher-directed repetition of material.

- Informal reports suggest that pupils now view their Year 7 mathematics lessons as both rewarding and challenging.

Background

The project was conducted in an Essex secondary school for boys which receives pupils from as many as fifty feeder primary schools. It is an over-subscribed selective school, where pupils are required to pass an entrance examination to secure a place. Informal estimates suggest that the school caters for the most-able 10% of the catchment population. The school is situated in an urban location but draws upon a large rural catchment area with wide variation in measures of socio-economic deprivation, and has relatively low numbers of pupils on free school meals. The feeder primary schools vary from large inner-city junior schools, to some of the smallest rural establishments.

Performance in mathematics was very good within the school, but there was a shared view that provision in Y7 was not well-tailored to the pupils' needs. Existing research from large scale studies (by Galton et al.: 1999; and in Suffolk LEA: see 'Suggestions for Further Reading') provided evidence to support this view. In these studies, identical tests were given to pupils in Year 6 and then again in Year 7. The results reported showed that up to 40% of pupils make no progress during the year after transfer.

Teaching processes and strategies

Phase 1

Diagnostic pre-tests were used to identify the level of subject knowledge pupils have in Y7, before the teaching of each topic. The results of these tests were compared with the records made by Y7 teachers of the amount of time spent teaching different elements of the course. A comparison of the two revealed the levels of 'redundancy' in the teaching.

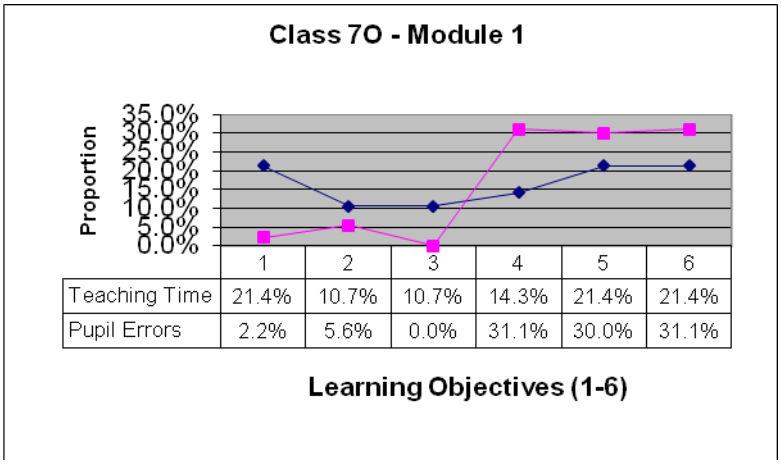
Phase 2

Diagnostic pre-tests were also used to identify the level of subject knowledge pupils have in Y7, before they began work on each topic. The results of these tests were tabulated using specially designed record grids, from which teachers were able to plan an efficient differentiated curriculum for their Y7 classes.

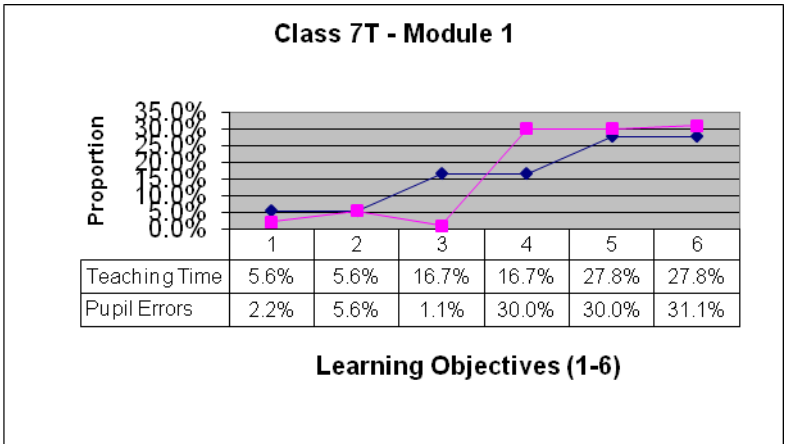
Findings

The first stage of the project sought to locate and measure any redundancy in the Year 7 programme of study. Graphs were created that compared the distribution of errors in the diagnostic pre-tests with the amount of teaching time (classwork and homework) assigned to that topic. In an ideal situation very low rates of error on the pre-tests, will match with a very limited allocation of teaching time. Clearly time need not be spent teaching a topic which is widely understood.

By examining two of the graphs in further detail, it became clear that the teaching provision was not always 'best matched' to the needs of the pupils.



In this class, the diagnostic test results indicated that less than 10% of the errors were related in total to learning objectives 1-3. The allocation of teaching time for these objectives is, however, approaching 50%. In contrast, whilst nearly one third of errors related to objective 4, less than one sixth of the time was allotted to this area of study. By considering the discrepancies between each of the percentages cited, it is possible to offer an informal measure of redundancy at about 35%: the percentage of teaching time allocated in excess to the demands of pupil errors.



A similar examination of this second class, reveals a much closer fit between the pupil errors and the allocation of teaching time. The equivalent measure of 'redundancy' is less than 20%.

Although the data for these two graphs showed a similar pattern of errors, it was agreed that any approach to revising the Year 7 programme of study had to be flexible enough to recognise that there would be variations from year to year, and from pupil to pupil as to what was already known.

In the later stages of the project, each Year 7 class completed a diagnostic pre-test before the teaching of each unit of the course. Their results were recorded on specially prepared marking grids. Each 'X' on a grid represents a pupil's inability to demonstrate a full understanding of the topic identified by the question numbers across the top of the grid. The purpose of the grid is to highlight what needs to be learned by the pupils, and to allow the teacher to structure their teaching accordingly. This can be illustrated by looking at three grids: two idealized, and one with real data.

Sample Grid 1
The first of the marking grids illustrates a situation in which all the pupils perform in an identical fashion:

		Learning Objective 1				Learning Objective 2			Learning Objective 3			Learning Objective 4		
		Qn 1	Qn 2	Qn 3	Qn 4	Qn 5	Qn 6	Qn 7	Qn 8	Qn 9	Qn 10	Qn 11	Qn 12	Qn 13
SURNAME1	Forename1		X			X	X	X						X
SURNAME2	Forename2		X			X	X	X						X
SURNAME3	Forename3		X			X	X	X						X
SURNAME4	Forename4		X			X	X	X						X
SURNAME5	Forename5		X			X	X	X						X
SURNAME6	Forename6		X			X	X	X						X
SURNAME7	Forename7		X			X	X	X						X
SURNAME8	Forename8		X			X	X	X						X
SURNAME9	Forename9		X			X	X	X						X
SURNAME10	Forename10		X			X	X	X						X
SURNAME11	Forename11		X			X	X	X						X
SURNAME12	Forename12		X			X	X	X						X
SURNAME13	Forename13		X			X	X	X						X
SURNAME14	Forename14		X			X	X	X						X
SURNAME15	Forename15		X			X	X	X						X
SURNAME16	Forename16		X			X	X	X						X
SURNAME17	Forename17		X			X	X	X						X
SURNAME18	Forename18		X			X	X	X						X
SURNAME19	Forename19		X			X	X	X						X
SURNAME20	Forename20		X			X	X	X						X
SURNAME21	Forename21		X			X	X	X						X
SURNAME22	Forename22		X			X	X	X						X
SURNAME23	Forename23		X			X	X	X						X
SURNAME24	Forename24		X			X	X	X						X
SURNAME25	Forename25		X			X	X	X						X
SURNAME26	Forename26		X			X	X	X						X
SURNAME27	Forename27		X			X	X	X						X
SURNAME28	Forename28		X			X	X	X						X

In this instance five questions have presented difficulties, and it would be reasonable for the teacher to proceed with a whole-class approach.

Sample Grid 2

The second of the marking grids illustrates a situation in which most of the pupils perform in an identical fashion, revealing no misunderstandings at all; but where a small number of pupils have sustained difficulties with all the material.

		Learning Objective 1				Learning Objective 2			Learning Objective 3			Learning Objective 4		
		Qn 1	Qn 2	Qn 3	Qn 4	Qn 5	Qn 6	Qn 7	Qn 8	Qn 9	Qn 10	Qn 11	Qn 12	Qn 13
SURNAME1	Forename1													
SURNAME2	Forename2													
SURNAME3	Forename3													
SURNAME4	Forename4	X	X	X	X	X	X	X	X	X	X	X	X	X
SURNAME5	Forename5													
SURNAME6	Forename6													
SURNAME7	Forename7													
SURNAME8	Forename8	X	X	X	X	X	X	X	X	X	X	X	X	X
SURNAME9	Forename9													
SURNAME10	Forename10													
SURNAME11	Forename11													
SURNAME12	Forename12													
SURNAME13	Forename13													
SURNAME14	Forename14	X	X	X	X	X	X	X	X	X	X	X	X	X
SURNAME15	Forename15	X	X	X	X	X	X	X	X	X	X	X	X	X
SURNAME16	Forename16	X	X	X	X	X	X	X	X	X	X	X	X	X
SURNAME17	Forename17													
SURNAME18	Forename18													
SURNAME19	Forename19													
SURNAME20	Forename20													
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SURNAME27	Forename27													
SURNAME28	Forename28													

In this instance five pupils have presented difficulties, and it would be reasonable for the teacher to proceed with a split-class approach: extension material - probably designed for self-supported study - for most of the group, whilst a concentrated support programme is offered for the minority.

Sample Grid 3

Based on the data from administering a diagnostic assessment to a Year 7 class, the final sample grid exhibits the characteristics of a typical Year 7 Mathematics class.

		Learning Objective 1				Learning Objective 2			Learning Objective 3			Learning Objective 4		
		Qn 1	Qn 2	Qn 3	Qn 4	Qn 5	Qn 6	Qn 7	Qn 8	Qn 9	Qn 10	Qn 11	Qn 12	Qn 13
SURNAME1	Forename1		X		X	X			X	X				
SURNAME2	Forename2					X				X		X		
SURNAME3	Forename3				X				X			X		
SURNAME4	Forename4	X	X	X	X	X	X	X	X	X	X	X	X	X
SURNAME5	Forename5		X		X	X				X		X		
SURNAME6	Forename6	X				X			X	X		X		
SURNAME7	Forename7		X		X				X	X		X		
SURNAME8	Forename8	X	X	X	X	X	X	X	X	X	X	X	X	X
SURNAME9	Forename9					X			X	X				
SURNAME10	Forename10		X		X	X			X	X		X		
SURNAME11	Forename11	X	X		X	X			X	X		X		
SURNAME12	Forename12					X			X	X		X		
SURNAME13	Forename13		X		X				X	X		X		
SURNAME14	Forename14	X	X	X	X	X	X	X	X	X	X		X	X
SURNAME15	Forename15	X		X		X	X	X		X	X	X	X	X
SURNAME16	Forename16	X	X	X	X		X	X		X	X	X	X	X
SURNAME17	Forename17					X			X	X				
SURNAME18	Forename18		X		X	X			X	X		X		
SURNAME19	Forename19	X	X		X	X			X	X		X		
SURNAME20	Forename20	X	X		X	X			X	X		X		
SURNAME21	Forename21													
SURNAME22	Forename22		X		X	X			X	X		X		
SURNAME23	Forename23		X		X	X			X	X				
SURNAME24	Forename24		X		X	X			X	X		X		
SURNAME25	Forename25		X		X	X				X		X		
SURNAME26	Forename26					X			X	X		X		
SURNAME27	Forename27		X		X				X					
SURNAME28	Forename28		X		X	X			X	X		X		

One pupil has no difficulties with any of the material. Several others have a few isolated misunderstandings, which tend to cluster around particular teaching objectives which have proved difficult for many of the pupils. A small number of pupils have extensive difficulties across many of the teaching objectives.

Having developed planning ideas from the earlier sample grids, it was possible to construct a teaching programme to more closely fit the needs of this class. The approach for this class was to identify first some preliminary familiarisation activities for most of the pupils to undertake, whilst concentrated help was given on the foundations of the topic to a selected group. This was followed by whole-class teaching on the areas of common weakness; after which the class was split again between those pursuing extension material, and those for whom further foundation or reinforcement activities were required (according to pupil self-selection).

Research methods

The diagnostic pre-tests generated individual and aggregated numerical data on pupil performance for each mathematical topic. This data was compared, graphically, with data derived from teaching logs which should how much time had been devoted to each topic being taught.

In the second phase of the project the diagnostic pre-test data was used to plan and adapt the Y7 scheme of work for each pupil.

Conclusion

Teachers of mathematics can learn from this study that levels of 'redundancy' in the delivery of otherwise successful Year 7 lessons (a measure of the discrepancy between teaching approach and pupil need) may be as high as 35%.

Diagnostic pre-tests were shown to have significant potential in planning differentiated classroom approaches for pupils after school transfer, when associated with purpose-made marking grids. They provide a way of developing differentiated learning, without adopting individualised schemes, and ensuring a minimum level of fruitless repetition.

Suggestions for further reading

A full report of the use of the diagnostic pre-tests appeared in 'Mathematics in School' (Vol. 31 No. 2 May 2002 and No. 5 Nov 2002) available from The Mathematical Association (www.m-a.org.uk)

On issues relating to transfer, good starting points are:

Delamont, S. and Galton, M. (1986)
Inside the Secondary Classroom.
London: Routledge and Kegan Paul.

Galton, M. and Willcocks, J. (1983)
Moving from the Primary Classroom.
London: Routledge & Kegan Paul

Galton, M., Hargreaves, L., Comber, C., and Wall, D. (1999)
Inside the Primary Classroom: 20 Years On.
London: Routledge.

Rudduck, J. (1996)
'Going to the "big school": the turbulence of transition'
Rudduck et al (eds.)
School Improvement: What Can Pupils Tell Us?
London: David Fulton.

Rudduck, J. Day, J. and Wallace, G. (1996)
"The Significance for School Improvement of Pupils' Experiences of Within-School Transitions"
Curriculum Vol. 17 No. 3: 1996 pp 144-153.

Suffolk LEA (1997)
A Report on An Investigation Into What Happens When Pupils Transfer Into Their Next School at the Ages of 9, 11 and 13.
Ipswich: Inspection and Advice Division, Suffolk Education Department.

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