Application of Number: an investigation into a theoretical framework for understanding the production and reproduction of pedagogical practices

Mhairi McAlpine and Jackie Greatorex

University of Cambridge Local Examinations Syndicate

A paper presented at the British Educational Research Association Conference, University of Cardiff, UK, 7-9 September 2000.

**Disclaimer**
The opinions expressed in this paper are those of the authors and are not to be taken as the opinions of the University of Cambridge Local Examinations Syndicate (UCLES) or any of its subsidiaries.

Note
This research is based on data collected by the University of Cambridge Local Examinations Syndicate for OCR.

Contact details
Jackie Greatorex, RED, UCLES, 1 Hills Road, Cambridge, CB1 2EU. greatorex.j@ucles.org.uk.

Autobiographical details
Mhairi McAlpine who previously worked at UCLES now works at Heriott-Watt University and Jackie Greatorex is a Research Officer at UCLES.

Application of Number: an investigation into a theoretical framework for understanding the production and reproduction of pedagogical practices

Abstract

This study focused on Application of Number (AoN), one of the Key Skills in GNVQs. It drew on quantitative and qualitative data (a survey and case studies) to describe how AoN was organised in different schools and colleges. The data illustrate that there was diversity in AoN provision, a finding supported by other literature. This diversity in provision can be explained by the continually changing political agenda which has instigated speedy changes in schools and colleges. The results of the survey and the case studies described the different coping mechanisms that schools and colleges have used to provide AoN. Bernstein offers a theoretical framework for understanding the production and reproduction of knowledge, associated pedagogical practices and related power issues. He explains that knowledge is organised in regions - academic and professional areas. This paper considers how far the data can be illuminated using Bernstein's framework. The staff and students' positive and negative reactions to these different arrangements are discussed.

The purposes of Key Skills

General National Vocational Qualification (GNVQ) students develop skills, knowledge and understanding in the vocational area they are studying. The majority of the assessment of students is through coursework, but externally assessed tests are also taken. GNVQ students take responsibility for their own learning e.g. by conducting research and regularly reviewing their progress. GNVQs focus upon the practical application of skills, knowledge and understanding within a broad vocational area (QCA, 2000).

Key skills have been part of the GNVQ curriculum since they were introduced in 1993. The original GNVQs included six Core (now Key) Skills: three which were compulsory - Communication, Application of Number and Information Technology, and three which were optional - Working with Others, Improving Own Learning and Problem Solving.

Key Skills were introduced to provide young people with the skills and knowledge necessary to fulfil job roles competently and to support them in everyday life. The Key Skills were to overcome the skills shortage experienced by employers in an attempt to enable Britain to compete more effectively in the global economy (DFEE, 1999). However there were two main flaws in this strategy:-
1) Robinson (1997) and Young (1999) argued that there is no necessary link between the economy and achievement in Key Skills. However the employment opportunities of some adults were reduced by low levels of ability in literacy and numeracy (Robinson, 1997).
2) As explained by Steinberg (1996, 194): *No curricula overhaul, no instructional innovation, no change in school organisation, no toughening of standards, no rethinking of teacher training or compensation will succeed if students do not come to school interested in, and committed to, learning.*

Rapid changes to Key Skills

NCVQ (1994) explained that Core (now Key) Skills were a continuation of similar educational initiatives. The difference between Key Skills (KS) and previous schemes was that Key Skills were designed to be more systematic about learning and assessment by clearly stating the outcomes which were expected of students (NCVQ, 1994). Key Skills has been an area of continual change (Hyland and Weller, 1996; Wolf, 1997) which is still ongoing, for example, from September 2000 a Key Skills qualification covering the three compulsory GNVQ Key Skills will be offered (DfEE, 1999) and the new GNVQs do not have a Key Skills requirement (QCA, 1999). UCAS (2000a) explain that: *A new Key Skills Qualification, based on the first three key skills listed above,* (AoN, Communication and IT) *will be available from autumn 2000. The certificate will give a profile of the level achieved in each key skill.*

Wolf (1997) undertook a survey of GNVQs and evaluated whether they had achieved the government's targets. She found that: *No major changes in GNVQ programme offerings are envisaged by centres. The general picture is of rapidly achieved stability… The way in which GNVQs are actually delivered is, by contrast, extremely variable. There are differences in the number of teaching and contact hours reported both by GNVQ co-ordinators and team leaders, and by GNVQ students themselves. There is particular variability in patterns of core (key) skills delivery. These vary between centres, but are also subject to change at the within-centre level. Most GNVQ teams find core (key) skills delivery highly problematic* (Wolf, 1997, 8). This suggested that centres found a diversity of ways to accommodate GNVQs but that they were having more difficulties implementing the Key Skills initiative.

With this in mind a research study (a survey and case studies) was undertaken to identify how centres were arranging their Key Skills provision and to investigate staff and students' reactions to the arrangements. The case studies were undertaken in early 1999 and the survey was administered the previous academic year. Application of Number was the focus for this investigation.

Given this state of diversity and continual change, one of the first tasks was to identify patterns of provision and organisation of Application of Number in different centres. Evidence from a survey distributed to all centres offering at least one GNVQ with the RSA Examination Board suggested that there were five models of the organisation of AoN; further details of the methodology used to complete this survey are given in McAlpine and Greatorex (1999a & b). These models are given below:

Table 1: *Summary of Key Identifiers of each of the Models*

Model	Teachers	Organisation	Do GNVQ students study GCSE mathematics?	Total no. of centres
1	Mathematics staff	As a separate AoN/KS course	yes - some/all study GCSE Mathematics separate from AoN	57
2[1]	Varies	Varies	Varies	46
3[2]	Mathematics staff	Within a GCSE Mathematics/AoN/KS course	yes - some/all study GCSE mathematics which incorporates AoN	6
4[3]	GNVQ staff	Integrated part of a GNVQ course	yes - some/all study GCSE Mathematics separate from AoN	42
5	Mathematics staff	Integrated part of a GNVQ course	Varies	36

McAlpine and Greatorex (1999a) noted that the constituent features of these 'models' were not mutually exclusive. For example, models 1, 3 and 5 all had mathematics staff teaching AoN but each of these three models took a separate approach to organising the teaching, as a separate course, within a GCSE mathematics/AoN/KS course and as an integrated part of GNVQ courses. A case study of a centre that used each type of model was undertaken. This constituted semi-structured interviews with 25 key staff and 11 students. The staff varied in seniority and role (McAlpine and Greatorex, 1999a & b). The case studies suggested that:-
- the situation was more complex and diverse than suggested by the five models identified from the survey (McAlpine and Greatorex, 1999a);
- some of the staff and students were experiencing the continual change of provision within centres which was also evidenced by Wolf's survey (1997).

---

[1] A number of these centres cited "devolved management" or "staffing reasons" to explain the variation in their provision.
[2] It is notable that these centres tended to be small 11-16/18 centres with limited GNVQ provision.
[3] From their comments, many of these centres implied that they would be hostile to the integration of AoN and GCSE mathematics as they were serving quite different purposes.

Given the continual and speedy change in the GNVQ and Key Skills these 'models' were not really models but coping mechanisms that the centres used to cope with the changes and meet the needs of their students.

Hyland and Weller (1996, 41) report that:*The delivery of core skills in almost all institutions had been integrated with the vocational units, though around a quarter of colleges had both separate and integrated provision for different core skills (11.7 per cent of institutions offered Information Technology as a separate core skill unit).* The results from McAlpine and Greatorex (1999a & b) were slightly different. Only 47% of centres integrated AoN delivery as part of a GNVQ programme. Wolf and Griffith (1996) found a similar pattern of provision to McAlpine and Greatorex (1999a & b). Brown (1999, 87) states that: *Wolf and Griffith (1996) note that the requirements of GNVQ have led to a variety of provision, with some colleges leaving tuition, if any, to occur through the vocational course using teachers who in terms of mathematics are poorly qualified non-specialists. Other schools and colleges are laying on specialist mathematics provision at varying levels of formality.*

Does Bernstein's work offer a framework for illuminating how centres have coped with the changes in the GNVQ curriculum?

McAlpine and Greatorex (1999a) reported that it was difficult to put a structure on what was happening in the centres in the study. They discussed the reasons for the difficulty in finding a structure.

Bernstein's work on classification and framing offers a framework for conceptualising the production and reproduction of knowledge**,** associated pedagogical practices and related power issues. What follows is an exploration of whether Bernstein's theory illuminates the findings of the AoN project. Essentially this was a reflective exercise. Initially the basics of Bernstein's theory are described, then the coping mechanisms which centres have used are considered in the light of this theory.

Bernstein's theory

Bernstein (1975) argued that the school curriculum was perpetuating the class system, that it was socially constructed to maintain the hierarchical order of a class society, and that there was an alternative way of conceptualising knowledge. On these premises he developed two key theoretical concepts, classification and framing, for analysing how knowledge was structured in the curriculum and transmitted in interaction to the learner.

'Classification' was used by Bernstein to conceptualise the way in which knowledge was socially constructed and maintained by reproducing the prevailing ideas about subject disciplines and the relationships between curriculum contents. The construction of boundaries within and between different contents also referred to the relationship between the taught content of one subject and another. Where classification was strong, there were strong boundaries between the disciplines and the contents of different disciplines were well insulated from one another. Where classification was weak there were blurred boundaries between the contents of the different disciplines. *Classification thus refers to the degree of boundary maintenance between contents* (Bernstein, 1975, 88).

The concept of 'Frame' referred to the context in which knowledge was transmitted and received: the *message system* or pedagogy (Bernstein, 1975, 89). It referred to the relationship between the teacher and the learner: to the boundary between what was and was not allowed in the pedagogical relationship. When framing was strong there were sharp boundaries between what could be transmitted and what could not be transmitted. When framing was weak there were blurred boundaries between what could be transmitted and what could not be transmitted. Framing was about the control of *the range of options available to teacher and taught* (Bernstein, 1975, 88). *Thus frame refers to the degree of control teacher and pupil possess over the selection, organisation, pacing and timing of the knowledge transmitted and received in the pedagogical relationship…*(Bernstein, 1975, 89). There is another dimension to frame*… the relationship between the nonschool everyday community knowledge of the teacher or taught and educational knowledge*

(Bernstein, 1975, 89).

Bernstein argued that the classification and framing of knowledge reflected dominant social values and the authority/power structure which controlled the selection and dissemination of educational knowledge. In Bernstein's words: *How a society selects, classifies, distributes, transmits and evaluates the educational knowledge it considers to be public, reflects both the distribution of power and the principles of social control* (Bernstein, 1975, 85).

The term "collection type" curriculum (Bernstein, 1975, 87) was used to refer to a curriculum that was based on subjects and that had clear boundaries between the subjects. Bernstein used the term "integrated curriculum" to refer to a curriculum where subjects were not bounded: subjects which used overarching ideas, concepts and principles that could be applied across subjects leading to a blurring of the boundaries between the subjects.

Within the integrated curriculum, there was ambiguity in knowledge and in the structure of staff/pupil relationships, which disrupted conventional views of power and control. Collection codes reduced the control that the pupils had over their learning, whereas integrated codes reduced the discretion of the teacher. The collection code resulted in students and pupils exhibiting subject loyalty. They were not integrated with other students, their identities and future were wrapped up in the subject. In an integrated curriculum the students of different subjects were brought together and developed horizontal relationships with one another, through the common task of sharing knowledge.

Bernstein's argument was that different types of curricula and different ways of classifying and framing knowledge, reflected changes and trends in society. The collection code reinforced the maintenance of power hierarchies (traditions and norms) that existed. In contrast the integrated curriculum reflected a dissatisfaction with the status quo, which filtered into the educators' choice of how to transmit knowledge.

Bernstein (1986) added that knowledge in the collection curriculum was privately owned with its own power structure and market situation. Bernstein (1975, 97) commented on a subject determined, i.e. collection curriculum and the consequences of the hierarchies that it maintained: *Any collection code involves a hierarchical organisation of knowledge, such that the ultimate mystery of the subject is revealed very late in the educational life.* Hence the higher echelons of knowledge and academia were closed to those who had not submitted to the educational initiation. In this situation knowledge was privately owned by a select group of specialists and academics who had completed the necessary programmes. This knowledge which was privately owned by specialist communities could not be easily controlled from outside the specialist community. In contrast, everyday knowledge or knowledge which should be common to everyone was much more susceptible to control. Consequently those in power, e.g. government, could manipulate an integrated school curriculum more easily than a collection curriculum to fit their own objectives. For example, young people might be taught Key Skills in the hope that the "well trained" workforce would improve Britain's competitive capabilities in the global economy. Bernstein (1990) also made a distinction between the producers and reproducers of knowledge. The producers of knowledge had greater power and autonomy. Fowler's (1996) example of a difference between a producer and a reproducer of knowledge was the difference between a researcher (producer of knowledge) and a teacher (reproducer of knowledge).

Classification, framing, Key Skills and centres' coping mechanisms

Brown (1999) explained that the content of AoN was intended to be applied rather than pure and that it would be taught in a contextualised thematic manner relating mathematical principles to vocational competence. She also argued that it was difficult to differentiate the content and aims of the 'mathematics' curriculum from the AoN curriculum at the same level. So the introduction of Key Skills across the GNVQ curriculum weakened the boundaries between one region of knowledge and another, i.e. weak classification. The government agenda that Key Skills should be included in the GNVQ curriculum came from employers and public opinion. In this scenario neither the teacher nor

the pupil was powerful so framing was neutral due to the increase in centralised power. Bernstein (1990) argued that some time ago the USA experienced a weakening of classification and less specialised professional identities formed. The practices of the professionals were technological rather than discipline based. He defined regions as a contextualising of disciplines into larger units which operated within the intellectual field of discipline and in the field of practice. The introduction of GNVQs with mandatory Key Skills fitted well with this notion of the regionalisation of knowledge. On the other hand there was evidence that young people who studied GNVQs did not tend to study other academic qualifications like A levels at the same time (Hodgson and Spours, 2000). At the post 16 stage young people were divided into the brightest who studied A levels and medium attainment students who tended to study vocational qualifications e.g. GNVQs. This A level/vocational stratification might be argued to maintain the vocational - academic divide. Young (1999, 466) contends that *academic/vocational divisions are, however, not just a form of curriculum organisation; in separating 'knowledge for its own sake' from 'the applications of knowledge' they parallel the divisions between mental and manual labour in the economy*.

Method

In applying Bernstein's theory to the data collected by the authors, each coping mechanism (model) was taken in turn and the characteristics of each were considered in the light of Bernstein's framework. For example, whether GNVQ staff or mathematics teachers taught AoN was a key identifier of the coping mechanism. Another key identifier was how AoN was organised in timetable blocks. Fowler (1996) suggested that separate timetable blocks were a good indicator of strong classification. Where it was possible further information from the study was taken into account before the judgements were made on how to allocate data to Bernstein's categories. A summary of the judgements is given in table 2. Further details of the rationalisation behind the judgements and the evidence are given in table 2a.

For the purposes of this investigation it was necessary to define where AoN fitted into mathematics, everyday and vocational knowledge. For this investigation AoN was viewed as a life skill. This definition was taken from the DfEE: *Key Skills are those essential skills which people need in order to be effective members of a flexible, adaptable and competitive workforce. They are also invaluable in helping people function in society – and for lifelong learning* (DfEE, 1999, 1).

Key Skills specifications cover skills important both in adult and working life (DfEE, 1999, 4).

Application of Number was considered to be the application of mathematical principles in a contextualised setting. It could be applicable to a greater or lesser extent across vocational areas and everyday life. As AoN has been identified as a life skill the two dimensions of framing (1) degree of teacher and pupil control and (2) the relationship between the everyday community knowledge of the teacher/learner and the educational knowledge were both important. It has already been suggested that the agenda that Key Skills should be included in GNVQs came from employers and public opinion. In this situation neither the teacher nor the pupil was powerful so the first dimension of framing was neutral due to increased centralised power. Unfortunately the data that were available about the centres did not allow us to make any further judgements about the first aspect of framing. Therefore it has not been included in the discussion of the survey results which focus upon how classification and framing vary from coping mechanism to coping mechanism.

The following questions were asked to judge whether classification and framing were weak or strong for each key identifier of each coping mechanism:

Classification	How strong were the boundaries between the taught content of one subject and another?	If the boundaries were strong then classification was strong.

Framing	How strong were the boundaries between the everyday knowledge of the teacher or learner and educational knowledge, i.e. between AoN and GCSE/other GNVQ knowledge?	If the boundaries were strong then framing was strong.

When classification and framing were strong the curriculum was considered to be a collection type curriculum. When classification and framing were weak the coping mechanism was categorised as an integrated curriculum.

The interviews from the case studies were analysed using grounded theory. Some of the text from transcripts was coded as being about the AoN coping mechanism which the centre had adopted (McAlpine and Greatorex, 1999a & b). For the purposes of this investigation these comments were additionally coded as positive or negative, in relation to the coping mechanism.

Table 2: Key identifier of each of the coping mechanisms and how they relate to classification and framing

	Teachers	*Organisation*	*Did GNVQ students study GCSE mathematics?*	*Type of curriculum*
Coping Mechanism 1	*Mathematics staff*	*As a separate AoN/KS course*	*Yes – some/all studied GCSE Mathematics separate from AoN*	Collection
Classification	Varied	Strong	Strong	
Framing	Varied	Strong	Strong	
Coping Mechanism 2	*Varied*	*Varied*	*Varied*	Neutral
Classification	Varied	Varied	Varied	
Framing	Varied	Varied	Varied	
Coping Mechanism 3	*Mathematics staff*	*Within a GCSE Mathematics /AoN/KS course*	*Yes – some/all studied GCSE Mathematics which incorporated AoN*	Integrated
Classification	Weak	Weak	Weak	
Framing	Weak	Weak	Weak	
Coping Mechanism 4	*GNVQ staff*	*Integrated part of a GNVQ course*	*Yes – some/all studied GCSE Mathematics separately from AoN*	Integrated
Classification	Weak	Weak	Strong	
Framing	Weak	Weak	Strong	
Coping Mechanism 5	*Mathematics staff*	*Integrated part of a GNVQ course*	*Varied*	Integrated
Classification	Weak	Weak	Varied	
Framing	Weak	Weak	Varied	

Table 2A: Key Identifiers of each of the coping mechanisms and how they relate to classification and framing (supplementary notes for Table 2)

Coping mechanism	Teachers	Organisation	Did GNVQ students study GCSE mathematics?
Coping mechanism 1	*Mathematics staff*	*As a separate AoN/KS course*	*Yes – some/all studied GCSE Mathematics separately from AoN*
Classification	All the responses to the questionnaires for the centre which used this coping mechanism indicated that the teaching and learning of AoN was sometimes set in the context of the GNVQ study area. So classification varied.	AoN was taught as a separate AoN or Key Skills course. Here AoN was separated from both mathematical and vocational knowledge and classification was strong.	Some/all GNVQ students in these centres studied AoN separately from GCSE mathematics, which meant that classification was strong.
Framing	Given the questionnaire responses above, the boundaries between everyday and GNVQ (vocational) knowledge varied.	Having a separate AoN or Key Skills course separated what was transmitted or selected as AoN or a life skill and what was selected as knowledge for the vocational/academic areas, in which case framing was strong.	Having a separate AoN or Key Skills course separated what was transmitted or selected as AoN or a life skill and what was selected as knowledge for the mathematics and the vocational areas, in which case framing was strong.
Coping mechanism 3	*Mathematics staff*	*Within a GCSE Mathematics /AoN/KS course*	*Yes - some/all studied GCSE mathematics which incorporated AoN*
Classification	All centres who used coping mechanism 3 reported that teaching and learning were often integrated with current GNVQ activities. This suggested that there were weak boundaries between the taught content of AoN and the rest of the vocational knowledge (GNVQ).	As AoN was taught as part of a GCSE mathematics course so the boundaries between what was taught as mathematics and AoN was weak.	As GCSE mathematics incorporated AoN this suggested that the boundaries between what was taught as AoN and mathematics were weak.
Framing	All centres who used coping mechanism 3 reported that teaching and learning were often integrated with current GNVQ activities. This suggested that there were weak boundaries between AoN and GNVQ knowledge.	As AoN was taught as part of GCSE mathematics this suggested that the boundary between AoN and mathematical knowledge was weak.	As GCSE mathematics incorporated AoN this suggested that the boundaries between what was thought to be AoN and mathematical knowledge were weak.

Coping mechanism 4	GNVQ staff	Integrated part of a GNVQ course	yes - some/all study GCSE Mathematics separate from AoN
Classification	Having GNVQ staff teaching AoN suggested that there were weak boundaries between the taught content of GNVQ and AoN.	AoN being taught as an integrated part of GNVQ suggested that there were weak boundaries between what was taught as the vocational area and AoN.	Having students studying GCSE mathematics separately from AoN suggested that what was taught as mathematics and AoN was different.
Framing	Having GNVQ staff teaching AoN suggested that there were weak boundaries between the GNVQ and AoN knowledge.	The life skill of AoN was taught as an integral part of GNVQ so there were weak boundaries between community knowledge and educational/vocational knowledge.	Having students studying GCSE mathematics separately from AoN suggested that what was considered to be mathematical and AoN knowledge was different.
Coping mechanism 5	Mathematics staff	Integrated part of a GNVQ course	Varies
Classification	The majority (83%) of the 36 centres using coping mechanism 5 reported that AoN teaching and learning often integrated with current GNVQ activities or that AoN teaching and learning was often set in the context of the GNVQ study area. In these cases AoN tended to be linked to GNVQ study and so classification was weak.	See coping mechanism 4.	
Framing	Given the responses above framing tended to be weak.	See coping mechanism 4.	

Discussion

Methodological issues

The results of this investigation might have been different if for the purposes of this paper Application of Number had been defined differently and if the concepts of classification and framing had been operationalised in a different way. It was difficult to operationalise Bernstein's concepts to use with these data. This might have been because:
- the concepts were ambiguous (Pring, 1975; King 1976, 1981; Delamont, 1996);
- the data collected in this study were not collected with the purpose of being considered in the light of Bernstein's theory and therefore the key identifiers which were considered might not have related directly to Bernstein's concepts. The data were collected to give a description of the way in which centres organised AoN. If the data had been collected for use with Bernstein's theory then there would have been more complete evidence upon which to make judgements about the strength and weakness of classification and framing. For example, data about exactly what was taught in the different centres in AoN lessons were not collected.

All the results discussed below should be evaluated with these methodological limitations in mind. Although the way in which Bernstein's theory has been operationalised has been explained above it might be that some criteria and judgements about the different coping mechanisms and how they relate to the concepts of framing and classification remain tacit. This will not aid readers' understanding of the method. Also this analysis was limited because only part of the concept of framing could be investigated from the available data (see the method section for further details).

Types of Curricula and Coping Mechanisms

There was a definite pattern of classification and framing for coping mechanism 3 but the pattern for this coping mechanisms was more defined than for others. In coping mechanism 3 both classification and framing were weak. Classification and framing in coping mechanism 2 varied with context as the key identifiers of the mechanism varied. In coping mechanisms 4 and 5 classification and framing both tended to be weak. But for coping mechanism 1 classification and framing tended to be strong. This suggested that the majority of centres (97%) found it difficult to arrange AoN in a coherent curriculum, i.e. a curriculum where classification and framing were always strong or always weak.

Based on the evidence for classification and framing given above:-
- coping mechanisms 3 to 5 (45% of centres) tended to be more of an integrated type curriculum;
- coping mechanism 1 tended to be more of a collection type curriculum (30% of centres);
- 25% of centres did not fall into either category.

(These figures do not include the 15 centres that were idiosyncratic about the coping mechanism which they used). This suggested that there were three main ways of organising AoN as an integrated, collection or neutral curriculum. The most popular type of curriculum was the integrated type and the others constituted significant minorities. This was not surprising for two reasons:-
1) AoN did not emerge as a new area of knowledge through developments in theory and research. Rather it was the result of a government initiative designed to meet the perceived needs of the economy through education and training. The advantage of the integrated curriculum is that students from different regions of knowledge are brought together and develop horizontal relationships with one another through sharing learning and knowledge.
2) In previous years vocational curricula have had weak classification, for example, Ranson (1984) and Moore (1987).

Bernstein (1975) explained that the integrated curriculum was associated with a wider dissatisfaction with the status quo in society. Using Bernstein's arguments the significant minority of centres who arranged AoN in a collection type curriculum were perpetuating the divide between vocational knowledge or life skill and academic knowledge.

Factors at the centre level

National policy initiatives (e.g. making KS compulsory in all GNVQs, and Curriculum 2000) and how they have influenced, and might influence, AoN are discussed below. Of course in addition to the national policy initiatives that influenced AoN provision there was also a whole host of centre specific factors which influenced the implementation of AoN and led to each centre developing different coping mechanisms. It is beyond the scope of this investigation to discuss all these factors. However one Key Skills Co-ordinator pointed out the importance of centre specific factors by explaining how vocational and Key Skills provision had evolved in their centre. Eventually they had reached coping mechanism 1: *Right, you have really got to look at the history of vocational education in the college because we're a large college and vocational education in a sense was developed piecemeal. Anyway we've got a lot of courses here which grew like Topsy so sometimes the course appeared within the umbrella of the Department, like, you could say, that you know, our Advanced GNVQ Science developed within the Department. It was an initiative that brought in other areas like Engineering like Health and Social Care. They didn't necessarily develop closely with the most obvious Department, Technology, and they developed separately and now because of this there has been a variety of practice.*

The Teaching and Organisation of AoN

It has been discussed above that the collection curriculum is associated with powerful producers of knowledge and that the integrated curriculum can be more easily manipulated by government to their own ends as the curriculum content is more widely shared. The survey responses described above indicated that AoN was generally taught by Mathematics staff. Given that Brown (1999) argues that the AoN and mathematics curricula are similar, it is not surprising that McAlpine and Greatorex (1999a & b) found that Mathematics teachers taught AoN. There was no mention of any AoN specialists teaching AoN. This suggested that someone who was formally a member of a specialist community was now asked to teach everyday knowledge. This might reduce the status and power of the Mathematics teaching role. However, there have recently been advertisements asking for specialists in Application of Number to teach this Key Skill, e.g. there were two such advertisements found on the TES website on 9/07/00. The emergence of specialists in AoN might be an attempt to raise the status of AoN.

Of course AoN is not the first attempt to transform the discipline of mathematics into a more accessible tool which can be used in everyday settings. In other words this was not the first attempt to change the curriculum from a collection to an integrated curriculum. Boaler (1994) described a series of attempts to make mathematics applicable to everyday knowledge. Most recently there was the case of 'mathematics in context'. She argued that rather than mathematics becoming more accessible because it was expressed in everyday terms, young people were asked to answer problems and engage with examples which sometimes defied common sense. Wiliam (1992) and others have described this fantasy world as 'mathsland'. An example given by Boaler (1994) was the following problem: *The cold tap on full will fill a bath in 5 minutes. The hot tap takes 20 minutes. When the taps are off, a full bath takes 8 minutes to empty. If both taps are turned on full but you forget to put the plug in, how long will it be before the bath overflows?* The common sense answer was that the bath never overflows because it has an overflow pipe (Boaler, 1994).

As mathematics teachers teaching AoN try to teach students about numbers in everyday and vocational settings or advise vocational tutors on how to bring number into the classroom AoN teaching might also suffer from the 'mathsland' phenomenon. A member of a Mathematics Department admitted that the scenarios used to assess and teach AoN were not everyday or real world examples: *We can fit it (AoN) in but it looks pretty contrived and I think students see through it within about three quarters of a second.* Another member of the Mathematics staff from a different centre described one of the AoN assignments that he and a hairdressing colleague designed: *The demands that people have are that they want to know how can they devise an assignment …which can cover volumes and areas for hairdressers and we'll sit down….So an application of number of*

volumes and areas for hairdressing is, and to tie in health and safety we'll decide how many canisters of an aerosol we can have in a box and how many boxes we can stockpile down a corridor which is a fire escape, without blocking it off and making it dangerous. And how many do we have to buy to make it effective, and so on and develop it into an assignment …so a ten or fifteen minute discussion over coffee and the staff can go away and write their own assignment. It was not clear precisely which qualification this assignment was designed for but if as implied by the first quote AoN assignments were based on this type of scenario students were being asked to enter an oversimplified fantasy world in AoN just as can happen in contextualised mathematics. For example, would the boxes hold the weight of the aerosols? Were aerosol cans and/or boxes in a fire escape a potential fire hazard even if they didn't block the corridor?

In this situation rather than students acquiring skills which would be useful in life and work they might become more alienated from mathematics and AoN. Students might develop the skills necessary to gain the AoN competencies thereby appearing to maintain or improve standards. This would look good in terms of national figures about certification but employers might still complain about the lack of young people with Key Skills. So whilst government has tried to make Key Skills and AoN a priority after pressure from employers and public opinion, GNVQs might not be seen to be 'delivering the goods'.

Staff and students' reactions to the coping mechanisms

McAlpine and Greatorex (1999a & b) undertook a series of case studies, one for each coping mechanism, to explore the reactions of staff and students to AoN and each coping mechanism. Key staff and students were interviewed in each centre. As explained above some of the text from transcripts was coded as being about the AoN coping mechanism the centre had adopted (McAlpine and Greatorex, 1999a & b). For the purposes of this investigation these comments were additionally coded as positive, negative or uncategorised, in relation to the coping mechanism.

An example of a student giving a positive comment about AoN within the coping mechanism that he experienced is given below: *I think it's good because you actually get a proper mathematics teacher to teach you the actual Application of Number and obviously they know what they're talking about really, so I think that that's good that each person, each teacher have got a different unit to you know, teach you, especially the application of number as I just said it's got a mathematics teacher teaching it to you.*

An example of a positive comment from a member of staff about coping mechanism 5 was:
Yes, unlike Communications, the Application of Number tends to be taught by the people who have got a Mathematics background, which is important.

An example of a negative comment about AoN within a coping mechanism was: *So we felt, and I think our external verifier felt, that our delivery of Application of Number along with a lot of other centres, along with a national problem, wasn't particularly strong, so because of that we looked at specific units where we could actually highlight Application of Number and where we could really work it in.* This member of staff was a Key Skills Co-ordinator.

There were also comments about staff and students' experiences of AoN within the coping mechanism which couldn't be categorised as positive or negative. These comments remained uncategorised.

Table 3 Frequency of positive and negative comments about each coping mechanism and type of curriculum

Type of curriculum	Coping mechanism	Staff				Students				Total				
		Positive Comments		Negative Comments		Positive Comments		Negative Comments		Positive Comments		Negative Comments		
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	A
collection	1	5	16.67	4	13.33	6	20.00	2	6.67	11	36.67	6	20.00	30
neutral	2	9	45.00	1	5.00	1	5.00	2	10.00	10	50.00	3	15.00	20
integrated	3	2	18.18	3	27.27	2	18.18	0	0.00	4	36.36	3	27.27	11
integrated	4	4	28.57	1	7.14	0	0.00	0	0.00	4	28.57	1	7.14	14
integrated	5	2	40.00	1	20.00	0	0.00	0	0.00	2	40.00	1	20.00	5
integrated	3-5	8	26.67	5	16.67	2	6.67	0	0.00	10	33.33	5	16.67	30

A = Number including uncategorised comments.

The neutral curriculum perhaps had the most positive response. The collection and integrated curricula both had more positive than negative comments and the proportions of these were similar for each type of curriculum. There was little to choose between the integrated and collection curriculum for AoN. However it was not possible to make too many generalisations from these numbers due to the low number of interviewees and the low number of comments.

There were different views about whether AoN knowledge was equally applicable to all GNVQs. One member of a Mathematics Department said: *What I've done is to actually learn other people's curricula and what's in their course content and suggest to them that if they rewrote that assignment they could build in the probability. So Leisure and Tourism share with Business an assignment about running a major sporting event. It could easily be shared by the Hospitality and Catering GNVQ because all the same problems of getting a marquee on site, timing everything, what's the probability that it's going to rain over two days in June? We can get all the Application of Number into the assignment.* But another member of a different Mathematics Department thought that it was: *Very, very difficult to get certain topics naturally into the subjects.* That is, the strength of classification and framing between AoN and various GNVQ subject areas varies. This issue of different requirements in different vocational areas might partly have explained why there was such variety in the provision of Key Skills (Wolf, 1997) and AoN (McAlpine and Greatorex, 1999a & b). It might also have partly explained why coping mechanism 2 was to vary the teaching and timetabling of AoN with the different vocational areas. It would also appear from Table 3 that this was a popular coping mechanism with staff and students.

From the small number of quotes that have been given above it appeared that AoN has had a mixed reception. The varied strength of classification and framing between AoN and different GNVQ subject areas might explain why centres had difficulties fitting it into a coherent curriculum. However, it is difficult to make generalisations from these findings as the interviews covered 25 staff and 11 students from 5 centres.

Forthcoming changes in AoN

For some time now Awarding Bodies and Higher Education have been interested in how centres might respond to the Curriculum 2000 changes. QCA (1999) have offered guidance in this area but centres, students and higher education all have a part to play in determining the outcomes of the government changes. Centres have the power to decide how they will organise and teach AoN, students can decide whether they wish to register for the Key Skills qualification and Higher Education can decide whether they want to include a Key Skills qualification in the requirements for

entry to different HE programmes. In other words if centres and/or students and/or Higher Education deem Curriculum 2000 inappropriate they can resist it. For example, Hodgson and Spours (1999) suggested that Key Skills might *not* be a priority for centres.

As explained above from September 2000 a Key Skills qualification covering the three compulsory GNVQ Key Skills will be offered as part of Curriculum 2000 (DfEE, 1999). The details of Curriculum 2000 and stakeholders' responses were explored in detail by Hodgson and Spours (2000). It was heralded as offering greater flexibility for young people who would be able to combine 6 unit GNVQs and A level studies (Hodgson and Spours, 2000). The new arrangements are essentially a unitised system although modularisation will not be instigated (Oates, 2000). Unitised or modular curricula are often associated with tight external control or facilitating speedy revisions to qualifications and their curricula (Oates, 2000). For example, NCVQ had tight control over the form of units in NVQs, and in HE modularisation has been used to regulate and monitor curriculum development (Oates, 2000). In the curriculum models which centres are likely to use next year KS are timetabled separately from GNVQs and other qualifications (UCAS, 2000b). This suggests that Curriculum 2000 will have some characteristics of the collection curriculum in which the old discipline specific power hierarchies will be maintained and reinforced. Rather than Curriculum 2000 offering freedom and flexibility it might be tightly controlled either externally and / or through the maintenance of discipline specific power hierarchies.

Fowler (1996) notes that the integrated curriculum is characterised by breadth, and the collection curriculum is characterised by depth. One of the aims of the changes to the curriculum in 2000 was to encourage students to broaden their studies. So Curriculum 2000 has one of the characteristics of the integrated curriculum. The qualifications that will be offered in Curriculum 2000 will be free-standing which is characteristic of the collection curriculum. However in certain qualifications like GNVQs KS will be 'signposted', that is in GNVQ specifications, links will be made between different qualification specifications. This is characteristic of the integrated curriculum. Also the size of many qualifications has been reduced - A levels have been cut in half to form AS qualifications and A2 programmes and GNVQs of 3 and 6 units will be offered besides the 12 unit awards. As Fowler (1996) argues about modularisation, this sectioning of the curriculum shows a lack of empathy for the traditional subjects i.e. education for depth and the collection curriculum. If Fowler's arguments are applied to Curriculum 2000 it appears that with the exception of the World Class Tests Curriculum 2000 might lead to educational breadth for the majority i.e. everyday knowledge but a lack of depth of understanding. This might reinforce the traditional divide between elitist academic education for the few and vocational or non-academic training for the majority. So Curriculum 2000 appears to have characteristics of both the collection and integrated curricula.

Brown (1999) offered an alternative plan which does not involve a division between specialist (A level) mathematics and applied or everyday mathematics (AoN). She argues that the fluid nature of employment requires everyone to maintain their mathematics studies to the highest possible level. She explains that a broad curriculum is required which is related to a wide range of applications and the current state of technology. That is: *there is little point in maintaining courses aimed at specific needs of particular subjects or careers at particular points in time* (Brown, 1999, 88).

Setting up a Key Skills qualification as part of curriculum 2000 which would be separate from GNVQs might be an attempt to raise the status of Key Skills and AoN. But Brown (1999) argues for a different approach to increasing the status of mathematics in society and the vocational arena. She explained that to raise the status of mathematics an improved mathematics curriculum was needed. This curriculum would differentiate by level of knowledge, understanding and competence rather than students' academic and vocational specialisms. In this situation links to vocational or academic specialisms would only be made through contextual problems and coursework projects. It would also maintain mathematics within the specialist mathematics community. Such a curriculum would have strong classification and framing except when contextual problems were used. Therefore it would tend to be a collection curriculum.

Whatever the precise nature of Curriculum 2000 centres will again experience the reorganisation of AoN. This will inevitably bring a shift in power relations. The small majority of centres who have used an integrated curriculum might find that staff and student relations become more hierarchical as the curriculum incorporates some of the qualities associated with the collection curriculum. Alternatively power might be seen to be shifting from teachers to managers who might be responsible for organising the timetable, e.g. Key Skills Co-Ordinators, or to politicians whose centralised power has increased in recent years.

Conclusions

Given the speedy changes in Key Skills any research in this area is soon dated. Good examples are the forthcoming changes in Curriculum 2000 described by Hodgson and Spours (2000). One of the questions raised in this paper was whether Bernstein's theory would illuminate the results of the study undertaken by McAlpine and Greatorex (1999a & b). The theory has been useful not only for seeing the results of the study from a different perspective but also for considering what might happen to AoN in Curriculum 2000 and how centres might respond to Curriculum 2000. We have learnt that rather than young people becoming equipped with Key Skills they might have experienced the 'mathsland' phenomenon. Also whilst Curriculum 2000 celebrates diversity there might be a good deal of control but stakeholders do have some power to determine the outcomes of the government's Key Skills initiative.

Bibliography

Bernstein, B. (1975) *Class, Codes and Control, Volume 3: Towards a Theory of Educational Transmission.* London: Routledge and Kegan Paul Ltd.

Bernstein, B. (1986) 'On Pedagogic Discourse' in Richardson, J. G. (ed) *Handbook of Theory and Research for the Sociology of Education.* London: Greenwood.

Bernstein, B. (1990) *Class, Codes and Control, Volume 4: The Structuring of Pedagogic Discourse*. London: Routledge.

Bernstein, B. (1996) *Pedagogy, symbolic control and identity: theory, research, critique.* London: Taylor and Routledge.

Boaler, J. (1994) When Do Girls Prefer Football to Fashion? An analysis of female underachievement in relation to 'realistic' mathematic contexts*, British Educational Research Journal,* 20, 5, 552 - 564.

Brown, M. (1999) One Mathematics for All? In C. Hoyles, C. Morgan and G. Woodhouse (eds) *Rethinking the Mathematics Curriculum*. London: Falmer Press.

Dearing, R. (1996) *Review of Qualifications for 16-19 Year Olds.* London: SCAA.

Delamont, S. (1996) Book Review of Bernstein, B. (1996) *Pedagogy, symbolic control and identity: theory, research, critique*. London: Taylor and Routledge. Sociology Research Online.

DfEE (1999) *Key Skills Explained.* London: DfEE.

DfEE (2000) *General National Vocational Qualifications: a brief guide*, www.dfee.gov.uk/gnvq/gnvq.htm.

Fowler, G. (1996) *Modularisation: Beauty and the Beast, A Bernsteinian Interpretation*, a paper presented at the International Conference The Dilemmas of Mass Higher Education, Staffordshire University, 10-12 April.

Hodgson, A. and Spours, K. (2000) *Qualifying for Success: Towards a framework of understanding*, the first report from the project Broadening the Advanced Level Curriculum: Institutional Responses to Qualifying for Success, Institute of Education/ Nuffield Project, London.

Hyland, T. and Weller, P. Monitoring GNVQs: a national survey of provision and implementation, *Educational Research*, 38, 1, 37-45.

King, R. (1976) Bernstein's sociology of the school: some propositions tested, *British Journal of Sociology*, 27, 430 - 43.

King, R. (1981) Bernstein's sociology of the school, *British Journal of Sociology*, 32, 259-65.

Mansell, W. (1999) Giant leap for mathematics-kind. *TES*, August 20 1999

McAlpine, M. and Greatorex, J. (1999a) *The implementation of the Application of Number,* a paper presented at British Educational Research Association (BERA) Conference, University of Sussex at Brighton, 2-5 September.

McAlpine, M. and Greatorex, J. (1999b) *The Application of Number Experience*, a paper presented at Researching Work and Learning, A First International Conference, School of Continuing Education, University of Leeds, UK, 10-12 September.

Moore, R. (1987) Education and the Ideology of Production, *British Journal of Sociology of Education*, 8, 2, 227-242.

NCVQ (1994) *Assessing Core Skills in GNVQs, For schools and colleges.* London: NCVQ.

Oates, T. (2000) *Issues of unitisation* a paper presented at the Advisory Group on Research into Assessment and Qualifications, Qualifications and Curriculum Authority, 2 March.

Pring, R. (1975) Bernstein's classification and framing of knowledge, *Scottish Educational Studies*, 7, 67-74.

QCA (1999) *Curriculum Guidance for 2000 – implementing the changes to 16-19 qualifications.* London: QCA.

QCA (2000) *Welcome to GNVQ,* http://www.qca.org.uk/gnvq

Ranson, S. (1984) Towards a Tertiary Tripartism: New Codes of Social Control and the 17+, in Broadfoot, P. (ed) *Selection, Certification and Control: Some Issues in Educational Assessment*, London: Falmer Press.

Robinson, P. (1997) *Literacy, Numeracy and Economic Performance.* London: Centre for Economic Performance.

Steinberg, L. (1996) *Beyond the Classroom: why school reform has failed and what parents need to do.* New York: Touchstone.

Wiliam, D. (1992) *What makes an investigation difficult?* a paper presented at the Secondary Mathematics Independent Learning Experience (SMILE) conference held at Nottingham University, March.

Wolf, A. (1997) *GNVQs 1993-1997 a national survey report.* Bristol: FEDA.

Wolf, A. and Griffith, G. (1996) *Improving the Delivery of Mathematics for Post -16 Vocational Students* (Paper for SCAA), London: SCAA.

UCAS (2000a) *Summary of changes to post-16 qualifications.*
http://www.ucas.ac.uk/higher/post16/index2.html

UCAS (2000b) *Changes to Post-16 Qualifications.* London: UCAS.

Young, M. (1999), Knowledge, Learning and the Curriculum of the Future [1], *British Educational Research Journal*, 25, 4, 463-477.