

BSRLM Day Conference
The Open University 11th June 2005

Speaker John Mason

Expressing Generality: reflections on the significance of a pedagogic construct for use both when teaching and when pointing during CPD.

My aim is to reflect upon what makes the construct of expressing generality so significant for me, drawing on my early experiences, especially of mathematics, and to review the refinement of it over time as a label for experiences intended to inform teaching. Seen as a case study, I hope it may illuminate aspects of how I and my colleagues in CME have tried to unite practice and theory, professional development and research.

I am using the term pointing to try to capture the essence of effective CPD which for me is not about teaching professionals, and certainly not about training. Rather it is about pointing (metaphorically) to phenomena and to ways of working on and with phenomena. Phenomena arise through incidents which others recognise as instantiating issues in teaching and learning. What effective CPD can do is highlight phenomena which may currently be being overlooked, and draw attention to ways of working on issues which others have found fruitful to use. The aim is to support teachers in increasing their sensitivity to notice possibilities, and to extend the range of options from which to choose to act, moment by moment.

Working groups

Steve Lerman, London South Bank University; Andy Noyes, University Of Nottingham

Mathematics Education and Policy

This is the first meeting of a Working Group on policy issues in mathematics education. Colleagues studying/researching the effects of the numeracy strategy, SATs, OfStEd, TTA policies, the Smith Report, etc., may like to participate in considering implications of DfES and TTA policy for pupils, teachers, parents and schools. The aim of this first session is to gain an overview of what people are doing and also to begin to identify what research needs doing by the maths ed. research community regarding policy and mathematics. Participants should come prepared with a few words about their research and/or interests relating to policy, as well as their hobby-horse, i.e. what we should consider as a community? This will probably comprise about half of the session time. Depending upon the level of participation, the second part of the session will include a short presentation and lead to a discussion about whether the group should continue and how.

Discussion group

Celia Hoyles, Institute of Education, University of London; Rosamund Sutherland, University of Bristol

Mathematics Education Research Capacity Building

In this session we will discuss ways in which mathematics education research capacity can be developed in the UK. This will include suggestions for:

- Funded doctoral students in mathematics education
- Support for young academics
- Research reviews for practitioners

- Links with ICMI Study Groups

Conference sessions

Shafia Abdul-Rahman

Construction tasks and learner's understanding of integration.

Time: 30 mins

In this paper, I report part of an investigation to obtain a range of responses that constitute conceptual understanding of integration. I consider the use of a framework referred to as 'structure of a topic' to study three kinds of learners' understanding, namely mathematics student, mathematics educator and technology lecturer. Learners seem to have different structures of attention that dominates their understanding compared to some experienced users. Their responses to a single construction task reveal the extent of their understanding. My conjecture is that encouraging learners to generate examples may help them gain a deeper appreciation and understanding of the concept.

Mojtaba Ammari Allahyar, Institute of Education, University of Warwick

Logo- Microworld and Understanding Recursion

Time: 30 mins

This paper presents the effects of using tool in understanding recursion. It also by modelling of trees and fractal-shape objects examines the relationship between recursion and iteration and self-similarity concepts as well as inter-relations of a recursive process with using the tool which is being designed during the study. The study is based on a design-based research methodology. Some of the results of early iterations are present here. The findings have some positive points as well as throwing light on how the software should change for the next iterations. These early results show that having a clear understanding of the relation between recursion and iteration and self-similarity concepts and flow of control could be helpful for understanding the recursion itself. Also the concept of functional abstraction is a key concept in dealing with recursion. In terms of these results we are going to open up the software in two levels of faith and mechanism in the next iterations.

Jenni Back, NRICH Project, Cambridge University

Talking about Maths on the Web

Time: 30 mins, age range: secondary; topic: pupil learning, language, computers, IT

An analysis of some webboard discussion about mathematical problems from the NRICH website. We will consider some data and suggest possible analyses of mathematical and social aspects of it.

Erhan Bingolbali, University of Leeds

Undergraduate Students' Departmental Affiliation and Conceptions of the Derivative

Time: 30 mins

The background of this presentation is a study of first year undergraduate mechanical engineering and mathematics students' conceptions of the derivative. The results indicate that mechanical engineering students develop proclivities towards the rate of change aspect of the derivative whilst mathematics students develop proclivities towards the tangent aspect. In explaining the differences between the proclivities of the

two groups of students, I introduce the notion of students' departmental affiliation. I will then consider the genesis and implications of departmental affiliation.

Tony Brown, Manchester Metropolitan University

New Teacher Identity and Regulative Government

Time: 1 hour; age: Tertiary, HE, teachers, secondary; topic: pupil learning

John has a project 'Linking School Mathematics to Out-of-school Mathematical Activities' which investigates ways that secondary school mathematics can be 'made real'. Tony is a teacher-researcher in this project. Tony approached a local tea and coffee packaging company who gave Tony a problem they had just been given by a supermarket – to design 'shelf-ready packaging' for a six pack of tea cartons. We will briefly describe the project, detail what the class did and raise issues around the themes: links with industry, the role of technology, learning & assessment (what maths is there in this?).

John Butlin, University of Central England

Working with Word Problems in the Primary School

Time: 1 hour; age range: primary; topic: pupil learning

This session reports on work with several Year 4 children involving sorting and categorising addition and subtraction word problems. Reference will be made to the features of the problems that the children's attention is drawn to and also to the effectiveness of sorting problems as a task for developing the children's performance in solving word problems.

Patricia George, University of Leeds

Making Mathematics Hard: Student views from a Caribbean perspective

Time: 30 mins

The presentation will report on an initial finding of a study which explored students' perceptions of mathematics in a Caribbean setting. Approximately half of the students in the survey sample thought that mathematics was hard, and this was the most frequent reason given by students for not liking mathematics. This in itself is not surprising, but what was surprising was that there appeared to be an implicit feeling by some students and explicitly stated by others, that it was the teacher who was 'making maths hard'. The presentation will look at what 'making maths hard' might mean or look like to students.

Marie Gibbs, University of Bristol

Patterns of Student Interactions: what can they reveal about the learning of mathematics?

Time: 30 mins; age range: secondary

This session will explore the analysis of video data collected in a secondary mathematics classroom. Students were working in small groups using graphing software (*Autograph*) to produce graphs of quadratic functions. The graphs were then sketched on a worksheet. The data has been analysed within a framework developed from Brousseau's (1997) notion of the 'modes of production' students engage in when they are doing mathematics. In this session, an example of the video data will be provided and participants will be shown how it was coded. The initial analysis of the coded data will be presented

and participants will be invited to comment. Brousseau, G (1997) Theory of Didactical Situations in Mathematics London:Kluwer

Ian Jones, Institute of Education, University of Warwick

Constructing Utility for the Equals Sign

Time: 1hr

It is well documented that children attend more readily to operator meanings than relational meanings of the equals sign (e.g. Behr et al 1980, Hughes 1986). When encountered in the classroom the utility of the equals sign tends to be 'get the answer' as in expressions such as ' $3 + 3 = []$ ' or the = button on a calculator. An initial exploration using the Visual Fractions microworld offers some insights into how certain settings might support the construction of relational meanings for the equals sign. I will discuss how these early results might be developed.

Kerem Karaagac, University of Leeds

Differences In Teachers' Selection and Use of Examples in Classrooms: An institutional perspective on teacher practice.

Time: 30 mins

The research presented here is an attempt to explore teachers' classroom practices in mathematics lessons in Turkish state schools and privately owned educational institutions. I will present data on the use of examples in mathematics lessons in two classrooms from different schools teaching the same content: inverse functions. The results indicate that the time given to student engagement with examples differs. In private college, the time allowed for students' engagement with problems is markedly less than in state schools. Further analysis on the use of examples shows that the examples teachers selected to use and the way they made use of them were also different. I will discuss the results under the light of socio cultural theories.

Phillip Kent and Arthur Bakker, London Knowledge Lab, Institute of Education

Statistical Reasoning in the Workplace: Techno-mathematical Literacies and learning opportunities

Time: 30 mins

The "Techno-mathematical Literacies in the Workplace" project (ESRC-TLRP) is investigating the needs of employees in a range of industrial and commercial workplaces to have functional mathematical and statistical knowledge that is grounded in their workplace situations and in the technological artefacts that surround them. This presentation will focus on statistical reasoning and "situated modelling", that is how employees construct knowledge about models of processes. We will present some emerging ideas using examples drawn from industrial workplaces where we have noted a "skills gap" concerning the use of statistical techniques for controlling and improving manufacturing processes. We will first review our analysis of Techno-mathematical Literacies in workplace situations, using a framework that combines activity theory and semiotic ideas. Then we will present some prototype "learning opportunities" for situated statistical reasoning based on the educational statistical software, TinkerPlots. The learning opportunities are intended to be flexible resources for learning that can be incorporated within, or be presented alongside, workplace training materials. Moreover, they are being developed in partnership between the research team, workplace trainers and managers, and experts from industry training organisations.

Dietmar Küchemann and Celia Hoyles, Institute of Education, University of London

Working with Teachers on the Proof Materials Project

Time: 30 mins, age: secondary, topic: curriculum

Over the last year we have been working with several groups of middle/secondary school teachers on finding ways of engaging pupils in explaining and proving in the mathematics classroom. We discuss some of the teachers' ways of working and the characteristics of the different kinds of tasks that they have used

Juan Pablo Mejia-Ramos, University of Warwick

Aspects of Proof in Mathematics Research

Time: 1 hour; age: secondary; topic: curriculum & assessment; pupil learning; computers, teacher education

Without having a clear definition of what proof is, mathematicians have been able to distinguish proofs from other types of argument. This has become increasingly difficult in the last thirty years, as mathematicians have been able to use ever more powerful computers to assist them in their research. A theoretical analysis of two types of proof (mathematical proof and formal proof) and two types of argument (mechanically-checked formal proof and computational experiment) reveals some of the main aspects of proof in mathematics research. The emerging theoretical framework builds on the distinction between public and private aspects of proof, and revises the characterization of mathematical proof as being formal, convincing, and a source of understanding.

Heather Mendick, Institute for Policy Studies in Education, London Metropolitan University

Hippy Chic and Geek Chic: what do positive images of women mathematicians look like?

Time: 1 hour; Age: young adult ; Topic: pupil learning

In this session I explore images of *women* mathematicians within popular culture (including film, TV and the internet) and how they might help young women to build positive relationships with the subject. There have been several films about male mathematicians, all depicting highly gendered images of mathematics and mathematicians. I explored these at BSRLM last year. Since then I have been looking at images of female mathematicians, and trying to be more positive. Among the images I will discuss are Carol Vorderman from *Countdown*, Willow from *Buffy the Vampire Slayer* and a cosmetics bag bearing an image of a woman and the words 'I'm too pretty to do math'. Television and film clips will be used to illustrate the discussions.

Frank Monaghan, The Open University

The Company of Words: Using concordances to develop language in the maths classroom'

Time: 1 hour

In this session I will describe the use of concordancing software to explore a corpus of mathematics materials. The aim is to show how this could deepen the understanding of the register of mathematics and to develop a linguistically principled curriculum for EAL learners in particular.

John Monaghan, Tony Staneff, University of Leeds

An Authentic Packaging Task in the Classroom

Time: 1 hour; age: primary

In studying changes to children's successful strategies while solving arithmetic tasks with primary school children, two methodological approaches were combined: the micro-developmental method and the clinical method of interviewing. This paper discusses the ways in which these approaches were combined in supporting the design of the project. Extracts from the data collected illustrate how the combination of the two methods can reveal a variety of aspects in children's ever changing problem solving behaviour, such as problem solving approach, efficiency and solution time as well as changes in children's verbal and non-verbal behaviour. The paper discusses specific aspects of the combination of the two methods of research that proved to be suitable and particularly effective in studying the *process* of behavioural and conceptual change in the domain of arithmetic problem solving.

Candia Morgan, Claire Tikly, Institute of Education, University of London

Recruitment to PGCE Mathematics Courses: How can we make them want to register?

Time: 1 hour; age: HE, teachers, secondary; topic: teacher education

A substantial number of those offered places on PGCE Mathematics courses at London HEIs do not proceed to registration. A TTA funded study of those registering and failing to register at four HEIs has used questionnaires and interviews to investigate the ways in which aspects of the selection process and pre-course experience affected successful applicants' reported feelings about accepting the offer of a place. Analysis of questionnaires has explored differences in the responses according to several demographic variables. In this session we shall report the main results and discuss implications for HEI institutions. The recommendations arising from the study so far have been informed by discussion with tutors at the HEIs involved. We hope to open up the discussion to consider their wider relevance.

Declan O'Reilly, University of Sheffield

Student Teachers' Experiences of using Spreadsheets

Time: 1 hour; age range: young

This paper recounts 14 student teachers' experiences of using spreadsheets to teach mathematics in secondary schools. As part of their formal assessment, they submitted accounts, listing the problems and benefits encountered in using this software. These accounts form the basis of the analysis. The overall results suggest that despite the problems encountered, the experience of using spreadsheets was positive with long-term benefits for their professional development.

Mehmet Fatih Ozmantar, University of Leeds, School of Education

Mathematical Abstraction: A dialectical view

Time: 30 mins

In the classical Aristotelian empiricist view, abstraction is associated with an ascending developmental process from the concrete to the abstract. In this presentation, however, I argue that the development coming about in the formation of mathematical abstraction can be best portrayed as a dialectical development *to and fro* between the concrete and abstract. This argument is exemplified on the basis of the verbal protocols of two students working together on a task connected to sketching the graphs of absolute value linear functions.

Sandra Pendlington, University of Bristol

Using Visual Tools to Promote Mathematical Learning

Time: 30 mins; age: primary; topic: pupil learning

Nunes (1997) explored the idea of mediated action in which tools are used to help learners make sense of mathematics and enter into the culture of the mathematical world. This paper describes research done with low achieving primary school children that explored the nature of successful and unsuccessful mediating tools. It discusses the importance of negotiating two elements of visual tools – their structure and the mathematical labelling attached to the structure. Using examples of tools from the research, it describes how the children needed time to make sense of the mathematical relationships inherent in the tools and that once these relationships were understood they were able to make connections between mathematical ideas. The research shows the importance of choosing visual tools carefully and that some of the visual tools suggested in the National Numeracy Strategy are inappropriate.

Tom Roper, University of Leeds

Functional mathematics: What is it?

Time: 1 hour, age range: secondary; topic: curriculum

"The term "functional mathematics" , which features strongly in the recent White Paper on 14-19 Education and Skills, is born of the Smith and Tomlinson Reports. Functional mathematics is one of the few survivors of the Tomlinson report , but what is functional mathematics? The term has a nice ring to it, every one can understand it, everyone has a feel for it, but no two conceptions are alike. As a part of its remit, the 14-19 Pathways in Mathematics (Leeds) team must arrive at a conception of functional mathematics, and propose a detailed curriculum and assessment approach for it at different levels.

The seminar will attempt to move towards a shared conception/definition/description of functional mathematics, by exploring the definitions and implementation of its antecedents (for example numeracy), by thinking through some possible conceptions currently available and by opening up a debate with participants in the seminar concerning its practical dimensions .

We very much intend that the seminar will be a forum for debate and discussion.'

Stuart Rowlands, University of Plymouth

A use of History in Teaching Calculus

Time: 1 hour; age range: secondary/tertiary/HE; topic: curriculum and pupil learning

A small sample of students who know how to perform and apply the techniques of differentiation could not answer the question 'what is differentiation?' This suggests that many students who have successfully completed a first course in calculus do not have a deep understanding of instantaneous rates of change. Without a conceptual understanding of its theoretical underpinnings, calculus becomes at best a meaningful set of rules, at worst, 'rules without reason'. The central point of this presentation is that history can serve to contextualise for the student the difficulties in understanding calculus and can provide an essential stepping stone to conceptual understanding.

Tim Rowlands, University of Cambridge

"Three cheers for Derek Haylock!": primary PGCE students' use of mathematics handbooks

Time: 30 mins; age range: Primary/HE; topic: teacher education

I was recently asked to review an American mathematics book intended for pre-service primary teachers, from a comparative perspective. It occurred to me that although we routinely recommend books like Derek Haylock's 'Mathematics Explained for Primary Teachers' to our own primary ITE students, we know very little, beyond anecdote, about how (or whether) they use such books during their training. In the session I shall present findings from a survey of about 200 such students, and

hope to find out whether these findings agree with the impressions of colleagues elsewhere. The quotation in the title is from earlier research by Maria Goulding.

Jonathan P. San Diego, James Aczel and Barbara Hodgson, Institute of Educational Technology, The Open University

She Said, “I’m Just Doing It Pure Visually!” Whilst The Other One Wrote, “ $(A,0) = (-0.5,0)$; $Y=X \rightarrow 8 \text{ IS MOD } 4$.”

Time: 1 hour

Research suggests that students often find it difficult to learn from multiple representations (e.g. numerical, algebraic and graphical), representations which can now be easily accessed and manipulated via computers. Yet the effects of having representations instantiated differently (static, dynamic or interactive) are unclear. This research is investigating how representations instantiated in different ways influence learners’ cognitive processes as evidenced by conjectures. The empirical work presented here incorporates data collection techniques of eye-tracking, digital video recording and Tablet PC screen capture; and state-of-the-art software for coordinating and analysing multiple sources of video data. This paper aims to initiate discussion of methodological issues involved in the conduct of such research.

Louise Sheryn, University of Leeds

Getting an Insight into How Students Use their Graphical Calculators

Time: 30 mins

I plan to report on a data collection tool that I used within my doctoral studies. My study investigates the depth and type of learning that takes place when a student uses a graphical calculator within an AS Level Mathematics course. I collected various types of data during the project: interviews; observations; key-stroke data from graphical calculators and combinations of all three. The key-stroke data was collected using a piece of software called Key Recorder that runs in the background of a graphical calculator recording all the user’s key strokes. It is then possible to playback the data file to see what the user saw and determine how they used their graphical calculator. I plan to outline some features of the Key Recorder followed by some initial observations made during analysis of the data I have collected.