BSRLM Day Conference
University of Warwick, Coventry
Saturday 25th February 2006

Plenary Speaker
Professor Heinz Steinbring, University of Essen-Duisburg, Germany

The Culture of the Mathematics Classroom and its Specific Symbols – Two Cases of

the Epistemology-Oriented Interaction Research from Elementary Teaching

Within the culture of mathematics teaching signs and symbols have a decisive function for coding, constructing and communicating mathematical knowledge. Nevertheless mathematical signs do not contain per se mathematical meaning and conceptual ideas. Mathematical signs – as every sign – ›stand for something else‹. Analysing the interactive use of mathematical signs in the classroom culture can help to better understand what could have been intended with a mathematical sign communicated. The talk will introduce fundamental notions of the epistemology-oriented interaction research. Two short teaching episodes will be presented and analysed showing the specific use and interpretation of mathematical signs and symbols. A comprehensive elaboration of the epistemology-oriented interaction research can be found in: H. Steinbring (2005), *The Construction of New Mathematical Knowledge in Classroom Interaction – An Epistemological Perspective*, Mathematics Education Library, vol. 38, Springer Science+Business Media, Inc. New York.

Conference sessions
(in alphabetical order)

Thabit Al-Murani, University of Oxford
Teachers' awareness of Dimensions of Variation: A Mathematics Intervention Project
Time: 30 min; age: secondary; topic: curriculum
> The session will report the findings of a 16-month longitudinal teaching intervention investigating the deliberate and systematic handling of content and its consequences in the teaching and learning of mathematics. A mixed methods approach was used. From this, the quantitative data indicates that intervention teachers attending to variation produce significant learning benefits for their students; the qualitative data was used to conjecture on the reasons why, and through which mechanisms these gains had been produced.

Mojtaba Ammari-Allahyari, University of Warwick
The role of Aesthetics in Mathematics Education
Time: 30 min; age: primary, secondary, tertiary, teachers, H.E.; topic: Pupil learning, Computers/IT, Teacher Education
> That is a pervasive opinion in society that mathematics is only understandable for certain people. In this paper I aimed to show that having appreciation of aesthetics in mathematics education will be helpful to show that that popular opinion has to be revised. For doing this I am going to use fractals and some applications of chaos game to introduce some serious mathematical concepts that are quite famous for complexity and being hard to achieve.

Amir Asghari, University of Warwick
Exemplifications and Conceptions

Time: 1 hour; age: tertiary/HE; topic: pupil learning
> I use this session to expand on my discussion in BCME6 (available from www.bsrlm.org.uk) where I suggested that there are certain interactions between generating an example and checking the status of something for being an example. Here, I discuss the relation between the learner's approach to generating and checking, and his or her conception of what the examples are of. To bring the above interconnections to the fore, I will ask the participants in the session to generate an example of a given definition, and to check the examplehood of some prepared objects. The only mathematical background needed is some familiarity with the coordinates in the plane.

Beth Ashfield and Stephanie Prestage, University of Birmingham
Analysis of Tasks in Secondary Geometry: from Durell to Cabri
Time: 30 min; age: secondary; topic: curriculum
> This paper contains some findings from a PhD thesis.
> Working with a group of students over two years I developed a framework for analysing tasks in secondary geometry. During this session I will define ideas of hinting support and inscriptions to support the analysis with reference to tasks ranging from Durell to Cabri.

Arthur Bakker (with P. Kent, C. Hoyles and R. Noss), Institute of Education, University of London
"It's not just magic!"- Learning opportunities with spreadsheets for the financial sector
Time: 1 hour; Age: workplace; topic: computers/IT
In the research project "Techno-mathematical Literacies in the Workplace" we have carried out case studies in several industry sectors to characterise employees' need of functional mathematical knowledge mediated by tools and grounded in the context of specific work situations. Derived from the sector-specific requirements, we have designed "learning opportunities" which we have tested and revised as part of design-based research. In a "boundary-crossing" approach we have tried to unpack the mathematics behind the everyday artefacts that employees work with. This paper gives examples from two pensions companies in which we have used spreadsheet-based learning opportunities to support administrative employees in their understanding of the (for them) hidden mathematical models on which pension investments are based.

Ibrahim Bayazit, University of Warwick
Task Selection and Task Implementation: Seven Dilemmas Affecting the Teacher's Instruction
Time: 30 min; age: teachers; topic: teaching
> This paper examines an experienced teacher's task selection and task implementation teaching the function concept. The results indicate that there are seven constraints in the teacher's selection and implementation of the tasks, and these factors potentially inhibit his students' engagements with the notion of function. Fundamentally, the evidence suggests that the task, by itself, does not speak to the students; instead it is the teacher's expertise in creating task conditions, such as using apposite language which is consistent with the epistemology of the function concept and establishing connections between the ideas and between the representations, which are critical to promote the students' conceptual development through the representations of the function.

Margaret Brown, Diana Coben, Jeremy Hodgen, Ian Stevenson, Hamsa Venkatakrishnan, King's College, University of London
Functional Mathematics and its Assessment

Time: 1 hour; age: secondary/tertiary; topic: curriculum, assessment and computers/IT

> In this paper we draw on our work on the assessment of Functional Mathematics in the King's College London / Edexcel project, Developing Curriculum Pathways in Mathematics. Functionality involves using mathematics for a purpose, whether it be solving a problem, communicating information or simply understanding a situation. At the heart of functional mathematics, we argue, is the process of making and using models, often involving the sophisticated use of elementary mathematics. Mathematical modelling can be seen as having two distinct but interrelated aspects: *exploration*, learning about a model that some else has made by exploring it, and *expression*, building a model in which learners can express their own understanding of a situation. Drawing on criteria developed by the Advisory Committee on Mathematics Education (ACME), the OECD Programme for International Student Assessment (PISA) definition of mathematical literacy and previous empirically-based work in mathematics assessment (Graded Assessment in Mathematics, GAIM), we are currently developing assessment structures for mathematics from Functional Mathematics Entry levels to level 3 and A-level. We will discuss our approach to functional mathematics curriculum and its assessment and will critique alternative approaches. We will examine the use of technology both in supporting students' access to mathematical concepts and as an integral part of the assessment. We will present for discussion a series of assessment items to illustrate our approach.

Margaret Brown and Diana Coben, King's College, University of London
Effective teaching of adult numeracy
Time: 1 hour; age: tertiary; topic: (adult) learning

> We will present the results of a 2.5 year project funded by the National Research and Development Centre for Adult Literacy and Numeracy and the European Social fund. The aim was to investigate different ways in which the teaching of adult numeracy takes place, and whether these seem to have any implications for learning gains and/or attitude changes among the students. Over the two years , the data-base included 413 students in 48 classes in a variety of settings, although only 250 of these were present to be assessed at both the start and end of their course . We will report characteristics of the students, the teachers and the lessons, drawing on interviews with students and teachers, lesson observations, teacher typology assessments and questionnaires. We will also discuss those few aspects which appeared to influence the learning gains and attitudes, and what might explain these.

Els De Geest, University of Oxford
The Art of Doing Mathematics: Mathematical Thinking approached from a Theory of Reception perspective
Time: 1 hour; age: primary/secondary/adult; topic: pupil learning

> I see Mathematical Thinking as the Art of doing Mathematics, with 'Art' taken as in its definition of 'branch of creative activity concerned with imitative and imaginative designs, sounds or ideas'. But I have a dilemma with the different sizes and intensities of mathematical thinking. For example what if a student says "I know 6 x 5 is not 35 because 6 is an even number and 35 is an odd number, so it must be wrong" or what if a student says about a pattern "it goes up in 3's". Is either of these Mathematical Thinking, the Art? Or both? Does Mathematical Thinking have to be a BIG idea, or can it be little as well? Looking for similarities in the literary world, I was inspired by Jauss' reception theory of when Art happens in literature. In this session I will review some of the relevant literature and by using examples of students' work, explore and

discuss these ideas and the transferability of Jauss' theory to mathematics pedagogy.

Liping Ding and Keith Jones, University of Southampton
<u>Teaching geometry in lower secondary school in Shanghai, China</u>
Time: 30 min; age: secondary; topic: curriculum/pupil learning
>This paper reports on a study of geometry teaching at the lower secondary school level in Shanghai, China. Through an analysis of data from observing a variety of Year 9 (Grade 8) lessons, and utilising data from the students' performance in school examinations, the study suggests that teachers in this region of China use classroom strategies that attempt to reinforce visual and deductive approaches in order to develop students' thinking in the transition to deductive geometry.

Bill Domoney and Janet Baker, Oxford Brookes University
<u>Comparing schools' performance over time</u>
Time: 30 min; age: primary; topic: assessment
>End of Key Stage 2 Tests are used to compare schools and compile league tables. This session reports on an evaluation project, comparing the mathematics test results of a sample of schools that used particular teaching materials, first with the national (English) average, and then with a matched sample of schools. We will report on the matching process, which used data easily accessed via the web, and could be applied to similar projects.
>We found that schools that were performing well against the national average in 2000 increased their advantage by 2004. The implication is that even using 'value' added' data we are disadvantaging schools that start from a low base point. We would welcome the opportunity to discuss the trends in test results from 2000 to 2004 in the light of these findings.

Marie Joubert Gibbs, University of Bristol
<u>Computer feedback in mathematics classroom tasks: developing a typology</u>
Time: 30 min; age: secondary; topic: computers/IT
>This session is concerned with the use of ICT in secondary mathematics classrooms. The preliminary analysis of classroom video data is presented and, from this analysis, an argument is developed for the need to problematise the nature of computer feedback in the context described. The discussion continues by demonstrating the feedback 'zigzags' that emerge from the data, which relate the feedback to the different 'modes of production' (Brousseau, 1997) in which students engage as they work on the task. These zigzags highlight the different roles computer feedback may take and from them, a typology of feedbacks is developed.

Jenny Houssart, The Open University
<u>The Views of Older Adults on School Mathematics Past and Present</u>
Time: 30 min; age: primary/secondary/adult; topic: curriculum/ pupil learning
>The session will consider the views of a group of people aged 75 and over on the teaching and learning of mathematics. It draws on written accounts of their use of and attitude to mathematics. Extracts are identified in which they reflect on their own experiences of learning mathematics at school or give their views on more recent mathematics education. Common themes are mental arithmetic and the use of calculators. Some accounts reveal inaccurate views of current practices in mathematics teaching.

Matthew Inglis, University of Warwick
<u>Preconscious biases in mathematical reasoning</u>

Time: 30 min; age: secondary; topic: pupil learning
> The notion of preconscious biases – cognitive 'rules of thumb' which bias attention towards "relevant" parts of the environment – have, in recent years, been studied by psychologists in an attempt to explain certain unexpected patterns of reasoning behaviour. In this seminar I will report data that explores how such preconscious biases affect mathematical reasoning.
> In particular, I will present eye-movement data that indicates that the loci of students' attention whilst evaluating "if…then" statements are significantly influenced by preconscious biases. Further experimental evidence will be discussed which suggests that similar biases affect the proof strategies adopted by students. Implications for task design will be considered.

Qaimah Ismail, University of York
An investigation of primary children's mathematics difficulties
Time: 1 hour; age: primary; topic: pupil learning
> This session will take the form of a presentation that will draw on my recently completed doctoral study which investigates the difficulties of primary children who are teacher-identified as having mathematics difficulties. It will report on and illustrate some of the findings from the research.

Dietmar Küchemann (and Celia Hoyles), Institute of Education, University of London
Secondary school students' approaches to proof in geometry
Time: 1 hour; Age: secondary; topic: pupil learning
> In the two-year Proof Materials Project we worked with a group of middle and secondary school teachers to develop proof activities. In this session we look at some secondary school students in their classrooms and consider the approaches they used and the difficulties they encountered on a variety of geometry tasks. We will also consider whether/how proof in geometry differs from proof in number/algebra.

Sandra Pendlington, University of Bristol
The balance of power in the mathematics classroom
Time: 1 hour; age: primary; topic: pupil learning
> Some psychologists see power as a dimension of self-esteem – having power over ones situation maintains high self-esteem. Within the classroom the teacher can be seen to have the power to 'direct learners' and be the 'holder of knowledge'. Learners are 'the directed' and 'receivers of knowledge'. During the presentation I hope to explore whether these views of the roles of teachers and students are necessary and unavoidable or in need of change. I will present data from a teaching project done with low achieving 10 year olds, who presented as feeling 'powerless' when learning mathematics at the start of the project. Post project interviews indicated a change in this position. Analysis indicated some possible reasons for this change. Audience discussion will form part of this presentation.

Stephanie Prestage and Pat Perks, University of Birmingham
Doing Maths or Practising the Finished Product
Time: 30 min; age: secondary; topic: teacher education
> This session will consider the teaching and learning of mathematics using the ideas of 'Adapting and Extending' (Prestage & Perks, 2001) in comparison with out observations of the use of exemplar materials such as those in the Secondary Strategy, to allow a discussion of the tensions for our ITE students' planning for teaching. In our test-based culture and the prevalence

of national materials do our students have time to do mathematics or is their only strategy to 'practise the finished product'.

Fauziah Abdul Rahim, University of Nottingham
<u>Adopting multicultural artefacts: Investigating mediating tools in a Malaysian primary school</u>
Time: 30 min; age: primary; topic: pupil learning

 In 2003 the Malaysian Ministry of Education introduced English Language as a medium of instruction for the teaching of science and mathematics. Simultaneously, primary schools have also been encouraged to allocate a period in a week to introduce abacus in the mathematics lessons. The participants (teacher and pupils) in this study are Malay and do not share the same culture to where the mediational artefacts belong i.e. language (English Language) or tool (abacus). However, in an attempt to establish a learning community that places mediation as central, the teacher and the pupils learn to adopt and work around these complexities.

 Taking a sociocultural perspective, this paper focuses on mediation provided by the teachers and better able peers in supporting pupils' learning of elementary mathematics using abacus. As part of a larger study that aims to answer a broader question of *how and why mediation is central in establishing a learning community to second language young learners learning Mathematics and English language?* , this paper presents and discusses a preliminary analysis of seven year old primary pupils learning mathematics. Classroom observations, field notes, interviews and discussion with the teachers were gathered as data within a period of three months.

Stuart Rowlands and Robert Carson, University of Plymouth
<u>Proof, Reasoning, Abstraction and Saltatory Leaps: A-Cultural Historical Approach to Teaching Geometry</u>
Time: 1 hour; age: secondary; topic: pupil learning

 How would you introduce to a class of pupils the angle property of the triangle? Geometry for most learners is an excursion into 'shape and space' without reason, deduction and proof. There seems to be a tacit assumption that deductive geometry is inappropriate, either because it is difficult to learn or that there are no obvious benefits that can accrue. We take the optimistic view that most secondary school learners are capable of engaging with the abstract and rule-governed but creative intellectual processes that became the world's first fully developed and comprehensive formalised system of thought. This presentation reports on a curriculum initiative that explores the few transformative events in the history of Greek geometry. Hopefully the initiative will encourage a meta-discourse that can develop a reflective consciousness, to provide an opportunity for induction into the formalities of proof and to engage even concrete thinkers with the abstract.

Margaret Sangster, Canterbury Christ Church University
<u>The influence of pace with primary mathematics lessons</u>
Time: 30 min; age: primary; topic: teacher education

 In this presentation the nature and role of pace in the mathematics lessons in primary schools will be discussed. Te introductory paper is based on observational research of student teachers conducting mathematics lessons during school experience.

Howard Tanner, Sonia Jones, Steve Kennewell and Gary Beauchamp
University of Wales Swansea

<u>Interactive Whole Class Teaching and Interactive White Boards</u>
Time: 30 min; Age: secondary; topic: Computers/IT

> In England and Wales, National Strategies promote pedagogies that emphasise interactive whole class teaching, although this is not defined precisely. In recent years major investment has been made in Interactive White Boards (IWB) and, whilst they do not determine pedagogy, as cultural tools they tend to support and encourage whole class teaching. This paper discusses the nature of interactive teaching. We conceptualise interactivity in whole class teaching on a continuum according to the degree of teacher / pupil control, the nature of the interaction and the character of the scaffolding provided through dialogue. We suggest that deep rather than surface features of interaction must be addressed if learning is to be improved.

Orit Zaslavsky, Dept. of Science & Technology Education, Haifa, Israel

<u>Features of Teachers' Choice and Treatment of Examples that may Support or Impede Mathematics Learning</u>
Time: 1 hour; Age: secondary; Topic: teacher education

> Initial findings of a study aimed at characterizing secondary mathematics teachers' ways of choosing and treating examples in their classrooms will be presented. In particular, excerpts from experienced teachers' lessons involving uses of examples will be presented followed by an analysis of their merits and limitations. Special attention will be given to the nature of examples that convey visual information. The audience will be invited to examine some of the excerpts, and discuss the complex considerations required for choosing or generating appropriate instructional examples that emerge from the findings – whether the examples are pre-constructed or spontaneously constructed during the lesson. Implications for teacher education, both pre-service and in-service, will be discussed.