

The International Community of Teachers of Mathematical Modelling and Applications.

www.ictma.net

The Community, through its membership, research and other activities, is recognised as "The International Study Group for Mathematical Modelling and Applications (ICTMA)" by its affiliation to the International Commission on Mathematical Instruction (ICMI).

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Please send future contributions to the editor by email <gloria.stillman@acu.edu.au>. The next Newsletter will be published in June, 2014. We are interested in your contributions to any of the current sections including theses, publications and project reports.

1. International Executive Committee

Following the business meeting in Blumenau on July 19, 2013, the ICTMA Executive for 2013-2015 was confirmed as follows:

President

Associate Professor Gloria Stillman (Australia) – Newsletter Editor & Secretary

Elected Members

Dr Jill Brown (Australia) [Email: Jill.Brown@acu.edu.au]

Prof Gabriele Kaiser (Germany) [Email: gabriele.kaiser@uni-hamburg.de]

Prof Jinxing Xie (China) – Webmaster & List Serve Moderator [Email: jxie@math.tsinghua.edu.cn]

Co-opted Members

Prof Helen Doerr (USA) [Email: hmdoerr@syr.edu]

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Prof Pauline Vos (Norway) [Email: pauline.vos@uia.no]

Conference Organisers

Prof Maria Salett Biembengut (Brazil) [Email: mariasalett@gmail.com]

Associate Prof Geoff Wake (UK) [Email: Geoffrey.Wake@nottingham.ac.uk]

2. Report from ICTMA 16

16TH INTERNATIONAL CONFERENCE ON THE TEACHING OF MATHEMATICAL MODELLING AND APPLICATIONS (ICTMA16)

Conference Theme: Mathematical Modelling: History and Future Perspectives

The 16th ICTMA Conference (ICTMA16) was hosted by the Universidade Regional de Blumenau, Blumenau, Brazil. It was chaired by Maria Salett Biembengut. The conference ran for 14-19 **July 2013**. *The conference brought together international experts in a variety of fields as well as local and regional teachers, post-graduate students and academics.*



Maria Salett and Emilia

The Academic programme included plenaries by internationally acclaimed speakers:

- Ubi D'Ambrosio (Brazil), Mathematical modelling as a strategy for building up knowledge in different cultural environments
- Henry Pollak (US), The place of mathematical modelling in the system of mathematics education: Perspectives and prospects
- Mogens Niss (Denmark), Prescriptive models - Opportunities and challenges
- Rodney Bazzanezi (Brazil), Teaching and learning with mathematical modelling – Training courses
- Gabriele Kaiser (Germany) Modelling competencies -- Importance in the past debate and future perspectives



Prof Ubi D'Ambrosio (Brazil) at the opening plenary with the ICTMA president, Gloria Stillman (Australia)



Prof. Rodney Bazzanezi (Brazil)



Prof Mogens Niss (Denmark) with discussant Jhony Alexander Villa-Ochoa (Colombia)

A plenary panel comprising Werner Blum (Germany), Gloria Stillman (Australia), Helen Doerr (US) and facilitator Jonas Bergman Arleback (Sweden) addressed the theme: *Mathematical modelling: History and future prospects*. There were also paper presentations related to research, theory, and practice, a Mathfair, and poster presentation session.

Eighty-one parallel lecture presentations addressed the following sub-themes: Modelling and applications with respect to environmental issues, health, industry, business, and the workplace; Pedagogical issues for teaching and learning; Applicability at different levels of schooling and in tertiary education; Research into teaching and practice; Innovative practices in research, teaching and practice; and Influences of technology and assessment in schools and universities. In addition there were 30 presentations in two Brazilian sessions. Participants came from 19 different countries.

At the business meeting at the end of the conference, paper presenters at the conference were invited to submit a book chapter for a proposed new book in the ICTMA series to be published by Springer in their series, *International Perspectives on the Teaching and Learning of Mathematical Modelling*. The editors for the book are Maria Salett Biembengut, Gloria Stillman and Werner Blum and its working title is *Teaching Mathematical Modelling: History and future prospects*. Reviewing of chapters is well under way but any further assistance you can give to the process is most welcome.



Part of plenary audience



Prof Henry Pollak (USA) with discussant, Rita Borromeo Ferri (Germany)



Xenia Reit (Germany) presenting

The venue for the conference was the Himmelblau Palace Hotel in Blumenau city. However, we did visit some beautiful restaurants for various lunches. An excursion took conference participants to Unipraias Park which is located in the trendy beach of Balneário Camboriú. Most took advantage of a cable car ride with panoramic views and stops at Mata Atlântica Station where the brave took a ride on zip lines.

Photographs are available at the conference website www.furb.br/cremm/ictma/

3. ICTMA 17

17TH INTERNATIONAL CONFERENCE ON THE TEACHING OF MATHEMATICAL MODELLING AND APPLICATIONS (ICTMA17) 19 – 24 JULY 2015
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Conference Theme: <i>Modelling perspectives: looking within and across boundaries</i>
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The Centre for Research in Mathematics Education (CRME), University of Nottingham, U.K., will host the 17th International Conference of the Community of Teachers of Mathematical Modelling and Applications.

Organisation

The conference will be organised locally by CRME staff, with Associate Professor Geoff Wake as Conference Chair, supported by Professors Hugh Burkhardt and Malcolm Swan (Director of CRME), University of Nottingham. They will be supported by others of the U.K mathematics education research community who have worked in the field of mathematical modelling and applications for many years including Profs. Julian Williams (University of Manchester) and Mike Savage (University of Leeds). This team of experienced researchers and educators will seek to involve a number of newly established researchers in accordance with the proposed policy of building community capacity.

Scientific Programme and Public lecture

The Conference theme is *Modelling perspectives: looking within and across boundaries*. It is intended to provide a stimulus to consider new approaches drawing on best practice from other related research in mathematics education and associated domains. Modelling is considered as having potential for interdisciplinary work that is required for effective problem solving in the world of work and more widely. In developing the scientific programme it is proposed to take the opportunity to strengthen and build our community taking the view that mathematical modelling and applications has potential appeal to a wider constituency than currently within the field of mathematics education research. The programme will include plenary lectures, research and theoretical paper presentations and working groups. In addition, drawing on the strength of CRME staff and others in the UK who work in mathematics education design research, we propose to invite participants to actively participate in an ‘exhibition’ of teaching and learning materials that prioritise mathematical modelling and applications. In the UK there is currently concern over public awareness of, and interest in, mathematics and science. A number of high-profile figures are working hard to reach audiences of those who ordinarily are wary of these subjects. It is hoped to organise a public lecture involving such a figure during the conference to assist this endeavor and to celebrate the ICTMA community assembling in Nottingham.

Venue and Travel

The conference will be held in the excellent academic facilities of University Park with a range of accommodation facilities for delegates on-site at a range of different costs. University Park is Nottingham’s largest campus at 300 acres. Part of the University since 1929, the campus is widely regarded as one of the largest and most attractive in the country. It is conveniently located only two miles from the city centre.

The University of Nottingham is a major UK university, set in an attractive campus on the outskirts of the City of Nottingham in the East Midlands region of England. It is easily accessible from both within the UK and internationally. The city is well-served by a number of airports with direct flights from many European cities and from other continents through London, Manchester and Birmingham. From the airports in these cities Nottingham can be reached by train in about 90 minutes – 2 hours depending on route and time of day. Close at hand, East Midlands Airport (EMA) is most convenient with the city centre being easily reached by bus service in about 30-45 minutes.

4. Brief News Items

4.1 Latest Book in ICTMA Series

The latest volume in the ICTMA book series, *Mathematical Modelling: Connecting to Research and Practice*, has been published by Springer. Springer has generously sent complimentary copies to all authors. Full registrants at ICTMA 15 in Melbourne and others who paid for a copy of the book will receive a copy once the bulk order arrives from Springer. The book starts with an introductory chapter by the editors, Gloria Stillman, Gabriele Kaiser, Werner Blum, and Jill Brown about the impact of globalisation on connections in teaching and research practices in the teaching of mathematical modelling. There are a further 51 chapters which are grouped into seven parts.

These are: (I) Innovative practices in modeling education research and teaching, (II) Research into, or evaluation of, teaching practice, (III) pedagogical issues for teaching and learning, (IV) Influences of technologies, (V) Assessment



L to R: Gloria Stillman, Jill Brown, Gabriele Kaiser, Werner Blum with advanced copy of the book.

in schools, (VI) Applicability at different levels of schooling, vocational education, and in tertiary education, and (VII) Modelling and applications in business and the lived environment.

4.2 Teacher Professional Development in Sweden

Starting this autumn of 2013 the Swedish government has launched a professional development programme for **all** mathematics teachers in Sweden to increase the quality of teaching. The municipalities in Sweden may apply for money so the teachers can go through one or more modules of the programme during their regular working hours. The programme is implemented using 'peer learning', which means that mathematics teachers discuss and evaluate teaching together with a mentor (one or more teachers are appointed by the community and specially trained to take care of the professional development course and act as mentor).

For the upper secondary school one of the modules in the programme is called *Teaching Mathematics by Problem Solving*. This module, as all modules in the programme, consists of eight parts, each including an outline of activities and a sequence for the teachers to follow. The work, the sequence to follow, in a module starts with a number of texts to read and discuss, followed by the collaborative development of short teaching activity. The developed activity is then implemented in the participating teachers' mathematics classrooms, and finally evaluated together with their peers. One of the eight parts in the module *Teaching Mathematics by Problem Solving* is called "mathematical modelling", and includes two texts about modelling and two problems related to geometry and similarity. Information about the programme as well as all the modules can be found (however only in Swedish) on the web-page: <http://ncm.gu.se/matematiklyftet>. We will follow this professional development programme with great interest and we hope that we can report on how the initiative is received and develops in future ICTMA Newsletters.

Peter and Jonas

4.3 Swedish Research Projects

Another new initiative in Sweden with the overall goal to strengthen the connection and collaboration between Linköping University and the schools in two nearby municipalities is a joint professional

development and research project. The project spans over 2.5 years with a probable extension for another 2.5-year period and the core idea revolves around collaborative work between researchers and small groups of 7-12-grade teachers in each of the municipalities. The research component of the project uses a *model and modeling perspective* on teaching and learning mathematics (Lesh & Doerr, 2003) and is centred on the design, implementation and evaluation of *model development sequences* (Lesh, Cramer, Doerr, Post, & Zawojewski, 2003). Small research projects around issues and questions based in the teachers' own everyday teaching practices and aiming at improving these are developed and carried out. The professional developmental part for the participating teachers within the project consists of the instructional designs in terms of sequences of lessons and material developed, experiences, guidelines for practices and so on. (There is a sister-project to this project within this initiative focusing on grades 1-6, but this does not use the same framing.) A central aspect taken in consideration and integrated throughout the project is the 'new' reform of the national curriculum at all educational levels from 2011.

References

- Lesh, R. A., & Doerr, H. M. (Eds.). (2003). *Beyond constructivism: Models and modeling perspectives on mathematics problem solving, learning, and teaching*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Lesh, R. A., Cramer, K., Doerr, H. M., Post, T., & Zawojewski, J. S. (2003). Model development sequences. In R. A. Lesh & H. M. Doerr (Eds.), *Beyond constructivism: Models and modeling perspectives on mathematics problem solving, learning, and teaching* (pp. 35–58). Mahwah, NJ: Lawrence Erlbaum Associates.

Jonas and Peter

4.4 Columbus Day Mathematical Modelling Symposium

In October, a Columbus Day Mathematical Modelling Symposium was held at Grace Dodge Hall, Teachers College, Columbia University. This symposium was held in honour of Professor Henry O. Pollak's 25 years of service to Teachers College, Columbia University. Henry is one of the pioneers in the field of applications and modelling in mathematics education. As early as the 1960s, when he was Director of Mathematics and Statistics Research at Bell Laboratories, he advocated integration of applications and modelling into mathematics teaching. Pollak's leadership was evident also at ICME-3 in 1976 where he gave the survey lecture on "The Interaction between Mathematics and Other School Subjects." During his 25 year career at Teachers College, Pollak has taught cohorts of doctoral students and supervised many doctoral dissertations in mathematics education. The Modelling Octoberfest included presentations by well known ICTMA members, Werner Blum and Rita Borromeo Ferri and others who often attend ICTMA related events, Sol Garfunkel of COMAP and Hugh Burkhardt of the Shell Centre and the well known mathematics educator, Alan Schoenfeld.

In 2014, school systems all over the USA will be preparing to begin to teach mathematical modelling as part of their adoption of the Common Core State Standards. This symposium aimed to take a concentrated look at the teaching of modelling, with ideas from international and national experts on how teachers could prepare to conduct this new task and fit it into their existing responsibilities, how students can learn modelling, and how everyone concerned can assess how successful the effort has been. How modelling will affect existing relationships between the system of mathematics education and mathematics itself was also examined.

4.5 The Mathematics Education for the Future Project Next Conference

The 12th International Conference of The Mathematics Education into the 21st Century Project, *The Future of Mathematics Education in a Connected World*, will be held September 21–26, 2014 at Hunguest Hotel Sun Resort, Herceg Novi, Montenegro. For ALL further conference details and updates please email alan@cdnalma.poznan.pl.

Alan Rogerson

5. Fuzzy Logic: A new powerful tool for Mathematical Modelling and Applications

From the time that Lotfi Zadeh introduced the notion of Fuzzy Sets [14] - and through this Fuzzy Logic (FL)- until now the relevant theory was expanded rapidly, to cover almost all sectors of human activities. Today one can see FL both as a formal theory which embraced classical mathematical areas such as Algebra, Graph theory, Topology, etc and as a powerful modelling tool that can cope with a large function of uncertainties in real life situations. In particular some important efforts have been attempted in applying principles of FL in Education (e.g. see [1-5]). In the book [6] we have introduced a series of stochastic (mainly Markov chain) and fuzzy models in the areas of Mathematical Education, Artificial Intelligence and Management, while in [12] we have developed a general fuzzy model representing several processes in a system's performance characterized by a degree of fuzziness and/or uncertainty. We may recall here that in the Management's language a *system* is understood to be a set of interacting components forming an integrated whole. A system comprises multiple views such as planning, analysis, design, implementation, deployment, structure, behaviour, input and output data, etc. Important applications of the above model for the learning and teaching of mathematical modelling can be found in [7-11], [13]. In Vol. 6, No. 1 of ICTMA's Newsletter there is an announcement (5.5, p.11) about a new journal on applications of fuzzy sets to general state spaces (IJAFS). This is an annual e-journal published by the Graduate Technological Educational Institute (T. E. I.) of Patras, Greece since 2011 (three volumes have been already released). The above journal has been now renamed to "INTERNATIONAL JOURNAL OF APPLICATIONS OF FUZZY SETS AND ARTIFICIAL INTELLIGENCE" (IJAFSAI), ISSN 2241-1240. It is an open access journal, where the accepted articles are published free from any charges. In the pages of IJAFSAI the reader can reach among the others some interesting articles on applications of FL to Mathematics Education in general and Mathematical Modelling in particular. Its home page can be found at <http://eclass.teipat.gr/eclass/courses/523103>, or at <http://www.drji.org/JournalProfile.aspx?jid=2241-1240> through the "Directory of Research Journals Indexing". Articles submitted for possible publication must be attached electronically (in MSWORD only) to the Editor-in-Chief at mvosk@hol.gr.

References

- [1] E. A. Espin & C. M. L. Oliveras, Introduction to the use of fuzzy logic in the assessment of mathematics teachers', in: A. Gagatsis (Ed.), *Proceedings of 1st Mediterranean Conference on Mathematics Education*, 107-113, Nicosia, Cyprus, 1997.
- [2] J. Ma, & D Zhou, Fuzzy Set Approach to the Assessment of Student- Centred Learning, *IEEE Transactions on Education*, 43(2), 237-241, 2000
- [3] S. Perdikaris, Using Fuzzy Sets to Determine the Continuity of the van Hiele Levels, *Journal of Mathematical Sciences & Mathematics Education*, 5(1), 39-46, 2011.
- [4] F. Spagnolo, Fuzzy logic, fuzzy thinking and the teaching/ learning of mathematics in multicultural situations, *Proceedings International Conference on Mathematics Education into the 21st Century (MEC21)*, 17-28, Brno (Czech Republic), 2003.
- [5] I. Ya. Subbotin, H. Badkoodehi & N. N. Bilotskii, Fuzzy logic and iterative assessment, *Didactics of Mathematics: Problems and Investigations (Ukraine)*, 25, 221-227, 2006.
- [6] M. Gr. Voskoglou, *Stochastic and Fuzzy models in Mathematics Education, Artificial Intelligence and Management*, Lambert Academic Publishing LAP, Saarbrucken, Germany, 2011 (for more details look at <http://amzn.com/3846528218>).
- [7] M. Gr. Voskoglou, A fuzzy model for the modelling process, in Munteanu, V. et al. (Eds.): *Recent Advances in Fuzzy Systems*, 44-49, WSEAS Press, Iasi, Romania, 2010.
- [8] M. Gr. Voskoglou, Mathematical modelling in classroom: The importance of validation of the constructed model, *Proceedings of the 11th International Conference MEC 21*, 352-357, Rhodes University, Grahamstown, South Africa, 2011.
- [9] M. Gr. Voskoglou, Measuring students modelling capacities: a fuzzy approach, *Iranian Journal of Fuzzy Systems*, 8(3), 23-33, 2011.
- [10] M. Gr. Voskoglou, Fuzzy logic and uncertainty in mathematics education, *International Journal of Applications of Fuzzy Sets and Artificial Intelligence*, 1, 45-64, 2011.
- [11] M. Gr. Voskoglou, Fuzzy measures for students mathematical modelling skills, *International Journal of Fuzzy Logic Systems*, 2(2), 13-26, 2012.
- [12] M. Gr. Voskoglou, A study on fuzzy systems, *American Journal of Computational and Applied Mathematics*, 2(5), 232-240, 2012
- [13] M. Gr. Voskoglou & A.-B, Salem, Fuzzy measures for students mathematical modelling skills, *Egyptian Computer Science Journal*, 37(3), 75-84, 2013.
- [14] L. Zadeh, Fuzzy Sets, *Information and Control*, 8, 338-353, 1965.

Michael Voskoglou

6. Recent Dissertations

Brown, J.P. (2013). Perceiving and enacting the affordances of technology-rich teaching and learning environments (TRTLE's) for student understanding of function. PhD The University of Melbourne. Supervisors: Professor Kaye Stacey and Associate Professor Robyn Pierce.

This thesis describes a study situated in a systemic context where electronic technologies were increasingly expected as part of the teaching and learning of secondary mathematics, in particular in the learning of functions. The aim of the thesis was to ascertain what affordances of technology-rich teaching and learning environments (TRTLE's) were being considered by teachers and students in the teaching and learning of this topic. Affordances are offerings of such an environment for facilitating and impeding learning. A qualitative case study of three purposively selected TRTLE's (2 in Year 11 and 1 in Year 9) focussed on what could be learned from the TRTLE's about the phenomenon of interest, development of student understanding of function in a TRTLE. Data collection occurred during general classroom teaching of functions and implementation of extended real world applications or modelling tasks where functions were used as models of different phenomena such as population growth. Rich, detailed descriptions of what was happening in these TRTLE's were assembled.

Affordances were identified as being perceived and/or promoted by the teachers in the TRTLE's. Most affordances were manifest in several ways for different purposes within the broad purpose of the particular affordance. Teachers undertook a variety of roles (behaviour or action particular to the circumstances) and tactics both (teacher actions for particular pedagogical purposes) both planned and in-the-moment, as they introduced particular affordances to students and worked towards student independent future enactment. For practical purposes, a focus on purpose rather than on how one's actions are undertaken seems more productive. When working independently on an extended task, an apparent lack of perception of the affordances Data Display-ability, Function view-ability, Represent-ability, and Check-ability restricted student opportunities for additional insight which should have been helpful during task-solving. Whilst teachers have responsibility for providing student opportunities to develop understanding of function in a TRTLE, students must bring their resources and competence in enacting affordances to the given enactment context to solve the task. This involves strategic decision-making, namely. Enactment management tactics being employed by students particularly in overcoming any difficulties.

Valsiner's Zone Theory, in particular the Zone of Free Movement/Zone of Promoted Action (ZFM/ZPA) complex and the laminal model of internalization/externalization were used as explanatory mechanisms for why some, but not all, students perceived and enacted affordances. As the ZFM approaches the ZPA the requirement for the students to engage in decision-making reduces, as does the need to attend to related reasoning for action. Consequently, ideas are either not internalized or not readily able to be externalized when required in task-solving.

This study provided clear evidence of the complexities of teaching and learning functions in a TRTLE. The major contributions are: (1) identification of affordances and their various manifestations useful in the teaching and learning of functions; (2) description of the complexities of solving function tasks in a TRTLE and the identification and impact of conditions (enabling perception, promoting enactment, and impeding) on various stages and actions in this process; and (3) construction of a grounded theory of teacher and student management of the perception and enactment of affordances of TRTLE's. These findings allow both in-service and pre-service teachers a deeper understanding of the complexities involved in teaching and learning in a TRTLE. Understanding of critical teaching roles and teaching tactics should result in increased student opportunities to expand repertoires of successful enactment management tactics. Subsequently, students should be more successful in demonstrating function understanding as they perceive and enact affordances of TRTLE's in solving function tasks.

Dierdorp, A. (2013). Learning correlation and regression within authentic sciences. PhD Utrecht University

One of the key challenges in mathematics and science education in secondary schools is to establish coherence between these school subjects. According to this PhD thesis statistical modelling can be a way to let students experience the connections between mathematics and science. The purpose of this design-based research was to gain insight into how to support upper-secondary school students' learning and understanding of correlation and regression models. The main research question was: What are characteristics of a valid and effective teaching and learning strategy to teach students about correlation and regression in such a way that they experience coherence between mathematics and the natural sciences? The design principle was to base the instructional activities on authentic problems in professional practices. We tested the evolving teaching and learning strategy in four studies. After a broad focus on statistical reasoning, the thesis zooms in on several specific concepts required: in particular measurement and sampling are considered important interfaces between mathematics and science. Last, the thesis zooms out and focuses more broadly on the coherence between mathematics, statistics, science and professional practices. In this thesis coherence is defined as the ability of students to make sense of the contexts so that they can apply scientific and mathematical knowledge when solving authentic problems.

Based on four studies conclusions are made that the designed strategy to teach students about correlation and regression seems valid and effective. It seems valid because the strategy is in line with prevailing epistemological ideas of the involved school subjects (e.g., mathematics: calculate standard deviation, statistics: produce a formula for the regression line, biology: aerobic respiration, geometry: reasons for subsidence, physics: operation of a thermometer). It seems effective because the involved students learned to solve real-world problems by correctly using correlation and regression models. They also appeared to understand the concepts and process of modelling and were able to combine mathematical and statistical techniques with concepts of the natural sciences when solving real-world problems.

The possible impact of this thesis for educational practice is multiple. Its scientific findings are directly applicable to educational practice. The practicality implies an effective intervention: an instructional unit and a research based student test that are realistically usable in the setting of secondary schools. Also, the developed set of design characteristics as criteria could be helpful for designers of similar teaching and learning strategies.

The designed module provoked or inspired students to learn about statistics and that stimulated them to use it in other practices. The analysis shows that such a strategy works to teach students statistical techniques, that they can learn to understand the mathematical background, use mathematical tools and that the natural sciences offer powerful contexts to evoke students' interests to learn and reason about statistics.

Frejd, P. (2011). Mathematical modelling in upper secondary school in Sweden: An exploratory investigation. University dissertation from Linköping. Supervisor: Christer Bergsten.

The official curriculum guidelines for upper secondary school in Sweden emphasise the use of mathematical models and mathematical modelling in mathematics education. However, no explicit definitions or descriptions of the notions are given in the curriculum. This licentiate thesis is an exploratory study which investigates teachers' and students' conceptions of the notion of mathematical modelling as well as their attitudes and experiences of working with mathematical modelling in mathematics classrooms. One experience of mathematical modelling that faces both students and teachers which is investigated is the national course tests in mathematics. The thesis includes five papers and a preamble, where the papers are summarised, analysed, and discussed. Both quantitative and qualitative methods are being used in the thesis and theoretical aspects concerning mathematical modelling and conceptions are examined. The results indicate that mathematical modelling plays a minor role in the investigated mathematics classrooms. The students as well as the teachers were not familiar with the notion of mathematical modelling. Only 23% of the

381 students and 50% of the 18 teachers had heard the notion before participating in the study. Both teachers and students participating in this study expressed a variety of different interpretations of the notion of mathematical modelling. Negative attitudes were expressed by the students as well as by some of the teachers concerning mathematical modelling. These negative attitudes may present obstacles for implementing mathematical modelling in the upper secondary mathematics classroom. However, these negative attitudes are related to the used test items, which may have had a negative impact on the research, especially, as the test items only test parts of the modelling process. One dominant conception found among the teachers was that mathematical modelling is related to physics or chemistry. The conclusion made from the investigation about national course tests in mathematics course D, is that there is a lack of holistic assessment of mathematical modelling. Intra-mathematical aspects of mathematical modelling are put in favour for extra-mathematical aspects. Researchers argue that if we want develop students' modelling competency, then modelling has to be explicitly used and practised in the mathematics classrooms. However, for the Swedish upper secondary school this study concludes that this is not the case. A suggestion for future research is to focus on mathematical modelling in teacher education and design studies of incorporation of modelling activities into mathematics classrooms.

Kinnear, V. (2013). Young children's statistical reasoning: A tale of two contexts. PhD Queensland University of Technology. Supervisors: Professor Lyn English and Professor Susan Danby

This thesis explored the knowledge and reasoning of young children in solving novel statistical problems, and the influence of problem context and design on their solutions. It found that young children's statistical competencies are underestimated, and that problem design and context facilitated children's application of a wide range of knowledge and reasoning skills, none of which had been taught. A qualitative design-based research method, informed by the Models and Modeling perspective (Lesh & Doerr, 2003) underpinned the study. Data modelling activities incorporating picture storybooks were used to contextualise the problems. Children applied real-world understanding to problem solving, including attribute identification, categorisation and classification skills. Intuitive and meta-representational knowledge together with inductive and probabilistic reasoning was used to make sense of data, and beginning awareness of statistical variation and informal inference was visible.

Reference

Lesh, R. A., & Doerr, H. M. (Eds.). (2003). *Beyond constructivism: Models and modeling perspectives on mathematics problem solving, learning, and teaching*. Mahwah, NJ: Lawrence Erlbaum Associates.

Pournara, C. (2013). Mathematics for teaching in pre-service mathematics teacher education: The case of financial mathematics. PhD University of the Witwatersrand, Johannesburg. Supervisor: Prof Jill Adler. Available at: <http://mobile.wiredspace.wits.ac.za/handle/10539/13412?show=full>

Mathematics for teaching (MfT) is complex, multi-faceted and topic specific. In this thesis, a Financial Mathematics course for pre-service secondary mathematics teachers provides a case for investigating MfT. The course was designed and taught by the author to a class of 42 students at a South African university. A purposive sample of 8 students participated as in two focus tutorial groups and undertook individual and group interviews. As an instance of insider research, the study uses a qualitative methodology drawing on a variety of data sources including lecture sessions and group tutorials, group and individual interviews, student journals, a test and a questionnaire.

The thesis is structured in two parts. The first part explores revisiting of school mathematics with particular focus on compound interest and the related aspects of percentage change and exponential growth. Four cases are presented, in the form of analytic narrative vignettes which structure the analysis and provide insight into opportunities for learning MfT of compound interest. The evidence shows that opportunities may be provided to learn a range of aspects of MfT through revisiting school mathematics. The second part focuses on obstacles experienced by students in learning annuities, their time-related talk, as well as their use of mathematical resources such as timelines and

spreadsheets. A range of obstacles were identified. Evidence shows that students use timelines in a range of non-standard ways but that this does not necessarily determine or reflect their success in solving annuity problems. Students' use of spreadsheets revealed these are a powerful tool for working with annuities. A key finding with regard to teachers' mathematical knowledge, and which cuts across both parts of the thesis, is the importance of being able to move between compressed and decompressed forms of mathematics. The study makes three key contributions. Firstly, a framework for MfT is proposed, building on existing frameworks in the literature. This framework is used as a conceptual tool to frame the study, and as an analytic tool to explore opportunities to learn MfT as well as the obstacles experienced. A second contribution is the theoretical and empirical elaboration of the notion of revisiting. Thirdly, a range of theoretical constructs related to teaching and learning introductory financial mathematics are introduced. These include separate reference landscapes for the concepts of compound interest and annuities.

7. Modelling Problems

At the business meeting in Blumenau it was suggested by members that we start a modelling problem section in the Newsletter for members to work on across the world. I am now calling for such problems to be contributed for distribution via the List Serve with solutions, comments, progress (as appropriate) published in the next Newsletter in June 2014. Please send your suggestion to the Editor so it can be placed on the Listserve for members to contribute.

8. Recent Publications of Interest

- Årlebäck, J.B., Doerr, H., & O'Neill, A. H. (2013). A modeling perspective on interpreting rates of change in context. *Mathematical Thinking and Learning*, 15(4), 314-336.
- Amit, M., & Gilat, T. (2013). Mathematical modeling through creativity lenses: Creative process and outcomes. In A. M. Lindmeier & A. Heinze (Eds.), *Proceedings of the 37th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 2 pp. 9-16). Kiel, Germany: PME.
- Blagdanic, C., & Chinnappan, M. (2013). Translation of data from a real-life context into graphical representations. In V. Steinle, L. Ball, & C. Bardini (Eds.), *Mathematics education: Yesterday, today and tomorrow* (Proceedings of the 36th annual conference of the Mathematics Education Research Group of Australasia, Melbourne, pp. 98-105.) Adelaide, SA: MERGA. [Available from: www.merga.net.au]
- Borromeo Ferri, R. (2013). Mathematical modelling in European education. *Journal of Mathematics Education at Teachers College*, 4(2), 18-24.
- Budinski, N., & Takačci, D. (2013). Using computers and context in the modeling-based teaching of logarithms. *Computers in the Schools*, 30, 30-47.
- Chang, C.-K., Chen, M.-F., Huang, S.-H., & Yu, Y.-C. (2013). A study of tenth graders' mathematical modelling process In Taiwan. In A. M. Lindmeier & A. Heinze (Eds.), *Proceedings of the 37th Conference of the International Group for the Psychology of Mathematics Education* (Vol.5, p. 37). Kiel, Germany: PME.
- Chan, C.M.E., Ng, K.E.D., Widjaja, W., & Seto, C. (2012) Assessment of primary 5 students' mathematical modelling competencies, *Journal of Science and Mathematics Education in Southeast Asia*, 35(2), 146-178.
- Doerr, H. M., Årlebäck, J. B., & O'Neil, A. H. (2013). Teaching practices and exploratory computer simulations. *Computers in the Schools*, 30(1-2), 102-123.
- Doruk, B.K. (2012). Mathematical modelling activities as a useful tool for values education. *Educational Sciences Theory & Practice*, 12(2) [supplementary Special Issue] 1667-1672.
- Edo, S.I., Hartono, Y., & Putri, R. I.I. (2013). Investigating secondary school students' difficulties in modeling problems PISA-model level 5 And 6. *Indonesian Mathematical Society Journal on Mathematics Education*, 4 (1), 41-58.
- Fleverages, L.M., & Schiff, J.R. (2013). Engaging young learners in integration through mathematical modelling: Asking big questions, finding answers, and doing big thinking. In L. E. Cohen, S. Waite-Stupiansky (Eds.), *Learning across the early childhood curriculum (Advances in early education and day care, Vol. 17)*, (pp.33-56.) Emerald Group Publishing Limited.
- Frejd, P. (2013). An analysis of mathematical modelling in Swedish textbooks in upper secondary school. *Nordic Studies in Mathematics Education*, 18(3), 59-95.
- Frejd, P. (2013). Modes of modelling assessment--a Literature review. *Educational Studies in Mathematics Education* 84(3), 413-438.
- Gainsburg, J. (2013). Learning to model in engineering. *Mathematical Thinking and Learning*, 15(4), 259-290.
- Galbraith, P. (2013). Students and real world applications: Still a challenging mix. In V. Steinle, L. Ball, & C. Bardini (Eds.), *Mathematics education: Yesterday, today and tomorrow* (Proceedings of the 36th annual conference of the M Mathematics Education Research Group of Australasia, Melbourne, pp. 314-321.) Adelaide, SA: MERGA. [Available from: www.merga.net.au]
- Ginovart, M. (in press). Discovering the power of individual-based modelling in teaching and learning: The study of a predator-prey system. *Journal of Science Education and Technology*, DOI 10.1007/s10956-013-9480-6
- Grünwald, S. (2013). Different approaches of fostering students' modelling competencies – An empirical study. In A. M. Lindmeier & A. Heinze (Eds.), *Proceedings of the 37th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 5, p. 66). Kiel, Germany: PME.
- Harvey, R., & Averill, R. (2012). A lesson based on the use of contexts: An example of effective practice in secondary school mathematics. *Mathematics Teacher Education and Development*, 14(1), 41-59.
- Hidiroğlu, C.N., & Güzel, E.B. (2013). Conceptualization of approaches and thought processes emerging in validating of model in mathematical modeling in technology aided environment. *Educational Sciences: Theory & Practice*, 13(4), 2499-2508.
- Huang, C-H. (2012). Investigating engineering students' mathematical modeling competency from a modeling perspective. In T.Y. Tso (Ed.), *Proceedings of the 36th conference of the International Group for the Psychology of Mathematics Education*, Vol. 2 pp. 307-314. Taipei, Taiwan: PME.
- Jankvist, U. T. (2013). History, applications, and philosophy in mathematics education: HAPh—A use of primary sources. *Science and Education*, 22, 635-656.
- Kadijevich, Dj. M. (2012). Examining errors in simple spreadsheet modeling from different research perspectives. *Journal of Educational Computing Research*, 47(2), 137-153.
- Kwek, M. L. (2013). Using mathematical modelling to engage students in real world problem solving. In A. M. Lindmeier & A. Heinze (Eds.), *Proceedings of the 37th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 5, p. 95). Kiel, Germany: PME.
- Laval, D. (2013). Modeling and algorithmic approach to a random situation: A help for students' understanding? In A. M. Lindmeier & A. Heinze (Eds.), *Proceedings of the 37th Conference of the International Group for the Psychology of*
-

-
- Mathematics Education* (Vol. 5, pp. 98). Kiel, Germany: PME.
- Lesh, R., English, L., Sevis, S., & Riggs, C. (2013). Modeling as a means for making powerful ideas accessible to children at an early age. In S. J. Hegedus & J. Roschelle (Eds.), *The SimCalc vision and contributions*. Dordrecht, The Netherlands: Springer.
- Liu, M (2013). Numeracy experiences and modelling behaviours. In A. M. Lindmeier & A. Heinze (Eds.), *Proceedings of the 37th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 5, pp. 109). Kiel, Germany: PME.
- Mehraein, S., & Gatabi, A.R. (2013). Primary school student's mathematical modelling competency In building house activity. In A. M. Lindmeier & A. Heinze (Eds.), *Proceedings of the 37th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 5, pp. 125). Kiel, Germany: PME.
- Mischo, C, & Maaß, K. (2013). The effect of teacher beliefs on student competence in mathematical modeling—An intervention study. *Journal of Education and Training Studies*, 1(1), 19-38.
- Neves, R.G.M., Neves, M.C., & Teodore, V.D. (2013). Modellus: Interactive computational modeling to improve teaching of physics in geosciences. *Computers & Geosciences*, 56, 119-126.
- Ng, K E D, Chan, C. M E, Widjaja, W., & Seto, C. (2013) Fostering teacher competencies in incorporating mathematical modelling in Singapore primary mathematics classrooms. In M. Inprasitha (Ed.), *EARCOME 6: Innovations and Exemplary Practices in Mathematics Education: Proceedings of the 6th East Asian Regional Conference on Mathematics Education 2013*, pp. 219-228. Center for Research in Mathematics Education (CRME), Khon Kaen University: Phuket, Thailand.
- Niss, M. (2012). Models and modeling in mathematics education. *Newsletter of the European Mathematical Society*, 86, 49-52.
- Ozgen, K. (2013). Self-efficacy beliefs In mathematical literacy and connections between mathematics and real world: The case of high school students. *Journal of International Education Research*, 9(4), 305-316.
- Park, J., Park, M-S., Park, M., Cho, J., & Lee, K-H. (2013). Mathematical modeling as a facilitator to conceptualization of the derivative and the integral in a spreadsheet environment. *Teaching Mathematics and Its Applications*, 32(3), 123-139.
- Prodromou, Th. (2013). Informal inferential reasoning using a modelling approach within a computer-based simulation. In A. M. Lindmeier & A. Heinze (Eds.), *Proceedings of the 37th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 4 pp. 57-64). Kiel, Germany: PME.
- Sekulić, T., & Đ. Takači, D. (2013). Mathematical modelling, computers and GeoGebra in university and college. mathematics education. In *Proceedings of MIPRO 2013/CE 36th International Convention on Information and Communication Technology, Electronics and Microelectronics* (pp. 751-756). 20 - 24. May 2013. Opatija, Adriatic Coast, Croatia.
- Schoenfeld, A.H. (2013). Mathematical modelling, sense making, and the Common Core State Standards. *Journal of Mathematics Education at Teachers College*, 4(2), 6-17.
- Schukajlow, S., & Krug, A. (2013). Planning, monitoring and multiple solutions while solving modelling problems. In A. M. Lindmeier & A. Heinze (Eds.), *Proceedings of the 37th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 4, pp. 177-184). Kiel, Germany: PME.
- Sole, M. (2013). A primer for mathematical modelling. *Journal of Mathematics Education at Teachers College*, 4(2), 44-24.
- Tropper, N. (2013). Characteristics of adaptive teacher behavior in mathematical modelling: A case study. In A. M. Lindmeier & A. Heinze (Eds.), *Proceedings of the 37th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 5, pp. 182). Kiel, Germany: PME.
- Widjaja, W. (2013). The use of contextual problems to support mathematical learning. *Indonesian Mathematical Society Journal on Mathematics Education*, 4 (2), 151-159.
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