NEWSLETTER OF THE INTERNATIONAL STUDY GROUP

FOR RESEARCH ON LEARNING PROBABILITY AND STATISTICS

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1. NOTES AND COMMENTS

Since the last issue, I have received two offers to put the newsletter on INTERNET. The first place is the Journal of Statistical Education Archives, where the newsletters can be found under the heading "Other Services" and are now available via gopher by using the command: gopher jse.stat.ncsu.edu

For those without the gopher software, the newsletters are available through any World Wide Web browser (such as Netscape or Mosaic). The location (URL) is: gopher://jse.stat.ncsu.edu. The newsletters can also be retrieved via ftp: ftp jse.stat.ncsu.edu. The filenames are:

otherservices/isg01.newsletter

otherservices/isg02.newsletter

The second place is the server on Mathematics Education "Una empresa docente", at the University of Los Andes, Bogotá, Colombia, in theweb site:

http://157.253.25.2/servidor/em/recinf/public.html. As this server contains useful material on Mathematics Education I am including a separate abstract within the "Internet Resources of Interest" Section.

In a few days many of you are going to meet here with us in Spain. We hope you will enjoy being with us at some of the Conference locations: PME 20 (Valencia), ICME 8 (Sevilla) and the IASE Round Table (Granada). As I am bringing copies of this issue to these conferences, I am including some information about the group.

If there are any corrections or additions to the newsletter, please post them to the entire list of members by using the email address alias: stated_list@goliat.ugr.es

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2. THE INTERNATIONAL STUDY GROUP FOR RESEARCH ON LEARNING PROBABILITY AND STATISTICS

1. A brief summary of the group's origin and development:

We are an informal research network of people from two dozen countries who share a common interest in research on teaching and learning statistics at all age levels. It was at the first International Conference on Teaching Statistics (ICOTS I) that the idea of forming a study group arose, possibly suggested by Ramesh Kapadia and Anne Hawkins. Ephraim Fischbein and David Green drew up a first statement of aims for the group, whose initial name International Study group on Probability and Statistics Concepts and Intuitions was slightly changed over the years. Other people contributing to starting the group were Leonart Rade, Hans Bentz, Ruma Falk, Michael Shaughnessy and Manfred Borovnick.

The group's first secretary was David Green. In 1988 Joan Garfield took over from David and held office until 1996. During that time Joan increased the group's membership, wrote and distributed a newsletter three times each year, convened meetings of group members attending ICOTS III and ICOTS IV, and undertook a review of the group's aims.

2. Aims:

In 1988 Joan Garfield published a paper in collaboration with David Green (Teaching Statistics, 1988, 10(2), 55-58), in which they categorized the activities of the group as follows:

a) Promotion of the exchange of information between members.

b) Encouragement of research activity by members.

c) Development of instruments by which concepts about probability and statistics can be assessed.

d) Improvement in the teaching and interpretation of probability and statistics by dissemination to educators of research findings.

e) Organization of meetings.

3. Activities by members

Currently our Study Group is an international network of people sharing a common interest in statistical education. They keep in touch through the newsletter, and by electronic or ordinary mail. At the time being the group has 140 members, from 24 countries, as shown in the table below:

Australia	xxxxxxxxxxx 11
Austriia	x 1
Belgium	x 1
Canada	xxxxxx 6
Colombia	xxx 3
England	xxxxxxxxxxxxxx 14
France	xxxx 4
Germany	xxx 3

Hong Kong	x 1
Hungary	x 1
Ireland	x 1
Israel	xxxx 4
Italy	x 1
Mexico	x 1
Netherlands	x 1
New Zealand	xxxxx 5
Norway	x 1
Poland	x 1
Scotland	x 1
Singapore	x 1
South Africa	xx 1
Spain	xxxxxxxxxxx 11
Turkey	x 1
USA	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx 65
Total	140

Members of the Study Group meet at the International Conferences on Teaching Statistics, held every four years. In addition there is an increasing group presence at the Psychology of Mathematics Education International Conferences (PME), the annual AERA meetings, and other national and international conferences. This year a Discussion Group has been organized by John and Kath Truran at PME 20, in which different study group members will participate. Other members have been actively involved in the organization of ICOTS, IASE and IASE Round Table Conferences.

5. The newsletter

A newsletter is produced about every three months to serve as a link between members and to provide information useful to researchers. This newsletter is now distributed by e-mail through the Stat_Ed list at the University of Granada and it is also available from Internet.

The newsletter typically contains summaries of research papers written by members who, when their work has been accepted for publication, send them to the Secretary of the Group. This enables information about current research to be disseminated quickly and in advance of actual publication dates. It also contains information about members, summaries of recent dissertations, other publications of interest (e.g., articles, research reports, books, information concerning recent and forthcoming conferences), and Internet resources on statistics education.

Requests to become a member or to contribute to the Newsletter should be sent to:

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3. NEW MEMBERS

Sarah Abramowitz

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Sarah is a teaching fellow at New York University, where she teaches mathematics and statistics to students in the School of Education. She is presently working on her doctoral dissertation which will be a comparison study of classes of introductory statistics taught with and without the use of SPSS.

Jinfa Cai

Marquette University

Department of Mathematics, Statistics, & Computer Science,

Milwaukee, Wisconsin, U.S.A.

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He is an Assistant Professor at the Department of Mathematics, Statistics, & Computer Science, Marquette University. His dissertation, which was published as a Journal for Research in Mathematics Education monograph #7, is not particularly about statistics, although one of the problems he used in his dissertation is related to averages. He is working on a paper involving middle school students' understanding of the average concept. The paper consists of two studies examining the instructional impact on students' understanding of the average concept.

J. T. Callender

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He is a lecturer to undergraduate engineers (probability, statistics and mathematics). All his lectures and tutorials and most of his examinations are spreadsheet based. This emphasis on the use of a spreadsheet is confirmed by his recent papers:

June 1995 SEFI Conference in Prague "Experimental Design and Analysis by Spreadsheet"; July 1995 International Modeling Conference in Belfast "Modeling on an Interactive Spreadsheet"; Sept 1995 Undergraduate Mathematics Teaching Conference in Nottingham "Probability and Statistics by Spreadsheet" ; Sept 1995 "The use of a Spreadsheet to estimate the parameters in a Weibull Failure Time Distribution" THETA, Mathematics Dept, Crewe Alsager Faculty, Crewe, Cheshire, CW1 5DU, England; 1996 "Teaching Engineering Field Theory using IT". _International Journal on Mechanical Engineering Education_ .

David Clark-Carter

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He teaches research methods and statistics to psychologists at all undergraduate and post graduate levels. His research interests is realted to the way that psychologists conduct and report research. Recent work has included a study of the extent to which statistical power is considered by researchers and a study of changes which have occurred since the earliest published psychological research in the techniques employed and the way they are analyzed and reported.

Jean Claude GIRARD

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Lecturer in Mathematics at Institut Universitaire de Formation des Maîtres de l'Académie de Lyon, he teaches statistics at the Institut Universitaire de Technologie de St-Etienne. He participates in two research groups on teaching probability and statistics at the Institut de Recherche sur l'Enseignement des Mathématiques (IREM), Lyon and the Commission Nationale Inter-IREM, Paris. He is mainly interested in the age level (12-16) and in the relationships between statistics and probability. He has sent me a recent paper on this subject, from which I include a summary in the section "publications by members".

Felipe Fernández

Una empresa docente. Universidad de los Andes

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His main interest is the design, development and evaluation of problem situations for teaching statistics to social science students at college level, which take into account the specific Colombian context. This activity will serve for starting a reflective process on the teaching of statistics and for getting a better formation for research. Other related papers include two books "Matematicas, Azar, Sociedad" and "Estadística y Sociedad". He participates in a research group into "Una empresa docente" (Universidad de los Andes, Bogotá, Colombia) whose first results are going to be presented at ICME 8.

Federico Palacios

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Federico is a lecturer at the "Facultad de Ciencias Económicas y Empresartiales", University of Granada. He teaches Quantitative Methods for business and finances. He has done research on these areas, as well as in applied statistics. He has also published some papers on decision theory and its application to assessment. More information is available from the web site: htpp://www.ugr.es. /~fpalacio

Candace Schau

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Professor at the Educational Psychology Program at the College of Education, University of New Mexico. He has published in 1995 an article entitled The Development and Validation of the Survey of Attitudes Toward Statistics in _Educational and Psychological Measurement_, 55, 868-875?

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4. CHANGES IN E-MAIL ADDRESSES

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Ana Maria Ojeda: fhitta@mailes.main.conacyt.mx

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5. PUBLICATIONS BY MEMBERS

Note: Throughout the newsletter, members names are highlighted in capital letters.

BATANERO, C., GODINO, J. D., & Navarro-Pelayo, V. (1996). "Razonamiento combinatorio en alumnos de secundaria." _Educación Matemática.,_ 8(1), 26-39.

In this paper we try to provide some answers to the following questions: What role does Combinatorics play in Probability and in Discrete Mathematics? Is combinatorial capacity merely a mathematical tool or is it a fundamental component of logical reasoning? Are there any task variables that could influence pupils' procedures and errors when solving combinatorial problems? How should we consider these variables in the teaching and assessment of the subject? Finally, we present a questionnaire to assess combinatorial reasoning and the results of its application to a sample of 720 14-15 year-olds pupils. This information could be useful to teachers and researchers interested in teaching Combinatorics at secondary school level.

CURCIO, F. R., & Artzt., ,A. F. "Assessing Students' Ability to Analyze Data: Reaching Beyond Computation."_ Mathematics Teacher_, expected November 1996.

This article suggests ways of improving graph tasks by enriching typical items, designing multiple-visual display tasks, tapping prior knowledge, and allowing students to invent their own visual displays.

ESTEPA, A., & BATANERO, C. (To be published). "Judgments of correlation in scatter plots: students' intuitive strategies and preconceptions". _Hiroshima Journal of Mathematics Education_, 1997.

In this paper we describe an experimental study of 213 university students' strategies when assessing correlation in scatter plots. We present an original classification of students' strategies from a mathematical point of view, which allows us to determine concepts and theorems in action. Correspondence analysis is used to show the effect of task variables of the items on students' strategies and, finally, we describe three different students' misconceptions concerning statistical association.

ESTEPA, A., & Sanchez, F. T. (1995). "Desarrollo histórico de la idea de asociación estadística" _Epsilon_, 30, 10(3), 61-73.

Statistical association is fundamental for understanding other statistical concepts and procedures. In this paper the historical development of the subject is analyzed, as well as the interest of this concept in Statistics. Consequently, some implications for the teaching of the subject are deduced.

GARFIELD, J. (1996). "Research Down Under"._Teaching Statistics, 18(2). 56-57.

Summary of research in Australian universities.

GIRARD, Jean Claude (1996). "Pourquoi il ne faut pas laisser de côte les chapitres de statistiques au collége"._Repères-IREM_, 23, 5-18.

Statistics is scarcely taught at secondary level (12-16) as teachers have received few formation on this subject, and therefore they do not see the interest of the topic. This paper point three aims that could be attained in developing the teaching of statistics at the period 12-16 and that would be useful to other mathematical concepts. These aims concerns graphical representation, calculation of parameters (mean, median,..) to made the idea of distribution arise, and the conceptual level, to grasp the concept of randomness and variability of results in an experiment. The general idea is that giving meaning to these points, could contribute to the students' intellectual development and facility the later teaching of probability.

KONOLD, C. (1996). "Representing probabilities with pipe diagrams"._The Mathematics Teacher_, 89(5), 378-382.

In this article it is described a modified version of the tree diagram that many students found helpful in making probabilities more meaningful. Basic features and educational advantages are discussed.

LAJOIE, S. P., JACOBS, V. R., & Lavigne, N. C. (1996). "Empowering children in the use of statistics"._Journal of Mathematics Behavior_ 14, 410-425.

Statistics pervade our society, yet the understanding of statistics has remained the domain of a select few. Although the majority of the literature has focused on the adult learner, there is a movement toward teaching statistics to children. This article addresses the ways in which the study of statistics has been examined in the elementary and secondary schools in term of connect, readiness of children to learn, pedagogy and assessment. A proposal is presented on how cognitive apprenticeship model can be developed from the empirical research findings in order to build more effective instructional and assessment methods for statistics education.

LEHRER, R. ,& Romberg, T. (1966). "Exploring children's data modeling". _Cognition and Instruction_, 4(1), 69-108.

Elementay students' reasoning about data modeling is explored by conducting two design experiments. In the first design experiment, a class of fifth-grade students worked in six different design teams to develop hypermedia documents about Colonial America. Students compared the lifestyles of colonists with their own lifestyles. To this end, 10 "data analysts" developed a survey, collected and coded data, and used the dynamic notations of a computer-based tool, Tabletop, to develop and examine patterns of interest in their data. Our general approach was to let the reasoning and thinking displayed in one session, with the data analysts provoke and steer the tasks and problems posed in the next session. Analysis of students' conversations, including their dialogue with the teacher-researcher, indicated that the construction of data was an important preamble to description, and inference. Moreover, students' ideas about many elements of data modeling arose and their classroom teacher were consulted about the use of a simple randomization distribution to test hypotheses about the nature of ESP. Here, experimentation afforded a framework for teaching about inference, grounded by the creation of a randomization distribution of the students' data. We conclude that data construction and analysis provided an opportunity to involve students in the important entreprise of mathematical modeling.

Lidster, S.T., Pereira-Mendoza, L., WATSON, J. M., & Collis, K .F. (1995) "What's fair for grade 6?". A paper presented at the Annual Conference of the Australian Association for Research in Education, Hobart, Tasmania.

Children experience the concept of fairness in a variety of contexts most of which are outside the school curriculum. The case study described in this paper developed from the initial stages of a larger project assessing higher order cognitive functioning during learning in probability and statistics. The study aims to identify the consequences these experiences have in terms of the development of a mathematical notion of fairness as it relates to probability. Students from Grades 6 and 9 were interviewed using a protocol designed to assess their understanding of fairness through playing games, and through data collection, representation, interpretation and prediction. The theoretical framework used to analyze student responses was the SOLO Model with Multimodal Functioning developed by Biggs and Collis. The results of the case study have implications for the larger project in terms of the design of the protocol exploring fairness and in determining the age range of students to be sampled. In turn the findings of the whole project will be applied to monitor the implementation of higher order objectives in the Australian chance and data curriculum.

NEMETZ, T. (1995). "Statistical decisions: classroom experiences". Technical report of the Math. Inst. of the Hungarian Acad. of Sciences, Submitted for publication to _Stochastik in der Schule_.

This paper reports on our experiments with the educational goal of a discussion type introduction to some notions of hypotheses testing problems through simple examples, which require a minimum of knowledge from probability calculus. This notions included the concept of decision rules, decision functions, and error probabilities. Emphasis was given to the nature of statistical decisions. The teaching followed hands-on, discovery methods of the new maths and open discussions, which were preferred to the frontal way of teaching. Whenever it was possible, we tried to find interrelations with traditional mathematics curriculum areas, or to find ways to comment on "modern maths" tasks. Our presentation goes through four rather simple examples which allow us to explain typical suggestions from the classroom floor. The paper also provides a set of further decision problems which proved rather useful to highlight these goals and offer some short comments to them. At the end of the paper an Appendix offers excursions to traditional mathematics. A second Appendix gives the solution of the problems raised within the report.

PFANNKUCH, M., & BROWN, C. M. (1996). "Building on and Challenging Students' Intuitions About Probability: Can We Improve Undergraduate Learning?" _Journal of Statistics Education _, 4(1).

Students of statistics must be allowed to experience the omnipresence of variation and experience the dual modes of thinking probabilistically and deterministically to explain that variation. A pilot study to investigate the understanding of variability and probability of a small group of students is described. These students have a strong tendency to think deterministically

(especially in real world settings); they have little understanding of variability and its relationship to sample size; and they are generally unable to reconcile their intuitions with the formal probability they have been taught. There were some initial indications that allowing students to experience variation personally made them more aware of their over-emphasis on causal explanations of variability. Lastly, it appears that students' awareness about probabilistic thinking can be raised by actively challenging and discussing their tacit intuitive models about chance.

SCHAU, C., Dauphinee, T. L., & Del Vecchio, A. (1995). "The development and validation of the Survey of Attitudes Toward Statistics". _Educational and Psychological Measurement,_ 55, 868-875.

The Survey of Attitudes Toward Statistics (SATS) was designed for use in both research and instruction. A panel of instructors and introductory statistics students identified by consensus four facets of attitudes toward statistics: (a) Affect -- positive and negative feelings concerning statistics; (b) Cognitive Competence -- attitudes about intellectual knowledge and skills when applied to statistics; (c) Value -- attitudes about the usefulness, relevance, and worth of statistics; and (d) Difficulty -- attitudes about the difficulty of statistics as a subject. This structure was validated for a sample of undergraduate students using confirmatory factor analysis. Additional validity evidence was obtained through the correlation of the SATS with Wise's Attitudes Toward Statistics scale, which showed significant, positive relationships between the two instruments.

SERRANO, L., BATANERO, C., & ORTIZ, J. (To be published). "Interpretación de enunciados de probabilidad en terminos frecuenciales por alumnos de bachillerato". _Suma_, 1996

In this paper we present a study of 277 secondary students understanding of statements referring to the frequentist approach to probability. As a consequence, we provide information concerning different difficulties in this interpretation, extending the results from Konold's research.

VALLECILLOS, A., & Pérez- Ocón, R. (1995). "Il curriculum statistico in Spagna: verso il 2000. Lla statistica nell'instruzione secondaria". _Induzione_, 10, 43-52.

In this work we briefly analyze, in reference to Statistics and Probability, the main changes introduced in the Mathematics curriculum of the Secondary Teaching in Andalucia (Spain). We comment the increase produced in the statistics contents in these programs, as well as the introduction of novel topics, such as that of tests of statistics hypotheses. Furthermore, important methodological innovations of great importance to improve the teaching of the Statistics and the Probability in these teaching levels have been produced. We comment this situation in relationship to the departure situation, what reflects in our concrete case, that the authorities are become aware of the formative needs in statistics of the citizens, according to the current trends in the developed countries.

WATSON, J. M., Collis, K. F., Callingham, R. A., & Moritz, J. B. (1995). " A model for assessing higher order thinking in statistics". _Educational Research and Evaluation_, 1, 247-275.

As in other areas of the school curriculum, the teaching, learning and assessment of higher order thinking in statistics has become an issue for educators following the appearance of recent curriculum documents in many countries. These documents have included probability and statistics across all years of schooling and have stressed the importance of higher order thinking across all areas of the mathematics curriculum. This paper reports on a pilot project which applied the theoretical framework for cognitive development devised by Biggs and Collis to a higher order task in data handling in order to provide a model of student levels of response. The model will assist teachers, curriculum planners and other researchers interested in increasing levels of performance on more complex tasks. An interview protocol based on a set of 16 data cards was developed, tried with Grade 6 and 9 students, and adapted for group work with two classes of Grade 6 students. The levels and types of cognitive functioning associated with the outcomes achieved by students completing the task in the two contexts will be discussed, as will the implications for classroom teaching and for further research.

WATSON, J. M., Collis, K. F., & Moritz, J. B. (1995, November). "The development of concepts associated with sampling in grades 3, 5, 7 and 9." A paper presented at the Annual Conference of the Australian Association for Research in Education, Hobart, Tasmania.

As part of a study of chance and data concepts covered in recent Australian curriculum documents, a sample of 171 girls was chosen from grades 3, 5, 7 and 9 in a private school in an Australian capital city. On the basis of responses to a 20-item questionnaire and a media survey, 30 students across the grades were selected for 45-minute interviews on nine problem solving protocols related to statistical thinking. For this report only items related to sampling will be analyzed: one interview protocol, one item from the 20-item questionnaire and two items from the media survey. The purpose is to propose a developmental sequence for learning of concepts associated with sampling over the years of schooling. This model will then be tested when

data from the complete study are analyzed. The theoretical basis for the analysis is the SOLO Taxonomy with Multimodal Functioning developed by Biggs and Collis. Educational implications of this developmental sequence will be addressed.

WATSON, J. M., Collis, K. F., & Moritz, J. B. (1996). "Authentic Assessment of the Concept of Average: A Developmental Approach.". Report prepared for the National Center for Research in Mathematical Sciences Education - Models of Authentic Assessment Working Group (University of Wisconsin) (51 pp.). Hobart: Department of Education, University of Tasmania. [Submitted for publication].

The development of the concept of average is explored for students from grades 3 to 11 through large scale survey items administered to a total of 1334 students, followed by more detailed interviews of 122 selected students. Responses are described using the SOLO model with multimodal functioning. A first cycle of development describes the building of the concept of average as "a central measure representing a data set," while a second cycle accounts for applications of the concept for assessing representativeness of different averages and determining aspects of the data set based on the average. The implications of the model for mathematics educators are discussed.

George W. BRIGHT sent this list of papers that have no abstract. If you are interested in them, you can write him for copies (Brightg@Steffi.Uncg.Edu).

FRIEL, S. N., & BRIGHT, G. W. (1995, October). Graph knowledge: Understanding how student interpret data using graphs. Paper presented at the annual meeting of the North American Chapter of the International Group for Psychology of Mathematics Education, Columbus, OH.

FRIERSON, D., Berenson, S., BRIGHT, G. W., & FRIEL, S. N. (1996, February). Elementary teachers' understanding of the arithmetic mean. Paper presented at annual conference of the Research Council for Diagnostic and Prescriptive Mathematics, Melbourne, FL.

FRIEL, S. N., & BRIGHT, G. W. (1996, April). Building a theory of graphicacy: How do students read graphs? Paper presented at the annual meeting of the American Educational Research Association, New York, NY.

BRIGHT, G. W., CURCIO, F.,& FRIEL, S. N. (1996, April). Building a theory of graphicacy: Where are we now? Paper presented at the Research Presession for the annual meeting of the National Council of Teachers of Mathematics, San Diego, CA.

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6. STATISTICS EDUCATION BIBLIOGRAPHY

Andy BEGG, from the Centre for Science and Technology Education Research, at the University of Waikato, sent me a very useful 90 pages bibliography. Its purpose is to provide a resource for students starting research in the area of statistics and probability education and it is also available on disk to ease searching.

Andy would be happy to send this bibliography either as an attached document or as a Mac disc to anyone who wants it. You can contact him at A.Begg@waikato.ac.nz

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7. NEW CHAPTER ON DATA HANDLING

Mike SHAUGHNESSY sent me the following abstract of the chapter on "Data handling" he has written with Joan B. GARFIELD, University of Minnesota and Brian GREER, Queens University-Belfast. This chapter is part of the _International Handbook of Mathematics Education_, edited by J. Kilpatrick & A. Bishop, which is going to be published this year by Kluwer (Dordrecht).

In the past decade, topics in data handling have begun to play a more prominent role in the mathematics curricula in many countries. In this chapter we note the historical roots of the current data handling (or data analysis) emphasis, point out some of the national reform efforts that have catalyzed an interest in data handling, and discuss various data handling curricula. Special attention is given to the use of technology in teaching data handling, to the importance of professional development of teachers of data handling, and to some issues for research in the teaching and learning of data handling.

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8. RECENT DISSERTATIONS

Ingram, N. (1995) _Cooperative learning in mathematics: a case study in a statistics class_. Masters thesis. University of Waikato, New Zealand. Supervisors Andrew BEGG and Jane McChesney.

This thesis is a study of cooperative learning in the context of a statistics classroom with 14-year old girls. It was undertaken

because of the increasing emphasis being placed on cooperative learning that has yet not been accompanied by much change in the classroom. The study looks at the effects of a cooperative learning statistics unit on students in two fourth forms classes in terms of indicators of learning displayed by the students (interest, enjoyment, involvement, ownership, students inquiring, on-task behavior, and achievement) and the dynamics of cooperative learning (group formation, strategies and activities, evaluation, and problems). The research is qualitative, combining the developmental ,action research, and case study approaches. The perceptions of the teachers, the researcher, and the students were collected through interviews, observations, audio-recording, and student journals. The research found that the students generally displayed the defined indicators of learning during the cooperative learning unit and conclusions were formed about the best way of setting up and dealing with the group dynamics.

Lesser, L. M. (1994). _The role of counterintuitive examples in statistics education_. Ph. D. The University of Texas at Austin. Supervisor: Ralph W. Cain. DAI n. 9506033

The purpose of this study was to develop a theoretical model for the use of counterintuitive examples in the introductory non-calculi-based statistics course at college level. While intuition and misconception continue to be of great interest to mathematics and science educators, there has been little research, much less consensus or even internal consistency in statistics curriculum development concerning the role of examples with counterintuitive results. Because the study intended to provide educators with useful connections to content, instructional methods (e.g., cooperative learning) and learning theory constructs that have been successfully used in mathematics or science education, the model that emerged was organized around a typical syllabus of topics.

The study critiqued and then reconciled "traditional " and "alternative" perspectives. The traditional position attempts to minimize possible confusion and frustration by avoiding such examples, while the alternative position uses them to motivate and engage students in critical thinking, active learning, metacognition, communication of their ideas. Real-world problem solving and exploration, reflection on the nature and process of statistics, and other types of activities encouraged by current reform movements.

The study delineated specific criteria and conditions for selecting and using counterintuitive examples to achieve numerous cognitive and affective objectives. Examples explored include the Monty Hall problem. Simpson paradox, the birthday problem, etc., and required sample size. The study connected many of these examples with other counterintuitive examples, with known probability or statistics misconceptions many students have, with representations from other branches of mathematics, and with the costructivist paradigm.

Problematic issues addressed include difficulty in construction of assessment instruments and multiplicity of terminology and typologies. Additional directions for research were suggested, including several empirical investigations of various facets of the model. The connections, examples, and representations presented should be extremely useful for teachers of statistics, but should also enrich the pedagogy of teachers of other courses.

Navarro-Pelayo, V. (1994). _Estructura de los problemas combinatorios simples y del razonamiento combinatorio en alumnos de secundaria_. Departamento de Didáctica de la Matemática. Universidad de Granada. Tesis Doctoral. Supervisor: J. D. GODINO

Elementary combinatorial problems can be classified into three different combinatorial models (selection, partition and distribution), depending on some key verbs included in the wording of these problems. The main goal of this research was to determine the effect of the implicit combinatorial model on pupils' combinatorial reasoning before and after instruction and it contains a theoretical and an experimental study. The theoretical study includes the description of the elementary combinatorial problems, concepts and models, from a mathematical, historical and phenomenological perspective and a summary of research about combinatorics in Psychology and Mathematics Education. The experimental part analyzes the solutions of 720 14-15 year-old students to a written questionnaire consisting of 13 simple combinatorial problems, in which we varied systematically the combinatorial model.

In building the questionnaire, we also considered, as task variables, the combinatorial operation and the type of elements. The analysis of variance was used to show the influence of the implicit combinatorial model on problem difficulty and the interaction of all the factors with instruction. Qualitative analysis was used to categorize student's errors in the solving process. Implicative analysis reveals an implication between success/failure in the different items before and after instruction and correspondence analyses shows the dependence of error types on task variables. Another result of this thesis is the questionnaire that can be use to assess students' combinatorial reasoning.

ORTIZ de Haro, J. J. (1996). _Significado de los conceptos probabilísticos elementales en los textos de Bachillerato._ Memoria de Tercer Ciclo. Departamento de Didactica de la Matematica. Universidad de Granada. Supervisor: C. BATANERO.

The new mathematics curricula for Primary and Secondary Education teaching levels propose to increase the study of random phenomena. It has also been suggested a change in the way of teaching probability so as to encourage students to confront and

correct their misconceptions about chance events. Students will be required to do experiments, record their results and assign experimental probabilities. Essential to ensuring its successful implementation is the choice of teaching materials and text-books, both of which are cited by numerous authors as having significant influence on how students approach their work.

The general aim of this research is to characterize the way in which probability has been taught in the first level of B.U.P. (14-15 year-old students), where the teaching of probability is presently started in Spain and to obtain criteria for the development of this topic in the new curricula.

From the mathematics secondary school textbooks published in Spain between 1975 and 1991, we have analyzed a sample of 11 for the following concepts: random experiment, sample space, random events, their types and operations; relative frequencies and its properties, and the different conceptions of probability (Laplace, frequentist, subjective and axiomatic). For each concept, we have studied the definitions and practical activities presented, identifying intensive and extensive elements of its meaning. Intensive elements of meaning refer to the essential properties defining a concept, while extensive elements of meaning are the problem situations from which the concept arises and which allow the student to understand the meaning of the concept and to observe its characteristics properties.

Finally, we have studied the text books to see how well the theoretical presentation and the practical activities match and, as a conclusion, we note the lack of correspondence between them. The list of elements of meaning that we have identified as a result of our research is included as an appendix and can be used for analyzing other texts- books, for constructing instruments to assess the students' knowledge and to provide guidelines to develop learning materials for the teaching of probability.

Wilson, B. L. (1994)._The development and evaluation of an instructional program in statistical literacy for use in post secondary education_. D. A. Illinois State University. Sypervisor: Michael J. Plantholt.

In response to increased use of data communications in our technological society, recent reform recommendations in mathematics education have advocated a greater curriculum emphasis on statistical literacy at all levels of education. The study responded to that advocacy by developing and evaluating an instructional program in statistical literacy that could serve as a model for continuing education and professional development programs in statistical literacy. It was expected to also have relevance for general education mathematics courses in community colleges and universities. The program was designed to enhance learners' statistical understanding and reasoning, awareness of the value of existing statistics, and confidence in using statistics. Special design features included (a) video contextual overviews that facilitated individual and group learning through demonstrations of real-life applications of statistics, (b) computer software that illuminated data analysis by enabling students to manipulate large data sets, and (c) an emphasis on writing that included reflecting upon each lesson using journal entries.

Fifty-two students enrolled in undergraduate general education mathematics courses were grouped according to age (less than 21 and older), algebra background and gender. Results of the evaluation indicated that significant gains had been made by all groups in statistical literacy and valuing statistics. There were no significant differences between the two age groups.

With regards to confidence in using statistics, there were significant gains by all groups except the group with little or no algebra. A significant positive correlation was found between students' statistical literacy and their beliefs and attitude toward statistics.

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9. THE JOURNAL OF EDUCATIONAL AND BEHAVIORAL STATISTICS: SPECIAL ISSUE

The Journal of Educational and Behavioral Statistics, 1996, 21(1) is dedicated to Teaching Statistics. After and introduction by the Editor Betsy Jane Becker, the following articles are included:

Harwell, M. R., Herrick, M. L., Curtis, D., Mundfrom, D., & Gold, K. (pp. 3-34): "Evaluating statistics texts used in education".

Evaluating texts is an important activity associated with teaching statistics. Surprisingly, the statistical education literature offers little guidance on how their evaluations should be conducted. This lack of guidance may be at least partly responsible for the fact that published evaluations of statistics texts almost invariably employ evaluation criteria that lack any theory-based rationale. This failing is typically, confounded by a lack of empirical evidence supporting the usefulness of the criteria. This article describes the construction and piloting of instruments for evaluating statistics texts that are grounded in the statistical education and text evaluation literature. The study is an initial step in a line of research which we hope will result in the establishment and maintenance of a database of evaluations of statistical tests. Evaluative information of this kind should assist instructors wrestling with text selection decisions and individuals charged with performing evaluations, such as journals reviewers, and should ultimately benefit the direct consumers of these tests, the students.

Cohen, S., Smith, G., Chechile, R. A., Burns, G. , &Tsai, F. (pp. 35-54): "Identifying impediments to learning probability and statistics from an assessment of instructional software".

A detailed, multisite evaluation of instructional software designed to help students conceptualize introductory probability and statistics yielded patterns of error on several assessment items. Whereas two of the patterns appeared to be consistent with

misconceptions associated with deterministic reasoning, other patterns indicated that prior knowledge may cause students to misinterpret the y-axis on a histogram as if it were a y-axis in a scatter plot and confusing the values a variable might take on by misinterpreting plots of normal probability distributions. These kinds of misconceptions are especially important to consider in light of the increased emphasis on computing and displays in statistics education.

Schram, C. M. (pp. 55-70). "A meta-analysis of gender differences in applied statistics achievement".

This meta-analysis of gender differences examines statistics achievement in post secondary level psychology, education and business courses. Thirteen articles examining 18 samples were obtained and coded for the analysis. The average effect size was -0.08 standard deviation units favoring females; however, the results were heterogeneous. Although no model accounted for all between -studies variation, gender differences could best be predicted from the percentage of undergraduate students in the sample, the department offering the course, and the use of course grade or points for the outcome measure. Undergraduate males showed an advantage over undergraduate females. Univariate tests showed that males also significantly outscored females when the outcome was a series of exams. Conversely, females significantly surpassed males when the outcome was total course performance. Lastly females outscored males in courses offered by business departments.

Becker, B. J. (pp. 71-90): "A look at the literature (and other resources) on teaching statistics".

Statistics instructors and others interested in the teaching of statistics will find many print and non print resources on this topic. The print literature on the teaching of statistics is largely anecdotal and comprises mainly recommendations for instruction based on the experiences and intuitions of individual instructors. Less than 30% of the print literature reports the results of empirical studies, but these cover a broad range of topics, including the use of computers in statistics instruction, teaching material, and teaching strategies. A large portion of the non empirical literature is devoted to descriptions of statistics courses and specific lessons that, though untested. still provide a resource for instruction. Recently, numerous non print (electronic) resources for instruction, problem solving, and discussions about statistics instruction have also become available. These include many data sets and other instructional resources, statistics discussion groups, and the electronic Journal of Statistics Education.

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10. MATHEMATICS IN SCHOOL: SPECIAL ISSUE ON LOTTERIES AND TEACHING PROBABILITY

This subject provides the main theme for volume 25, n. 1, 1996 of Mathematics in School . This is the table of contents:

Steward, I. "It could be you but here's why it won't be me", pp. 2-4.

Almeida, D. "Triangle numbers and lottery probabilities", pp. 5-6.

Tapson, F. "Have you tried the lottery as a source of data?, pp. 7-9.

Bailey, P. "Maths resource- instant rip-offs", pp. 10-15.

Ravenscroft, L. "Dastardly dice", pp. 16-19.

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11. OTHER PUBLICATIONS OF INTEREST

Ball, B. (1996). "Using software to teach statistics". _Micromath_, 12(1), 20-25.

How does a teacher get started on using an unfamiliar piece of software to teach statistics. Barbara describes the process of choosing the software, planning the lessons, teaching the classes and evaluating the outcomes.

Cosmides, L., & Tooby, J. (1996). "Are humans good intuitive statisticians after all? Rethinking some conclusions from the literature on judgment under uncertainty". _Cognition_, 58, 1-73.

Professional probabilists have long argued over what probability means, with, for example, Bayesians arguing that probability refer to subjective degrees of confidence and frequesntists arguing that probability refer to the frequencies of events in the world. Recently, Gingerenzer and his colleagues have argued that these same distinctions are made by untutored subjects, and that, for many domains, the human mind represents probabilistic information as frequencies. We analyze several reasons why, from an ecological and evolutionary perspective, certain classes of problem solving mechanisms in the human mind should be expected to represent probabilistic information as frequencies. Then, using a problem famous in the "heuristics and biases" literature , we show that correct Bayesian reasoning can be elicited in 76% of subjects. indeed , 92% in the most ecological valid condition- simply by expressing the problem in frequentist terms. This results show that frequentist representations cause various cognitive biases to disappear, and that the conclusion most common in the literature on judgment under uncertainty will

have to be re-examined.

Hastie, R., Hammerle, O., Kerwin, J., Croner, C. M., & Hermann, D. J. (1996). "Human performance reading statistical maps". _Journal of Experimental Psychology: Applied_. 2(1), 3-16.

Three experiments were conducted to explore the conditions under which certain map formats would most effectively represent certain types of statistical information. The major practical finding was that multiple-hue formats convey either numerical or categorical information more efficiently than ordered monochrome brightness formats when the task is to identify data values for single map locations. However, the advantage of the multiple -hue formats was eliminated when more complex tasks were performed. These included tasks such as integrating values form several locations to estimate an average for a region. The researchers concluded from these studies that the nature of the reader's task when selecting a format is at least as important a consideration as the nature of information represented in the map.

Koehler, J. (1996). "The base rate fallacy reconsidered: Descriptive, normative and methodological challenges"._Behavioral and Brain Sciences_, 19, 1-53.

We have been oversold on the base rate fallacy in probabilistic judgments from an empirical, normative and methodological standpoint. At the empirical level, a thorough examination of the base rate literature does not support the conventional wisdom that people routinely ignores base rates. Quite the contrary, the literature shows that the base rates are almost always used and that their degree of use depends on task structure and representation. Base rates play a relatively large role in tasks where base rates are implicitly learned or can be represented in frequentist terms. Base rates are also used more when they are reliable and relatively more diagnostic than available individuating information. At the normative level, the base rate fallacy should be rejected because few tasks map unambiguously into the narrow framework that is held up as the standard of good decision making. Methodologically, the current approach is criticized for its failure to consider how the base rates of the real world should be used. Where decision makers' assumption and goals vary, and where performance criteria are complex. the traditional Bayesian standard is insufficient. Even where predictive accuracy is the goal in commonly defined problems, there may be situations in which base rates can be ignored with impunity. A more ecologically valid research program is called for that should emphasize the development of prescriptive theory in rich, realistic, decision environment.

Nash, J. C., & Quon. T. K. (1996). "Issues in Teaching Statistical Thinking with Spreadsheets". _Journal of Statistics Education_, 4(1).

Spreadsheet software is widely used and now includes statistical functionality. This paper discusses the issues raised in teaching statistics with spreadsheet software. The principal concerns relate to aspects of the spreadsheet view of computation that make it difficult to keep track of what calculations have actually been carried out or to control the spreadsheet by means of a script. We also discuss a number of other advantages and deficiencies of spreadsheets for teaching statistics.

Quilici, J. L., & Mayer, R. E. (1996), "Role of examples in how students learn to categorize statistics word problems". _Journal of Educational Psychology, 88(1), 144-161.

In experiment 1, students who studied example word problems that were grouped by t test correlation, and chi-square were more likely of sort subsequent problems on the basis of structure and less likely to sort on the basis of surface characteristics than students who received no examples. In experiment 2 this pattern was strongest when students studied structure-emphasizing rather than surface-emphasizing examples. In experiment 3. students who studied and practiced 4 structure-emphasizing worked-out examples of t test and correlation problems were more likely to apply the appropriate statistical test correctly to subsequently presented statistics word problems than students who had studied surface-emphasizing examples. This pattern was strong for lower but not for higher ability students. Implications are discussed.

Quin, R. J. (1996). "Exploring probability and statistics with preservice and inservice teachers". _School Science and Mathematics_, 96(5), 255-257.

This article presents a lesson designed for preservice and inservice teachers that permits participants to: a) strengthen their conceptual understanding, and b) experience learning in a cooperative environment that encourages communication. Opportunities are provided for participants to discover patterns and construct mathematical knowledge concerning theoretical probability.

Shah, P., & Carpenter, P. A. (1996). "Conceptual limitations in comprehending line graphs"._Journal of Experimental

Psychology: General_, 124(1), 43-61.

This article examines the conceptual limitations that influence a viewer mental representation of a data set of 3 continuous variables. Such data can be graphed in 2 ways, depending on which variable is depicted on the x axis and which is made a parameter on the curve (the z variable). The results of several studies indicate that a viewer internal representation of a graph expresses quantitative functional information about the x-y relations (such as "y decreases exponentially as x increases"). By contrasts, the z-y information is represented ordinally or even nominally. This difference in the mental representation for the variables was evident when viewers described interpreted simple line graphs or judged the equivalence of successively presented graphs. The difference persisted in spite of the viewers' accurate encoding of the graph's visual pattern, as indicated by accuracy in reproducing them from memory. Viewers seldom formed an integrated representation for the 3 variables, even when explicitly instructed to encode them. The x-y line patterns may automatically activate quantitative concepts, whereas viewers may be unfamiliar with the quantitative interpretation of Z-y patterns.

Yilmaz, M. R. (1996). "The Challenge of Teaching Statistics to Non-Specialists". _Journal of Statistics Education_ 4(1).

Traditional methods of teaching introductory statistics are often viewed as being ineffective because they fail to establish a clear link between statistics and its uses in the real world. To be more effective, it is essential that teaching objectives are clearly defined at the outset and issues of content and methodology are addressed accordingly. This paper proposes that the relevant objectives should aim to develop the following competencies: (1) ability to link statistics and real-world situations, (2) knowledge of basic statistical concepts, (3) ability to synthesize the components of a statistical study and to communicate the results in a clear manner. Towards these objectives, we propose a revamp of the traditional course design together with the creation of a new software tool that is currently unavailable.

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12. INTERNET RESOURCES OF INTEREST

1. New Mathematics Education site in which you can find our newsletters:

"Una empresa docente", mathematics education research center of the University of los Andes in Bogota, Colombia, is pleased to announce a new WWW mathematics education site: Servidor de Educacion Matematica.

Our purpose is to gather information about Mathematics Education in one place and make it available to all Internet users.. The information has been classified in several categories: bibliographical databases, articles, documents, journals and magazines, software, events and fairs, community, etc.

URL: http://ued.uniandes.edu.co/

Contributions for any of the sections are welcome. We are very interested in receiving articles, papers and data about people and institutions.. We also want to let you know, about our recently published mathematics education journal, called Revista EMA. The first two numbers are available at the WWW site mentioned above. As before, papers are welcome.

Additionally Luisa Andrade, who works in "Una empresa docente" has included some information about our research group at:

http://ued.uniandes.edu.co/servidor/em/comunidad/organizac/organizac.htm

2. Free nonparametric software

Richard MAY (rmay@utah-inter.net) is sending the following note:

If you still have interest in nonparametric statistical testing, you will find a modest contribution (NPSTAT/NPFACT) on the WWW at the following address -

http://home.utah-inter.net/rmay/npstat.html

The page has five sections with links to a) download NPSTAT and documentation and reading list, b) mailbase in the UK (for listing of related software for randomization tests), and c) contact with the co-authors.

We would appreciate your letting us know of any problems here or your reactions.

3. The Journal of Statistics Education information service now has a mirror site at Universita' degli Studi in Perugia, Italy.

Readers outside the Americas should find this faster to access than the one at North Carolina State University. Please contact Tim Arnold (arnold@stat.ncsu.edu) if you have any problems or suggestions concerning the service.

The URL for the site is http://www.stat.unipg.it/ncsu/info/jse/homepage.html

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13. RESAMPLING PROJECT

Peter Bruce, from the University of Maryland, has kindly sent us this summary about his Resampling Project, and about a related text available from the Resampling Project's web site.

Resampling methods (including the bootstrap and other simulation procedures) have revolutionized the practice of statistics in the 1980's and 1990's. To help spread the word about resampling, the Resampling Project offers you a free copy of the only introductory text on resampling. A new edition of this book is in the works, and the author hopes that you will provide comments that will help him make improvements.

You can download a copy of this introductory text from the Resampling Project's web site -- www.statistics.com. You can contact us at stats@resample.com. If you include your regular address ("snail mail"). We will mail you an article about resampling from Science News and other printed material. These are just a few of the items about us and by us that are available:

"Pick a Sample," by Ivars Peterson, _Science News_, July 27, 1991

"Resampling: A Tool for Everyday Statistical Work," by Julian L. Simon and Peter C. Bruce, _Chance_, Vol. 4, No. 1, 1991, pp. 22- 32.

"What Some Puzzling Problems Teach About the Theory of Simulation and the Use of Resampling", by Julian L. Simon, _American Statistician_, Nov. 1994

"Probability and Statistics With Resampling Stats and Mathematica," by Julian L. Simon and Peter C. Bruce, _The Mathematica Journal_, Vol. 3, Issue 1, Winter, 1993, pp. 48-55.

"The New Biostatistics of Resampling", by Julian L. Simon and Peter C. Bruce, _MD Computing_, v. 12, #2, 1995

"The Resampling Method for Statistical Inference," by Julian L. Simon, forthcoming in _Scientific American_

"Evaluations of Teaching Introductory Statistics Via Resampling", by Julian L. Simon and Peter C. Bruce, preprint
"Resampling: Origins, Definitions and Roles", by Julian L. Simon

Resampling: The New Statistics, by Julian L. Simon, published in preliminary edition by Duxbury Press in 1993.

The Philosophy and Practice of Resampling Statistics by Julian L. Simon.

ADDITIONAL MESSAGE ABOUT TEACHING RESAMPLING:

The Resampling Project at the University of Maryland, headed by Julian Simon and Peter Bruce, reports success in teaching statistics -- especially introductory statistics -- from a resampling perspective. This is based on assessments from 510 students in 23 classes at 13 schools, including both community colleges and universities in the U.S. and abroad. Between 70% and 80% of all the students found statistics more interesting, less frightening and more valuable than expected. Similar percentages said statistics should be taught with resampling and would recommend a course taught with resampling.

A one-year follow-up study at one of the schools compared students in resampling sections with those in conventional formula-based sections of the same introductory course: the resampling students were about twice as likely to say that they "Learned a fair amount in course" (81% vrs. 46%) "Retained a fair amount" (64% vrs. 22%), and "used stats in work/personal life" (69% vrs. 33%).

The Resampling Project's recent work follows split- class controlled studies in the 1970's that showed that resampling section students learned more quickly and did better on exams than did their counterparts in the conventional sections.

The Resampling Project is seeking statistics instructors interested in implementing resampling in introductory statistics instruction (particularly those interested in doing additional controlled studies). Preprints, articles and more information (including a text that can be downloaded from the internet) are available.

Contact us at stats@resample.com, or check out our web site at www.statistics.com.

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14. NEW SPANISH SOCIETY FOR RESEARCH ON MATHEMATICS EDUCATION AND NEW STATISTICS GROUP

Professor Luis Rico, from the University of Granada is sending information about aims and subgroups of the Spanish Society SEIEM, in which a statistics group has been formed:

During the last two decades Didactic of Mathematics Spanish university departments have supported a great effort to develop research on mathematics education and to reach the standards of quality currently used in this field by the researchers of the international community. Nowadays the Spanish group of research on mathematics education has grown and it has a vigorous and increasing production, involving all levels of the Educational System and trying to inquire about the main problems of teaching and learning mathematics. This context explains the feeling of a great number of researchers about the necessity to set up their own Society. The Spanish Society of Research on Mathematics Education (SEIEM) was finally founded in March 1996 and among its aims we underline the following:

* To maintain a space of communication for criticizing and debating about research on mathematics education; this space will be used to pose questions, to communicate and exchange results, to deepen into theoretical constructions, and to improve and validate methodological designs.

* To promote steady research groups on mathematics education, with a qualified production, prepared to delimit priorities and to tackle specific inquiry questions.

* To promote mathematics education in research institutions and educational agencies; to stress the regular application submission for research and educational programs.

* To contribute and to lead the development, assessment and uses of research on Didactic of Mathematics.

* To contribute to the diffussion of research outcomes in the mathematics education forums, meetings and reviews.

* To establish relations and to promote collaborative work with other research groups on mathematics education.

* To actively foster the cooperation and exchange between research and practice along the whole educational system.

To carry out this wide plan of work, the SEIEM society elected its Committee: President: L. Rico, from Granada University, Secretary: E. Lacasta, from Navarra University; Treasurer: M. Sierra, from Salamanca University; members: C. Azcarate from Barcelona Autonomous University, V. Sanchez from Seville University and L. Puig from Valencia University.

After this, the new society begun with a debate on priority mathematics education research subjects; the undertaken discussion led to organize several working groups among the members. Six groups were decided: 1) Didactic of Analysis, coordinated by C. Azcárate from Barcelona Autonomous University.

2) Geometry Learning, coordinated by A. Gutiérrez from Valencia University. 3) Didactic of Statistic, Probability and Combinatorics, coordinated by C. Batanero from Granada University. 4) Numerical and algebraical thinking, coordinated by B. Gómez from Valencia University. 5) Research on the Mathematics Teacher: Attitudes, Beliefs, Knowledge and Understanding, Development and Teacher Education, coordinated by S. Llinares from Sevilla University. 6) Research Methodology on Didactic of Mathematics, coordinated by L. Rico from Granada University, and.E. Lacasta from Navarra Public University.

More information about this society is available from:

Dr. D. Luis Rico

Departamento Didáctica de la Matemática

Facultad de Ciencias de la Educación. Campus de Cartuja Universidad de Granada. 18071 Granada, España. Tlf. (34)- (58)-243949. Fax: (34)-(58)-243949 E-Mail: lrico@goliat.ugr.es

Specific information concerning the Statistics subgroup is available form Carmen BATANERO (cbatanero@goliat.ugr.es

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15. INFORMATION ON PREVIOUS CONFERENCES:

XVI ANNUAL CONFERENCE OF THE MATHEMATICS EDUCATION RESEARCH GROUP OF AUSTRALASIA (MERGA), Brisbane, Australia, July, 9-13, 1993'

Williams, A. (1993). "Is a pass good enough in tertiary statistics?". In B. Atweh, C. Kanes, M. Carss, & G. Booker (Eds.), _Contexts in mathematics education: Proceedings of the Sixteenth Annual Conference of the Mathematics Education Research Group of Australasia (MERGA)_ (pp. 587-591). Brisbane: Kelvin Grove, Ql

Research in mathematics education and cognition suggests that knowledge, its acquisition, and its transfer are complex processes. In this study, end of semester totals are recorded for a large group of students in a traditional introductory subject in statistics at the tertiary level. A group of eight students was selected for observation while solving four statistical problems during the semester. This paper illustrates the capacity of students to pass an exam, yet highlights their limited understanding of statistical concepts, their narrow mechanical focus, their poor study habits and the lack of statistical transfer in atypical problems. Alternatives to the traditional approach are suggested.

Peard, R. F. "The concept of fairness in simple games of chance". In B. Atweh, C. Kanes, M. Carss, & G. Booker (Eds.), _Contexts in mathematics education: proceedings of the Sixteenth Annual Conference of the Mathematics Education Research Group of Australasia (MERGA)_ (pp. 469-475). Brisbane: Kelvin Grove, Ql

This study examines the mathematical concepts of `fairness' and `expectation' in probabilistic situations. The subjects were 40 high school students in semester 1, Year 11, maths in society classes in three Queensland high schools. Twenty `gamblers' were identified by questionnaire and subsequent interview. A control group of similarly achieving `non gamblers' was selected. The research compares the ability of each group to contract a working definition of the concept of mathematical expectation and to use this concept in determining the fairness of a number of games of chance.

XVII ANNUAL CONFERENCE OF THE MATHEMATICS EDUCATION RESEARCH GROUP OF AUSTRALASIA (MERGA), Southern Cross University, Lismore. Australia, 5-8 July, 1994

Williams, A. (1994). "A proposal for investigating students' knowledge of hypothesis testing. In G. Bell, B. Wright, N. Leeson, & J . Geake (Eds.), _Challenges in mathematics education: constraints on construction: Proceedings of the Seventeenth Annual Conference of the Mathematics Education Research Group of Australasia_ (pp. 699-707). Lismore, Australia.

Hypothesis testing is conceptually complex. It builds on a basic knowledge of probability, sampling distributions and the central limit theorem. It includes new concepts such as null/alternative hypothesis, alpha level, type 1 and 2 errors, power, sample size, statistical tests, critical value, p value, observed value and decisions about hypotheses. The web of interrelationships between these concepts requires their holistic understanding for rational decision making. Firstly, this paper briefly summarizes how these concepts may be linked together, and secondly, presents a methodology for research into what students know in these areas, their understanding of simple design concepts, and the sources of their difficulties with hypothesis testing.

Way, J. (1994). "Developing a clinical interview protocol to assess children's understanding of probability" . In G. Bell, B. Wright, N. Leeson, & J. Geake (Eds.), _Challenges in mathematics education: constraints on construction: Proceedings of the Seventeenth Annual Conference of the Mathematics Education Research Group of Australasia_ (pp. 683-690). Lismore, Australia.

This paper presents a model devised for the development of a clinical interview protocol to assess children's understanding of probability. The model is based on the work of both Australian and overseas researchers, and attempts to address the many issues that need to be considered when undertaking research of this nature.

Smith, N. F., Wood, L. N. Gillies, R. K., & Perrett, G. "Analysis of student performance in statistics". In G. Bell, B. Wright, N. Leeson, & J. Geake (Eds.), _Challenges in mathematics education: constraints on construction: proceedings of the Seventeenth Annual Conference of the Mathematics Education Research Group of Australasia_ (pp. 539-545). Lismore, Australia.

This paper reports on an investigation of students' difficulties in first year statistics examinations at university. The authors' hypothesis was that difficulty with language was an important factor in student performance in statistics examinations. Our data consisted of examination questions ranked in order of difficulty based on student performance, lecturers' perceptions of difficulty and a measure of the linguistic complexity of the questions. The examination paper that was analyzed was a typical short answer paper for students studying statistics in their first year at university. The paper was not designed specially for analysis but rather was the normal end of the year paper for a business statistics subject with an enrollment of 600 students. Three statistics lecturers not involved in teaching the subject ranked questions according to their perception of the level of difficulty and these were compared with the performance of 186 students. The examination paper was also analyzed for linguistic complexity as measured by lexical density and this was compared with students' responses. The results were surprising. There was no correlation between student performance and the linguistic complexity of the questions as measured by formal measures of lexical density. The lecturers' rankings were consistent and correlated highly with student responses in most cases. Certain topic areas appeared to cause more difficulties than others and further research will concentrate on these topics.

Callingham, R., A. "Teachers' cognitive functioning in the context of questions using the arithmetic mean". In G. Bell, B. Wright, N. Leeson and J .Geake (Eds.), _Challenges in mathematics education: constraints on construction: proceedings of the Seventeenth Annual Conference of the Mathematics Education Research Group of Australasia_ (pp. 539-545). Lismore, Australia.

The arithmetic mean is probably the most commonly taught statistical measure. This study of 136 preservice and inservice teachers concentrates on responses to questions about the arithmetic mean in different contexts. It was devised to allow for increasingly sophisticated understanding of the concept to be demonstrated in the concrete symbolic mode, and also allowed for iconic mode processing. The results are considered from the perspective of cognitive development. Cycles of response in both

iconic and concrete symbolic mode are identified and described. A theoretical model to explain the interaction between the modes is proposed. The implications of these findings is briefly discussed.

Watson, J. M., Collis, K. F., & Moritz, J. B. (1994). "Assessing statistical understanding in Grades 3, 6 and 9 using a short answer questionnaire". In G. Bell, B. Wright, N. Leeson, & G. Geake (Eds.),_Challenges in Mathematics Education: Constraints on Construction_ (pp. 675-682). Lismore, NSW: Mathematics Education Research Group of Australasia.

This paper presents some results of a pilot study which devised a 20-item paper-and-pencil, short-answer/multiple-choice questionnaire to assess students' understanding of statistics and probability in Grades 3, 6 and 9. The items are presented, with discussion of response differences over the three grades, and the level and type of cognitive functioning associated with responses.

XVIII ANNUAL CONFERENCE OF THE MATHEMATICS EDUCATION RESEARCH GROUP OF AUSTRALASIA_ Northern territory University, Darwin, Australia, 7-10 July, 1995.

Callingham, R. A., Watson, J. M., Collis, K. F., & Moritz, J. B. (1995). "Teacher attitudes towards chance and data". In B. Atweh & S. Flavel (Eds.), _Proceedings of the Eighteenth Annual Conference of the Mathematics Education Research Group of Australasia_ (pp. 143-150). Darwin, NT: Mathematics Education Research Group of Australasia.

Seventy-two teachers from Tasmanian government primary and secondary schools were surveyed regarding (i) their agreement to statements relating to personal confidence with chance and data, (ii) their views of the importance of statistics in society, and (iii) their confidence in teaching chance and data. Differences across gender and school type were found in measures of individual items and also combined scales. These results help to specify needs for professional development.

Watson, J.M., Collis, K.F., & Moritz, J.B. (1995). Children's understanding of luck. In B. Atweh & S. Flavel (Eds.), _Proceedings of the Eighteenth Annual Conference of the Mathematics Education Research Group of Australasia_ (pp. 550-556). Darwin, NT: Mathematics Education Research Group of Australasia.

This paper presents an analysis of two questionnaire items which explore students' understanding of the concept of luck in relation to the development of ideas of formal probability. The items were administered to 1014 students in Grades 3, 6 and 9 in Tasmanian schools. The analysis was based on the multimodal functioning SOLO model. The results lead to a hypothesised structure and implications for curriculum and teaching practice.

Peard, R. (1995). "Student decision making in a game of chance and misconceptions in probabilistic reasoning". In B. Atweh & S. Flavel (Eds.), _Proceedings of the Eighteenth Annual Conference of the Mathematics Education Research Group of Australasia_ (pp.550-556). Darwin, NT: Mathematics Education Research Group of Australasia.

This research determined whether a group of 50 Year 9 students playing a card game that involved probabilistic reasoning demonstrated a type of misconception in the selection of strategy they employed. Earlier research into misconceptions in probabilistic reasoning by the author identified widespread use of the heuristics of availability and representativeness by Year 11 students. The present research identified a misconception of a different nature relating to the concept of mathematical expectation.

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16. FORTHCOMING CONFERENCES

IASE ROUNTABLE CONFERENCE, Granada, Spain , July 23-27, 1996. "Research on the Role of Technology inTeaching and Learning Statistics,"

Program Committee:

Joan GARFIELD, Program Chair

Rolf BIEHLER, Germany

Anne HAWKINS, UK

Carol Joyce BLUMBERG, USA

Lionel PEREIRA-MENDOZA, Singapore

Gail BURRILL, USA

Michael SHAUGHNESSY, USA

Local Organizers:

CARMEN BATANERO, JUAN D. GODINO and ANGUSTIAS VALLECILLOS, Spain

Presentations:

A. HAWKINS, Nottingham, UK: "Myth-Conceptions!"

Section 1: How Technology is changing the teaching of statistics at the secondary level

G. BURRILL, University of Wisconsin, USA: "Technology and the Teaching and Learning of Statistics".

J. Nicholson, Belfast, Royal Academy, Ireland: "Developing probabilistic and statistical reasoning at secondary level through the use of technology".

Y. Ersoy, S. Bulut & P. Cemen, Middle East Technical University, Turkey: "Effects of Computer-Assisted Instruction on Achievement and Attitudes toward Probability".

D. BEN-ZVI, A. Froedlander, Wiezmann Institute of Science, Israel: "Statistical thinking in a technological environment."

S. LAJOIE, McGill University, Canada: "The Use of Technology to Model Performance Standards in Statistics."

Section 2: Developing Exemplary Software

R. DELMAS, University of Minnesota: "A framework for the development of software for teaching statisical concepts".

M. MCCLOSKEY, University of Strathclyde, Scotland: "QUERCUS and STEPS - The experience of two CAL projects from Scottish Universities."

S. Cohen and R. A. Chechile, Tufts University, USA: "Overview of ConStatS and the ConStatS Assessment".

J. BEHRENS, Arizona State University, USA"Using GEESC: "A Graphical Environment for Exploring Statistical Concepts".

Section 3: What we're learning from Empirical Research

P. WILDER, De Montfort University Bedford, UK: "Computer Simulations and the Concept of Randomness".

K. LIPSON, Swinburne University, Australia: " What do students gain from computer simulation exercises".

C. KONOLD, A. Pollatsek, A. Well & A. Gagnon, University of Massachusetts, USA "Students analyzing Data: Research of Critical Barriers".

R. BIEHLER, Unversity of Bielfeld, Germany: "Students' difficulties in practicing computer supported data analysis- Some hypothetical generalizations from results of two exploratory studies".

C. BATANERO, A. ESTEPA & J. GODINO, University of Granada, Spain: "Evolution of students' learning of statistical association in a computer-based teaching environment" .

G. SCHUYTEN, University of Gent, Belgium: " Computer-based and computer-aided learning of applied statistics at the Department of Psychology and Educational Sciences".

Section 4: How Technology is changing the teaching of statistics at the college level

A. Rossman, Dickinson College,USA: "Workshop statistics: Using Technology to Promote Learning by Self Discovery".

P. Jones, Swinburne University, Australia: "Examining the education potential of computer based technology in statistics".

S. STARKINGS, South Bank University, England: "How Technological Introduction Changes the Teaching of Statistics and Probability at college level" .

J. L. Snell, Dartmouth College: "The internet: a new dimension in teaching statistics".

M. Wood, University of Portsmouth, England: "Computer Packages as a substitute for Statistical Training?".

Section 5: Questions to be addressed on the Role of Technology in Statistics Education

J. WATSON and J. Baxter, University of Tasmania, Australia: " Learning the Unlikely at Distance as an Information Technology Enterprise: Development and Research" .

M. GLENCROSS and K. Binyavanga, University of Transkei, South Africa: "The role of technology in statistics education: a view form a developing region" .

"20 PME": International Group for the PSYCHOLOGY OF MATHEMATICS EDUCATION, Valencia, Spain, July 9-12, 1996. Organized by the Department of "Didactica de la Matematica" at the University of Valencia.

Papers TO BE PRESENTED:

BATANERO, C., SERRANO, L., & GARFIELD, J. "Heuristics and biases in secondary school studentsU reasoning about probability".

Charron, C. "Bayesian implicative analysis: How to identify the concepts necessary to acquisition of a competence? One example of application to the conceptualization of fraction in teenagers" .

ESTEPA, A., & Sanchez, F.T. "Association judgements in the comparison of two samples".

FISCHBEIN, E., & Schnarch, D. "Intuitions and schemata in Probabilistic Thinking".

GATTUSO, L. "Development of concepts of the arithmetic average from high school to university".

GORDON, S., Nicholas, J., & Crawford, K. "Psychology Students' Conceptions of a Statistic Course".

Jones, G .A.; Thornton, C. A.; Langrall, C. W., & Mogill, T.A.:"Using Children's Probabilistic Thinking to inform Instruction".

Pratt, D., & Noss, R. "Designing a domain for stochastic abstraction".

Reading, C., & Pegg, J.:"Exploiting understanding of data reduction".

Rowland, T. "Counting, estimation and the language of uncertainty".

TRURAN, J. M. "Children' s misconceptions about the independence of random generators".

TRURAN, K. M. "Children' s use of representativeness heuristic".

VALLECILLOS, A., BATANERO, C. "Conditional probability and the level of significance in the test of hypotheses".

Way, J. "Children' s strategies for comparing two types of random generators".

Posters

Peard, R. "Student decision making in a game of chance and misconceptions in probabilistic reasoning".

Queiroz, C., Esteves, I., Henry, & M., Campos, T. M. M. "Introduction of the concept of probability to teenagers - 12/13 years old".

ROA, R., BATANERO, C., GODINO, J.D., & CANIZARES, M.J . "Strategies used by mathematics university students solving combinatorial problems".

ICOTS 5, SINGAPORE, JUNE, 1998.

Place: Nanyang Technological University, Singapore, June 21 - 26, 1998

Theme: Statistical Education - Expanding the Network

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Chair International program committee: Brian PHILLIPS; email: bphillips@swin.edu.au

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