

Topic Study Group 12

The Teaching and Learning of Statistics

TSG-12 Working Team¹

1. Theme and Description

In today's world rapid technological advances have facilitated the production and management of large data sets in diverse forms. Being able to create value with data by converting them to meaningful information, to critically evaluate and effectively utilize the information for decision-making, and to understand social and natural phenomena are important 21st century skills for all citizens. Thus, the importance of teaching and learning statistics as the "science of data" is increasingly gaining recognition at all educational levels. The study of statistics provides students with tools, skills, ideas and dispositions to use in order to react intelligently to information in the world around them. Reflecting this need to improve students' ability to think statistically, statistical literacy and reasoning are becoming part of the mainstream school and university curriculum in many countries. Emerging issues in statistics education relate to dealing with "big data" and dealing as a "data scientist" and to the use of statistics in thinking about social changes and policy decisions and the impact of these on both the school and university curricula. In light of these trends, statistics education is a growing and exciting field of research and development that will enable us to build from the knowledge we have accumulated in the past about teaching and learning statistics to move forward in productive ways.

At TSG-12, academic work on major issues in statistics education research were presented and discussed along any one of the four themes:

1. Recent research on teaching and learning statistics in school and at the tertiary level including global trends;
2. Development and assessment of statistical literacy, including the connection of statistics education to social and political issues;

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3. Preparation and professional development of statistics teachers and of statistics teacher educators; and
4. The impact of “big data” and technology-rich learning environments in statistics education, and the connection between learning statistics and learning data science.

2. Program Overview

At ICME-14, TSG-12 provided the venue for statistics educators, teachers and researchers for presentation of research and discussion of issues on these themes. The discussion included time to reflect on the status of research in statistics education related to the various themes and highlighted areas of high priority for the statistics education research community. There were four group sessions at TSG-12 which included invited and contributed papers, as well as posters, primarily delivered through online conference platforms.

2.1. Online Paper Presentations

These online presentations in four sessions start with invited papers and move to contributed papers. Except for one on-site presentation by a Chinese national, all these papers were presented virtually using Zoom conference platform with around 20–30 participants per session. The papers presented in these four sessions are outlined in Tab. 1 on the next page.

2.2. Poster Presentations

The posters presented in these four sessions are outlined in Tab. 2 following Tab.1.

3. Future Directions and Suggestions

After TSG-12 at ICME-14, the post-conference discussion focused on submission of selected papers from TSG-12 into a monograph to be published by Springer. The Call for Papers among the TSG-12 presenters was initiated by Gail Burril, one of the TSG-12 team members. This volume of papers from TSG-12 of ICME-14 will not be proceedings but rather collections of papers, each of which shares some common ground with the original paper presented during TSG-12. With the exception of the opening chapter with short country reviews, this volume consists of 14 chapters each representing a paper presented at ICME-14 for TSG-12 and the discussion that ensued. These papers will constitute a book publication entitled Reasoning with Data and Statistical Thinking: An International Perspective to be published by Springer with five sections, namely: Statistics Education Across the World, Data and Young Learners, Data and Simulation to Support Understanding, Data and Society, Statistical Learning,

Reasoning and Attitudes. The editors Gail Burrill, Enriqueta Reston and Leandro Souza are members of TSG-12 technical working group.

Tab. 1. List of papers presented

Paper and author(s)	
Session 1	
[1]	Designing embodied tasks in statistics education for grade 10–12. Lonneke Boels (The Netherlands).
[2]	Teaching statistics and sustainable learning. Hanan Innabi (Sweden).
[3]	Reading and interpreting distributions of numerical data in primary school. Daniel Frischemeier (Germany).
[4]	Statistical literacy as central competence to critically understand big data. Karen François and Carlos Monteiro (Brazil).
[5]	Students beliefs about statistics and their influence on students' attitudes toward statistics in introductory courses. Florian Berens (Germany).
Session 2	
[6]	Interdisciplinary data workshops. Danny Parsons , David Stern , Balázs Szendröl , and Elizabeth Dávid-Barrett (UK).
[7]	Distinctive aspects of reasoning in statistics and mathematics: implications for classroom arguments. Anna Marie Conner and Susan A. Peters (USA).
[8]	A school experiment for introductory inferential statistics in Hungarian secondary schools. Péter Fejes Tóth and Ödön Vancsó (Hungary).
[9]	An informal statistical inferential reasoning experience with seventh graders: a lesson study. Soledad Estrella , Maritza Méndez-Reina , Tamara Rojas , and Rodrigo Salinas (Chile).
[10]	Research on teaching strategies of the mean from the perspective of statistical literacy. Jiaqi Wu (China).
Session 3	
[11]	Margin of error: connecting chance to plausible. Gail Burrill (USA).
[12]	Critical citizenship in statistics teacher education. Lucía Zapata-Cardona , Cindy Alejandra Martínez-Castro , Lucía Zapata-Cardona , and Gloria Lynn Jones (Colombia).
[13]	Mathematics ability and other factors associated with success in introductory statistics. Adam Molnar and Shiteng Yang (USA).
[14]	Elementary students' responses to quantitative data. Karoline Smucker and Azita Manouchehri (USA).
Session 4	
[15]	Implementation of a course on Tidyverse in Pakistan under the ASA Educational Ambassador Program. Saleha Naghmi Habibullah (Pakistan).
[16]	Young learners' reasoning with informal statistical models and modeling. Michal Dvir and Dani Ben-Zvi (Israel).
[17]	The binomial model: coin tosses or clay pots? Von Bing Yap (Singapore).
[18]	Variability modeling and data-driven decision-making using socially open-ended problems: a comparative study of high school students in Thailand, Brunei and Zambia. Orlando González (Thailand).
[19]	Algebraization levels of statistical tables in secondary textbooks. Mara Magdalena Gea and Jocelyn D. Pallauta , Pedro Arteaga , and Carmen Batanero (Spain).
[20]	Data modelling with young learners as experiences of allgemeingbildung. Stine Gerster Johansen (Denmark).
[21]	Investigating mathematics teacher educators' conceptions for informal line of best fit. Jale Gurbak Hatil and Gulseren Karagoz Akar (Turkey).

Tab. 2. List of posters presented

Poster and author(s)
[22] Does climate change really exist? high school students discover statistical methods by solving a modeling problem. Maren Hattebuhr and Martin Frank (Germany).
[23] Do students in grade 10 generate ideas of statistical hypothesis testing spontaneously? Hiroto Fukuda , Naoya Miwa , and Yoshiki Hashimoto (Japan).
[24] Model proposal to promote the construction of the strong meaning of volatility. Miguel Andres Diaz Osorio (Columbia).
[25] Improving statistical pedagogy among K to 12 mathematics teachers in the Philippines. Enriqueta Deguit Reston (Philippines).
[26] Developing mathematical knowledge for teaching mean and median of prospective mathematics teachers through the lesson study. Thi Ha Phuong Nguyen (Vietnam).
[27] Analysis of the most frequent errors in practical works on tables and graphs in biostatistics. Teresita Evelina Teran (Argentina).
[28] Comparing the statistical content of elementary school mathematics textbooks from Japan, India and China. Yuqi Li , Xue Li , and Zhemín Zhu (China).
[29] Comparing the statistical content of elementary school mathematics textbooks from Japan, India, the United States, Singapore and China. Zhemín Zhu , Yuqi Li , Yilin Li , Lulu Li , and Xue Li . (China).
[30] Aspects of critical thinking in statistical education-research survey on sixth-grade elementary school. Naoki Ohta and Ken Teraguchi (Japan).