Teaching Bits: Statistics Education Articles from 2015

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Journal of Statistics Education Volume 23, Number 3 (2015),
www.amstat.org/publications/jse/v23n3/frytb.pdf

I located 15 total articles and 1 dissertation that have been published from July 15 through November 15, 2015 that pertained to statistics education. In this column, I highlight a few of these articles that represent a variety of different journals that include statistics education in their focus. I also provide information about the journals and a link to their websites so that abstracts of additional articles may be accessed and viewed.

Statistics Education Dissertations from IASE website

http://iase-web.org/Publications.php?p=Dissertations
The International Association for Statistical Education (IASE) website features various publications including recent doctoral dissertations focused on statistics education. In July 2015, I highlighted three recently completed dissertations in statistics education, and one more dissertation has been posted on the IASE website since then:

"Assessment of cognitive transfer outcomes for students of introductory statistics"
By Matthew Beckman, University of Minnesota, 2015
Supervisors: Joan Garfield and Robert delMas

From *Teaching Statistics*

http://onlinelibrary.wiley.com/journal/10.1111/%28ISSN%291467-9639
Teaching Statistics is an International Journal for Teachers that first appeared in 1979 and has been published three times a year ever since. It is available by paid subscription.

"Using a discussion about scientific controversy to teach central concepts in experimental design"

By Kimberley Ann Bennett

Volume 37, Number 3 (2015)
http://onlinelibrary.wiley.com/doi/10.1111/test.12071/abstract
Abstract: Students may need explicit training in informal statistical reasoning in order to design experiments or use formal statistical tests effectively. By using scientific scandals and media misinterpretation, we can explore the need for good experimental design in an informal way. This article describes the use of a paper that reviews the measles mumps rubella vaccine and autism controversy in the UK to illustrate a number of threshold concepts underlying good study design and interpretation of scientific evidence. These include the necessity of sufficient sample size, representative and random sampling, appropriate controls and inferring causation.

“Slow thinking and deep learning: Tversky and Kahneman's taxi cabs”

By Mike Bedwell
Volume 37, Number 3 (2015)
http://onlinelibrary.wiley.com/doi/10.1111/test.12079/abstract
Abstract: This article is based on classroom application of a problem story constructed by Amos Tversky in the 1970s. His intention was to evaluate human beings' intuitions about statistical inference. The problem was revisited by his colleague, the Nobel Prize winner Daniel Kahneman. The aim of this article is to show how popular science textbooks can serve as a source for rich classroom activity, with a little care in the implementation by teachers. Kahneman describes the problem as ‘standard’ and answers using a fixed point number. I describe how I have encouraged my students to challenge the certainty of this assertion by identifying ambiguities that are left unexplained in the story. This way, I claim to stimulate individuals to indeed move towards *Thinking, Fast and Slow*, the title of Kahneman's book.

“An alternative teaching method of conditional probabilities and Bayes' rule: an application of the truth table”

By Eiki Satake andAmy Vashlishan Murray
Volume 37, Number 3 (2015)
http://onlinelibrary.wiley.com/doi/10.1111/test.12080/abstract
Abstract: This paper presents a comparison of three approaches to the teaching of probability to demonstrate how the truth table of elementary mathematical logic can be used to teach the calculations of conditional probabilities. Students are typically introduced to the topic of conditional probabilities—especially the ones that involve Bayes' rule—with the help of such traditional approaches as formula use or conversion to natural frequencies. The truth table approach is an alternative method for explaining the concept and calculation procedure of conditional probability and Bayes' rule.

From *Mathematics Teacher*

http://www.nctm.org/publications/mathematics-teacher/
MT is an official journal of the National Council of Teachers of Mathematics. It is published nine times a year and is available by paid subscription.

"Tackling Misconceptions about Linear Associations"

By Maryann E. Huey and Deidra L. Baker
Volume 109, Number 1 (2015)
http://www.nctm.org/Publications/Mathematics-Teacher/2015/Vol109/Issue1/Tackling-Misconceptions-about-Linear-Associations/
Abstract: Many teachers of required secondary school mathematics classes are introducing statistics and probability topics traditionally relegated to college or AP Statistics courses. As a result, they need guidance in preparing lesson plans and orchestrating effective classroom discussions. In this article, we will describe the students' learning and the associated challenges related to the topics of correlation and linear regression. Our intent in sharing the results of one Algebra 2 class is to equip teachers with insight into relevant experiences, identify common misconceptions, and provide recommendations related to selecting and implementing activities.

From *The American Statistician*

http://www.amstat.org/publications/index.cfm
The American Statistician contains articles related to statistics education that are organized into the following sections: Statistical Practice, Teacher's Corner, Reviews of Books and Teaching Materials. It is published quarterly and is available by paid subscription.

"What Your Future Doctor Should Know About Statistics: Must-Include Topics for Introductory Undergraduate Biostatistics"

By Brigitte Baldi & Jessica Utts
Volume 69, Number 3 (2015)
http://www.tandfonline.com/doi/full/10.1080/00031305.2015.1048903
Abstract: The increased emphasis on evidence-based medicine creates a greater need for educating future physicians in the general domain of quantitative reasoning, probability, and statistics. Reflecting this trend, more medical schools now require applicants to have taken an undergraduate course in introductory statistics. Given the breadth of statistical applications, we should cover in that course certain essential topics that may not be covered in the more general introductory statistics course. In selecting and presenting such topics, we should bear in mind that doctors also need to communicate probabilistic concepts of risks and benefits to patients who are increasingly expected to be active participants in their own health care choices despite having no training in medicine or statistics. It is also important that interesting and relevant examples accompany the presentation, because the examples (rather than the details) are what students tend to retain years later. Here, we present a list of topics we cover in the introductory biostatistics course that may not be covered in the general introductory course. We also provide some of our favorite examples for discussing these topics

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"The Challenges in Developing an Online Applied Statistics Program: Lessons Learned at Penn State University"

By Derek S. Young, Glenn F. Johnson, Mosuk Chow & James L. Rosenberger
Volume 69, Number 3 (2015)
http://www.tandfonline.com/doi/full/10.1080/00031305.2015.1038583
Abstract: Numerous professional fields have an increasing need for individuals trained in statistics and other quantitative analysis techniques. Today there exists great potential to fulfill this need by providing opportunities through online learning. However, to provide a high-quality education for returning adult professionals seeking advanced degrees in applied statistics online, many challenges need to be overcome. Based on our experience developing Penn State University's online program in applied statistics, we discuss the evolution of the program's curriculum, recruitment and development of online faculty, and meeting the requirements of students as important areas that require consideration in the development of an online program. We also highlight program evaluation strategies employed to ensure innovation and improvement in online education as cornerstones to a program's success.

From *ZDM: The International Journal on Mathematics Education*

http://www.springerlink.com/content/120453
ZDM is one of the oldest mathematics education research journals. ZDM publishes seven themed issues a year. Papers in ZDM are by invitation only. The journal is available online by paid subscription.

"The intuitiveness of the law of large numbers"

By Stephanie Lem
Volume 47, Issue 5 (2015)
http://link.springer.com/article/10.1007/s11858-015-0676-5
Abstract: In this paper two studies are reported in which two contrasting claims concerning the intuitiveness of the law of large numbers are investigated. While Sedlmeier and Gigerenzer (J Behav Decis Mak 10:33–51, 1997) claim that people have an intuition that conforms to the law of large numbers, but that they can only employ this intuition in specific circumstances, Kahneman and Tversky (Cogn Psychol 3:430–454, 1972) claim that people have an intuition that prohibits them from correctly applying the law of large numbers to certain tasks, making it necessary to reason analytically and inhibit the intuitive response. The dual processing theory of reasoning was used as the theoretical framework to study these two claims, while priming and a working memory load method were used to study the claims in more detail. No evidence was found for the claims of Sedlmeier and Gigerenzer (J Behav Decis Mak 10:33–51, 1997). Various possible explanations for the results are provided and options for further research are suggested.

"Designing to support critical engagement with statistics"

By Melissa Sommerfeld Gresalfi
Volume 47, Issue 6 (2015)
http://link.springer.com/article/10.1007/s11858-015-0690-7
Abstract: The purpose of this paper is to describe a trajectory of designing for particular forms of engagement with mathematics. The forms of engagement that were targeted through these design experiments involved making intentional choices about which procedures to leverage in order to support particular claims (what I call critical engagement). In particular, this paper presents two rounds of a design cycle of a statistics unit, created in the context of an online, interactive videogame called Quest Atlantis. Examining the design history of the unit, this paper demonstrates how iterative refinements of the unit supported increasing critical engagement with the content, and specifically, the importance of fostering both intentionality and experiences of consequentiality in the designs. Finally, the paper considers the implications of the lessons learned for this targeted intervention for our understanding of how elements of design support students' mathematical reasoning more generally.

"Scaffolding norms of argumentation-based inquiry in a primary mathematics classroom"

By Katie Makar, Arthur Bakker, & Dani Ben-Zvi
Volume 47, Issue 7 (2015)
http://link.springer.com/article/10.1007/s11858-015-0732-1
Abstract: Developing argumentation-based inquiry practices requires teachers and students to be explicit about classroom norms that support these practices. In this study, we asked: How can a teacher scaffold the development of argumentation-based inquiry norms and practices in a mathematics classroom? A primary classroom (aged 9–10) was videotaped during the school year to address this question. Using key features of scaffolding (diagnosis, responsiveness, handover to independence) we analysed strategies the teacher used to establish the required norms and practices. Interviewed reflections from the teacher provided further insights into her intentions and adaptive responses to students' emerging practices. The analysis showed how the teacher constantly diagnosed the classroom norms and responsively used strategies that changed as norms emerged, developed and stabilised. After nine months, there was evidence of argumentation-based inquiry norms practiced by students, independent of the teacher's presence.

"Combining scaffolding for content and scaffolding for dialogue to support conceptual breakthroughs in understanding probability"

By Sibel Kazak, Rupert Wegerif, & Taro Fujita
Volume 47, Issue 7 (2015)
http://link.springer.com/article/10.1007/s11858-015-0720-5
Abstract: In this paper, we explore the relationship between scaffolding, dialogue, and conceptual breakthroughs, using data from a design-based research study that focuses on the development of understanding of probability in 10–12 year old students. The aim of the study is to gain insight into how the combination of scaffolding for content using technology and scaffolding for dialogue can facilitate conceptual breakthroughs. We analyse video-recordings and transcripts of pairs and triads of students solving problems using the TinkerPlots software

with teacher interventions, focusing on moments of conceptual breakthrough. Data show that dialogue scaffolding promotes both dialogue moves specific to the context of probability and dialogue in itself. This paper focuses on episodes of learning that occur within dialogues framed and supported by dialogue scaffolding. We present this as support for our claim that combining scaffolding for content and scaffolding for dialogue can be effective in students' conceptual development. This finding contributes to our understanding of both scaffolding and dialogic teaching in mathematics education by suggesting that scaffolding can be used effectively to prepare for conceptual development through dialogue.

From *International Journal of Science and Mathematics Education*

http://www.springer.com/education+%26+language/mathematics+education/journal/10763
The *International Journal of Science and Mathematics Education* publishes articles on a variety of topics and research methods in science and mathematics education. The journal is published 6-7 times a year and is available by paid subscription.

"Combining Multiple External Representations and Refutational Text: An Intervention on Learning to Interpret Box Plots"

By Stephanie Lem, Goya Kempen, Eva Ceulemans, Patrick Onghena, Lieven Verschaffel, & Wim Van Dooren
Volume 13, Issue 4 (2015)
http://link.springer.com/article/10.1007/s10763-014-9604-3
Abstract: Box plots are frequently misinterpreted and educational attempts to correct these misinterpretations have not been successful. In this study, we used two instructional techniques that seemed powerful to change the misinterpretation of the area of the box in box plots, both separately and in combination, leading to three experimental conditions, next to a control condition. First, we used multiple external representations: Histograms were used as an overlay on box plots in order to give students a better insight in the way box plots represent data distributions. Second, we used refutational text to explicitly name and invalidate the area misinterpretation of box plots. Third, we combined multiple external representations and refutational text. A box plot test showed that students in the refutation and combination condition scored statistically significant better than students in the control condition with respect to the misinterpretation of interest. The condition with multiple external representations scored in between. The implications of these results for theory and educational practice are discussed.
