Chapter 10
Supporting the Development of College-Level Students’ Conceptions of Statistical Inference

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ABSTRACT

The transition from descriptive to inferential statistics is a known area of difficulty for students taking introductory statistics courses. This chapter shares the experiences from a teaching experiment in a college-level introductory statistics classroom that implemented an informal, data-driven approach to statistical inference using the dynamic statistics software Fathom© as an investigation tool. Findings from the study indicate that the informal inferences on which instruction focused in the first part of the course helped students develop understandings of fundamental aspects of inferential and argumentative reasoning that served as foundations for the formal study of inferential statistics in the latter part of the course. The affordances offered by the tool for delving deeply into the data to make sense of the situation at hand were instrumental in supporting student understanding of both informal and formal inferential statistics.
INTRODUCTION

Statistics, the science of learning from data, is divided into two main areas: descriptive statistics and inferential statistics. Descriptive statistics is devoted to organizing, summarizing, and presenting data. It involves using tabular, graphical, and numerical techniques to analyze and describe a dataset. Inferential statistics, on the other hand, is intended to reach conclusions that extend beyond the immediate data, to deduce that observed patterns in the data at hand are also present in some broader context. It improves decision-making in a variety of real-world situations by providing tools that enable the drawing of causal inferences, or inferences to populations using sample-based evidence.

Although statistical inference is the cornerstone of modern statistical concepts and methods, grasping the key ideas related to inferential statistics is a known area of difficulties for students (Green, 1982; Rubin et al., 1990; Garfield & Ahlgren, 1998; Gordon & Gordon, 1992; Rubin et al., 2006). Research in statistics education has long suggested that students have difficulty using inferential statistics methods appropriately in applied problems. For example, research on introductory college-level statistics courses suggests that even students who can successfully implement procedures for hypothesis testing and parameter estimation are often unable to use these procedures appropriately in applications (e.g. Gardner & Hudson, 1999; Reichardt & Gollob, 1997). As Erickson (2006) points out, “inference is so hard that even professional researchers use it inappropriately” (p. 1).

Traditionally, introductory statistics courses adopt a linear, hierarchical approach to the different statistical topics encountered in the course. The structure of almost every introductory statistics course is to first start with descriptive and exploratory data analysis, then move into probability, and finally go to inferential statistics. Statistical inference is presented in the statistics classroom as a set of formal tests and procedures, through which information contained in sample data is used either to estimate the values of the respective population parameters (i.e., construct confidence intervals), or to check claims made regarding the values of population parameters (i.e., perform hypothesis testing). The research literature indicates major student difficulties in the transition from descriptive to inferential statistics (Green, 1982; Garfield & Ahlgren, 1998; Gordon & Gordon, 1992). After having investigated the teaching and learning of statistical reasoning for several years, Rubin, Bruce, and Teney (1990), came to the conclusion that grasping the basic concepts of sampling and statistical inference is extremely hard for students. Understanding, according to the researchers, seems to break down as soon as non-determinism enters the classroom.

Recent advances of technology provide schoolteachers and college instructors with new tools for adopting informal, data-driven approaches to statistical inference that can help lay the conceptual groundwork for formal inferential reasoning (Rubin et al., 2006). The appearance, in particular, of dynamic statistics learning environ-
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David Farrell and David C. Moffat (2014). *International Journal of Game-Based Learning* (pp. 23-34).
[www.igi-global.com/article/adapting-cognitive-walkthrough-to-support-game-based-learning-design/117697?camid=4v1a](www.igi-global.com/article/adapting-cognitive-walkthrough-to-support-game-based-learning-design/117697?camid=4v1a)

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