

Teaching for Statistical Literacy and Services of Statistics Agencies

Iddo GAL

Increasing attention is given to the importance of developing statistical literacy of citizens and students. This article examines approaches to teaching for statistical literacy and identifies areas that need attention, in light of limitations on skill transfer and reliance on exemplars that illustrate problematic reports in the media. The article discusses the potential role of products of statistics agencies in education for statistical literacy. Implications for needed collaboration between educators and statistics agencies and for research are examined.

KEY WORDS: Adult education; Critical reading; Numeracy; Official statistics; Statistics education.

1. INTRODUCTION

Recent years have seen efforts to define and differentiate constructs related to the ability of people from all walks of life to act as informed consumers of statistical information. Educators, researchers, and professional organizations have attended to interrelated concepts such as statistical literacy (Wallman 1993), quantitative literacy (Landwehr, Swift, and Watkins 1987; Kirsch, Jungeblut, Jenkins, and Kolstad 1993; Steen 2001), mathematical literacy (OECD 2001), or numeracy (Gal et al. 1999). In addition, preliminary efforts examined the interdependencies between these constructs and reflected on the extent to which there is a developmental hierarchy; that is, whether some capacities have to be acquired before other capacities can emerge (Gal 2000; Garfield 2002; Watson 1997).

The commonalities and distinctions between the above and related concepts, or their exact nature and developmental stages, may continue to be a matter for dialogue and research (deMas 2002). Nonetheless, diverse sources seem clear about the need for people (including learners in both formal, nonformal, and workplace contexts) to develop the ability to comprehend, interpret, and critically evaluate messages with statistical elements or arguments conveyed by the media and other sources (European Commission 1996; NCTM 2000; Steen 2001). This ability will be termed here "statistical literacy," following an early use of this term by Wallman (1993).

What are the building blocks of statistical literacy, on which educators should focus their efforts? According to Gal (2002), understanding, interpreting, and reacting to real-world messages that contain statistical elements or findings require more than

the possession of statistical knowledge per se. Such actions are founded on an interaction between several knowledge bases and supporting dispositions. Literacy skills must be activated, *together* with statistical knowledge, mathematical knowledge, and general world knowledge.

Critical evaluation of statistical messages also depends on people's knowledge of what questions to ask and on dispositions, such as their willingness to take a critical stance, their sense of comfort in engaging in what they perceive as mathematical tasks or using their quantitative knowledge, or their beliefs about the trustworthiness of statistical findings or the predictability of chance processes.

While the knowledge bases and beliefs and attitudes that underlie statistically literate behavior have been outlined in some detail, it is much less clear *how* to go about developing them. For example, Batanero (2002) discussed the need to develop micro-level models, and Rumsey (2002a) noted the lack of coherence between educational goals and the reality in textbooks and classes. This article aims to contribute to the efforts to promote statistical literacy by critically examining current approaches to teaching statistical literacy and identifying areas that need further attention by educators and researchers. In light of the problems identified, the article discusses the hitherto unexplored role of products of statistics agencies as a tool or resource that can support statistical literacy education. The article concludes with a discussion of the implications and needed collaboration between educators and statistics agencies.

2. ON METHODS FOR DEVELOPING STATISTICAL LITERACY

An analysis of recent literature on statistics education and adult numeracy points to two approaches towards developing learners' ability to act in a statistically literate way, through transfer of general statistical knowledge, or direct practice on critical questions and exemplar messages. This section discusses these approaches and problems with implementing them.

2.1 Direct and Indirect Methods

Curricular statements describing undergraduate statistics courses (Garfield, Hogg, Schau, and Whittinghill 2002) expect students to become sensitive to the value of statistical thinking and methods outside the classroom and turn into intelligent consumers of data. Similar ideas appear in K-12 mathematics or statistics curricular frameworks (Scheaffer, Watkins, and Landwehr 1998)

Although statistical literacy is touted as a key educational goal, reform efforts in statistics education usually emphasize teaching methods that can advance learning of "core" topics in introductory courses (Hogg 1992; Moore 1997), and do not

Iddo Gal is Lecturer, Department of Human Services, University of Haifa, Haifa 31905, Israel (E-mail: iddo@research.haifa.ac.il). This article is adapted from an invited paper for the Sixth International Conference on Teaching Statistics, held in July 2002, and appears here in revised form with permission from the International Association for Statistical Education.

elaborate on the importance of using real-world materials (e.g., from the media), or on issues involved in developing the dispositions subsumed under statistical literacy (Gal, Ginsburg, and Schau 1997). For instance, in a survey of more than 240 instructors of introductory statistics (Garfield 2000) less than 25% said they “frequently used” discussions of statistics in the media, and roughly half indicated they *never* ask students to critique news articles in classroom assessments. It seems that many instructors neither teach for statistical literacy nor assess it. It is as if instructors expect that learning key statistical principles and methods, coupled with personal experience in conducting and communicating about a data-analysis project, suffice to produce in their students the skills and dispositions needed to act in a statistically literate way outside the classroom.

A different approach stems from the expectation that people can respond critically to statistical messages (Rutherford and Ahlgren 1991) and know how to pose questions about the source of the research, the persons questioned, or the magnitude of effects reported (Utts 1996). To that effect, statistical literacy education may involve (a) direct exposure of learners to principles and “worry questions” (Gal 2002) that should be applied when evaluating real-world statistical communications, coupled with (b) the use of selected examples for “misleading” graphs, “flawed” statistical reports, or “problematic” probabilistic claims in various media channels (e.g., Crossen 1994; Best 2001; Moreno 2002; Snell 2002).

2.2 Problems With Current Methods for Developing Statistical Literacy Skills

Three potential problems emerge regarding the two approaches outlined above. The first involves *limited skill transfer* if learners do not get a chance to understand or practice key *sub*-skills, as suggested by extensive research on cognitive aspects of learning (Lovett and Greenhouse 2000) and on transfer of *literacy* skills (Wagner and Stites 1999). The second problem stems from *over-reliance on exemplars for “bad” reporting*, for example what information is *missing* from given reports or *misleading* in given displays. Students in introductory courses should also develop a sense for what good, fair, or effective reporting looks like, if they are expected to act as *informed consumers of research* (Love and Hildebrand 2002), or develop effective communication skills regarding quantitative matters (Steen 2001). The third problem is created by *inattention to statistical reports or messages from sources other than the media*. Although the media is a key communicator of statistical information (Rumsey 2002a), the information landscape to which citizens and workers in modern societies are exposed is broader. Statistical information is generated and reported through channels other than the media, such as statistics agencies or research organizations.

These three problems together imply that current methods for developing students’ statistical literacy may be less effective than hoped for or assumed by the statistics and mathematics education communities. With this in mind, this article argues that *statistics agencies* offer teachers ready access to large pools of *positive exemplars for “good” statistical reporting*, and that such products can be used to reduce the three problems noted above and support efforts to improve students’ statistical literacy.

3. STATISTICS AGENCIES AS A PUBLIC LEARNING RESOURCE

Statistical information is released to the public by many types of organizations, both public (e.g., national statistical offices, OECD), nonprofit (e.g., nongovernmental organizations such as Greenpeace, advocacy groups), and commercial (e.g., manufacturers, survey organizations such as Gallup). This article focuses on the first type, statistics-producing organizations funded by public sources. These organizations produce an array of different types of products on a very broad range of topics. Web sites of statistics agencies carry hundreds and, in some cases, thousands of individual reports, press releases, executive summaries, and other product types (Gal 2003) which educators, students, and citizens at large can use.

3.1 Statistics Agencies and Their Clients

According to Murray and Gal (2002), statistics agencies serve a range of clients with different information needs. Statistics agencies were established primarily to inform policy-makers, public officials, and politicians. They need to access pertinent information quickly, and due to their information load and skills often have to rely on highly abstracted information, such as executive summaries or highlights of key findings. More detailed reports enable the staff that supports this group to analyze trends in important indicators and variables, prepare position papers, or propose action plans. Statistics agencies also release statements to the press, which transmits the output of statistics agencies to the public and alerts it to particular findings or importance conclusions reached by the agencies. Finally, other users of statistics agencies include administrators and advocacy groups, the general public, researchers, and students.

Agencies can be divided into three subtypes (Gal 2003), which may affect the breadth of topics covered by their products, and hence the richness or type of statistical issues their publications deal with:

National/central agencies. Organizations responsible for conducting a nation’s census and associated surveys and reporting their results (e.g., U.S. Bureau of the Census), or for producing all national social and economic statistics (e.g., Statistics Canada).

National thematic agencies. Organizations assigned to report official statistics in designated areas not covered by the agency conducting the census (e.g., National Center for Education Statistics, National Agricultural Statistics Service).

International agencies. Organizations or projects established by groups of nations to contribute to social, human, and economic progress, and in this capacity report and sometimes collect comparative statistics (e.g., World Bank, International Adult Literacy Survey).

3.2 Products of Statistics Agencies

In response to the information needs of different client groups, statistics agencies create multiple types of products and services, mainly: indicators, press releases, executive summaries, full reports, aggregate data, technical documentation, and data files (Murray and Gal 2002; Gal 2003). Of these, press releases and executive summaries seem of most relevance to the development

of statistical literacy. *Press releases* are short summaries written in a journalistic style to inform media personnel about new findings and conclusions from recent studies or analyses conducted by the agency. Therefore, press releases can illustrate to students how statistics get reported to the media, and can serve as a positive mirror image of “biased” or “flawed” media articles. *Executive summaries* are designed primarily for policy makers and officials, and describe key findings and conclusions using an abstracted language that is more complex and formal than the colloquial language used in press releases, and may also include selected graphs and tables that summarize complex trends in a concise form. Executive summaries are relevant for statistical literacy education as they represent a key type of nontechnical yet formal statistical report that students may encounter in managerial or professional roles. As Gal (2003) illustrates, press releases and executive summaries, despite their brevity, require that readers understand, even if informally, a wide range of statistical ideas, concepts, and procedures.

4. DISCUSSION

Numerous calls have been made for improving the statistical literacy of citizens at large and students in high schools and colleges in particular (Wallman 1993). However, little has been written about the relative capability of specific instructional approaches in this regard. This article made two observations. First, it is difficult to expect students to develop statistical literacy through instruction on general principles of statistics and personal experience in data analysis, due to limitations on skill transfer, lack of familiarity with critical questions, and inattention to dispositions that support statistically literate behavior. Second, it is difficult to expect students to develop full statistical literacy through instruction that presents only negative examples for statistical reports, that is based only on brief media reports, and that does not provide models for effective or fair statistical reporting.

Given the limitations of each of the methods outlined earlier, and the inattention to *assessment* of statistical literacy skills (Garfield 2000), educators and statisticians should re-examine their educational expectations regarding the efficacy of current efforts to develop statistical literacy skills of students at the college or high-school levels. It also seems prudent to consider Moore’s (2001) recent call for “diminished expectations,” a proposal that instructors in introductory statistics courses cannot teach all the topics they hope to cover, given the need to teach at a pace and depth that enable students to construct their own understanding.

If Moore’s call is accepted, it follows that serious attention to statistical literacy issues (in terms of both skills and dispositions) cannot be accomplished within an introductory course focused on core statistical topics, unless educators find ways to (a) address both core issues and statistical literacy issues at the same time, and (b) also assess students’ actual gains in statistical literacy skills. Otherwise, statistical literacy will remain a lofty goal that is hardly realized in regular introductory courses. Where this is the case, separate courses focused on statistical literacy will have to be planned.

4.1 Towards a Solution

With the above in mind, this article advocates for instruction that exposes students to a *balanced* dose of exemplars for *both* problematic and effective (or negative and positive) real-world statistical reports and graphical and tabular displays. One readily available resource that can support this approach is information products of official statistics agencies. Educators have paid little attention to such products, although they are the basis for many media messages that are of interest to the general public, officials, and interest groups (Rumsey 2002a).

The analysis of the characteristics of press releases and executive summaries suggests that their use offers four benefits to educators who want to promote students’ statistical literacy.

1. *Prepare students to interpret and evaluate examples for “good” statistical reporting.* Sources discussing the skills and critical questions that students should possess (e.g., Utts 1996) argue that users should be able to find out and reflect on many aspects of published reports, such as: the subjects and methods used, the relevance of the findings presented to the study’s purpose, the trustworthiness of the inferences drawn from the analyses, the limitations imposed by the data-gathering process on the quality of the data and on the possible conclusions, or the social, economic, or other importance of the findings and conclusions.

Students’ ability to critically reflect on these and other relevant issues can be effectively practiced on executive summaries or press releases, as they normally contain concise but detailed information about *all* aspects of a study, using statistics that cover many elements of the basic statistics curriculum (Gal 2003). Media articles or graphs, in contrast, for reasons such as space limitations, editorial considerations, or the statistical sophistication of the reporter, present only selective statistical information, often skip key details, and may include incorrect statistical statements.

2. *Increase student sensitivity to the dilemmas involved in reporting results.* Students have to become sensitive to the value-laden and sometimes political choices made by those who are involved in reporting results from statistical studies. Such choices include, for instance, what data patterns to show, what implications to emphasize, what language to use when describing differences or trends found, or what results to downplay or ignore (Murray and Gal 2002).

Since statistics agencies often carry multiple products regarding the same study (e.g., a press release, an executive summary, a full report), it is possible to ask students to compare press releases, executive summaries, and actual media articles about the same study, and comment on the choices and emphases chosen in each one. Alternatively, they could be asked to write an alternate press release that will provide a different “angle” on the results and their implications. An interesting illustration of this approach was provided by Gelman et al. (1998). Frankenstein (1990) described an example where learners in a community college basic math class are asked to evaluate how gender or minority groups are negatively portrayed in a statistical yearbook or in official data tables.

3. *Increase opportunities for statistical communication.* Calls for reform in statistics education emphasize the need to

develop students' communication skills, but this often revolves around students' own projects or other class-based activities (Stromberg and Ramanathan 1996). When external materials are brought in, they often are comprised of media articles whose limitations were mentioned earlier, or academic research papers which are likely to be difficult for many students due to terse language and unfamiliar contexts.

Executive summaries and press releases enables teachers to confront students with texts that (a) use *different levels of formality or complexity*, (b) illustrate *proper statistical language*, not journalistic writing styles affected by various needs of the media, such as pressures for sensational reporting, and (c) present statistical findings and their limitations and implications in a *socially meaningful context*. These features may help to stimulate students' interest and develop effective statistical communication skills.

4. *Help to reduce logistical and time pressures on teachers.* Most students who learn statistics, especially at the college or tertiary level, take only a single statistics course (Garfield et al. 2002). Instructors face a challenge if they want to cover in the same class both core statistical topics and issues related to statistical literacy, which involve interdependent but partially different agendas. Press releases and especially executive summaries can serve both purposes. They contain examples for a diverse range of statistics analyses, and discuss research methods as well as limitations of studies, so cover a range of topics included in the standard statistics curriculum.

Teachers can use these materials as a basis for classroom discussions or for assignments requesting students to critique reported studies or suggest alternate designs. Discussing details of studies and analyses may improve students' understanding of issues that affect the design and execution of data-gathering processes, and support instructional goals associated with developing statistical enquiry skills (Wild and Pfannkuch 1999).

4.2 Limitations

Products from statistics agencies can support many but not necessarily all instructional needs when teaching for statistical literacy. Many statistics agencies are involved with surveys and descriptive studies much more than with experiments. Publications regarding experimental studies and the unique issues they involve are more likely to exist on sites of thematic or international agencies or other organizations interested in such research, for examples those dealing with health or agriculture. Products of interest are of course available from other research or survey organization such as in the nonprofit and commercial sectors, and could be put to good use with the understanding that some of them are created to serve specific organizational agendas that may affect the findings and points of views selected for presentation.

5. CONCLUSIONS

The quest to develop the statistical literacy of all citizens can take different routes, depending on the target population and the players interested in it. This article has focused on issues in promoting the statistical literacy of students in high schools and academic institutions who are taking introductory level statis-

tics courses. However, thousands of press releases and executive summaries exist from which educators can choose. There is a need to identify those particularly suited for use in classes that aim to promote statistics literacy, and develop guidelines and suggestions for linking these materials to specific course elements or topics.

The needed selection of materials and preparation of guidelines and suggestions cannot be placed solely on the shoulders of individual teachers, who may be struggling to improve teaching of core areas in statistics or may be burdened with logistical constraints. The involvement of organizational stakeholders is needed. Such a process was undertaken by the CHANCE project (Snell 2002) with regard to media articles, though the harvesting and adaptation of materials is an ongoing effort requiring continued investment of resources. The development of a similar resource regarding products of statistics agencies can follow the same approach, that is, be based in academia, or involve other stakeholders such as statistics agencies.

Collaboration with statistics agencies. Statistics agencies plan products and services in response to the needs of different user groups and until a few years ago focused on traditional clients, primarily officials/politicians and the media. However, statistics agencies have increasingly expanded the range of services for other client groups, such as journalists (Podehl 2002), institutional clients (Helenius 2002), or students. Agencies in several countries (e.g., Conti and Lombardo 2002) have developed census-related activities, where students collect student-related data that are uploaded and analyzed by statistics agencies and results are presented back to students to support mathematics curricula. Several federal statistics agencies, for example the National Agricultural Statistics Service or the Environmental Protection Agency, as well as English-speaking agencies outside the USA such as Statistics Canada, offer Web-based lesson plans and project ideas for K-12 teachers and students.

Statistics agencies should thus be seen as important players in statistics education and in promoting statistics literacy (Murray and Gal 2002). As a group, they can serve a key role by functioning as a clearinghouse for lesson plans and teaching guidelines. Statistics agencies are also in the best position to provide educators with sets of press releases matched with the actual media articles that used these releases, since most agencies retain detailed files with media quotes and excerpts from publications based on their releases.

Agencies can compile a searchable collection of press releases and executive summaries, organized by *statistical concepts/methods* (e.g., frequencies, percents, averages, variation, sampling, research design, etc.), *topic* (e.g., education, health, industry, agriculture), and *level* of complexity. The development of such a collection should involve a long-term collaboration between statistics agencies and teachers, the latter providing field-tested materials and teaching ideas. The involvement of numerous agencies would allow them to pool their efforts and resources. Such a collection can benefit statistics agencies, as well. This is because the collections of educational resources would provide "user-support" for their information products, and it would allow agencies and teachers to make the consumers or clients of statistics agencies—the learners—better able to use those products.

Research and assessment. As the statistics education community searches for ways to improve students' statistical literacy, it is important to note that no studies have examined the relative effectiveness of different teaching methods in this area. Only recently has a consensus begun to form regarding the sequencing of key components when teaching introductory statistics courses (Chance and Rossman 2001). Preliminary ideas regarding models of teaching for statistics literacy are still forming (Rumsey 2002b).

Furthermore, there are no established models for classroom assessment regarding statistical literacy skills. This is not surprising given the plethora of possible stimuli that teachers could use and the dependency of students' reactions on their cognitive knowledge bases and skills but also on their beliefs, attitudes, and action tendencies (Gal 2002). Hence, future educational developments should be coordinated with and accompanied by proper assessment tools and research models suited to the unique nature of statistically literate behavior.

[Received January 2003. Revised February 2003.]

REFERENCES

- Batanero, C. (2002), "The Role of Models in Understanding and Improving Statistical Literacy," *International Statistical Review*, 70, 37–40.
- Best, J. (2001), *Damned Lies and Statistics: Untangling Numbers From the Media, Politicians, and Activists*, Berkeley, CA: University of California Press.
- Chance, B. L., and Rossman, A. J. (2001), "Sequencing Topics in Introductory Statistics: A Debate on What to Teach When," *The American Statistician*, 55, 140–144.
- Conti, C., and Lombardo, E. (2002), "The Italian Census at School," in *Proceedings of the 6th International Congress On Teaching Statistics*, ed. B. Phillips, July 7–12, 2002, Cape Town, South Africa, Voorburg, the Netherlands: International Statistical Institute.
- Crossen, C. (1994), *Tainted Truth: The Manipulation of Fact in America*, New York: Simon & Schuster.
- delMas, R. C. (2002), "Statistical Literacy, Reasoning, and Learning: A Commentary," *Journal of Statistics Education*, 10(3); online at www.amstat.org/publications/jse/v10n3/delmas.html.
- European Commission (1996), White paper on Education and Training: Teaching and Learning—Towards the Learning Society, Luxembourg: Office for Official Publications of the European Commission.
- Frankenstein, M. (1990), "Incorporating Race, Gender, and Class Issues into a Critical Mathematical Literacy Curriculum," *Journal of Negro Education*, 59, 336–347.
- Gal, I. (2000), "The Numeracy Challenge," in *Adult Numeracy Development: Theory, Research, Practice*, ed. I. Gal, Cresskill, NJ: Hampton Press, pp. 1–25.
- (2002), "Adult Statistical Literacy: Meanings, Components, Responsibilities," *International Statistical Review*, 70, 1–25.
- (2003), "Expanding Conceptions of Statistical Literacy: An Analysis of Products From Statistics Agencies," *Statistics Education Research Journal*, 2(1); online at <http://fehps.une.edu.au/serj>.
- Gal, I., Ginsburg, L., and Schau, C. (1997), "Monitoring Attitudes and Beliefs in Statistics Education," in *The Assessment Challenge in Statistics Education*, eds. I. Gal and J. B. Garfield, Amsterdam: IOS Press, pp. 37–54.
- Gal, I., van Groenestijn, M., Manly, M., Schmitt, M. J., and Tout, D. (1999), "Numeracy Assessment Framework for the Adult Literacy and Lifeskills Survey," Washington, DC: National Center for Education Statistics; online at <http://nces.ed.gov/surveys/all>.
- Garfield, J. (2000), "An Evaluation of the Impact of Statistics Reform," final report for National Science Foundation project REC-9732404; online at <http://education.umn.edu/edpsych/faculty/garfield.html>.
- (2002), "The Challenge of Developing Statistical Reasoning," *Journal of Statistics Education*, 10(3); online at www.amstat.org/publications/jse/v10n3/garfield.html.
- Garfield, J., Hogg, R., Schau, C., and Whittinghill, D. (2002), "First Courses in Statistical Science: The Status of Educational Reform Efforts," *Journal of Statistics Education*, 10(2); online at www.amstat.org/publications/jse/v10n2/garfield.html.
- Gelman, A., Nolan, D., Men, A., Warmerdam, S., and Bautista, M. (1998), "Student Projects on Statistical Literacy and the Media," *The American Statistician*, 52, 160–166.
- Helenius, R. (2002), "Development of Customer Oriented Learning Environment at Statistics Finland," in *Proceedings of the 6th International Congress On Teaching Statistics*, ed. B. Phillips, July 7–12, 2002, Cape Town, South Africa, Voorburg, the Netherlands: International Statistical Institute.
- Hogg, R. (1992), "Report of Workshop on Statistics Education," in *Heeding the Call for Change* (MAA Notes No. 22), ed. L. Steen, Washington: Mathematical Association of America, pp. 34–43.
- Kirsch, I. S., Jungeblut, A., Jenkins, L., and Kolstad, A. (1993), *Adult Literacy in America: A First Look at the Results of the National Adult Literacy Survey*, Washington, DC: National Center for Education Statistics.
- Landwehr, J. M., Swift, J., and Watkins, A. E. (1987), *Exploring Surveys and Information from Samples*, (Quantitative Literacy series), Palo Alto, CA: Dale Seymour publications.
- Love, T. E., Hildebrand, D. K. (2002), "Statistics Education and the Making Statistics More Effective in Schools of Business Conferences," *The American Statistician*, 56, 107–112.
- Lovett, M. C., and Greenhouse, J. B. (2000), "Applying Cognitive Theory to Statistics Instruction," *The American Statistician*, 54, 196–206.
- Moore, D. S. (1997), "New Pedagogy and New Content: The Case of Statistics," *International Statistical Review*, 65, 123–137.
- (2001), "Undergraduate Programs and the Future of Academic Statistics," *The American Statistician*, 55, 1–6.
- Moreno, J. L. (2002), "Toward a Statistically Literate Citizenry: What Statistics Everyone Should Know," in *Proceedings of the 6th International Congress On Teaching Statistics*, ed. B. Phillips, July 7–12, 2002, Cape Town, South Africa, Voorburg, the Netherlands: International Statistical Institute.
- Murray, S., and Gal, I. (2002), "Preparing for Diversity in Statistics Literacy: Institutional and Educational Implications," in *Proceedings of the 6th International Congress On Teaching Statistics*, ed. B. Phillips, July 7–12, 2002, Cape Town, South Africa, Voorburg, the Netherlands: International Statistical Institute.
- NCTM (2000), *Principles and Standards for School Mathematics*, Reston, VA: Author.
- OECD (2001), *Knowledge and Skills for Life: First Results from PISA 2000*, Paris: Author.
- Podehl, W. M. (2002), "Statistical Literacy and the Media," in *Proceedings of the 6th International Congress on Teaching Statistics*, ed. B. Phillips, July 7–12, 2002, Cape Town, South Africa, Voorburg, the Netherlands: International Statistical Institute.
- Rumsey, D. J. (2002a), "Statistical Literacy: Implications for Teaching, Research, and Practice," *International Statistical Review*, 70, 32–36.
- (2002b), "Statistical Literacy as a Goal for Introductory Statistics Courses," *Journal of Statistics Education*, 10(3); online at www.amstat.org/publications/jse/v10n3/rumsey.html.
- Rutherford, F. J., and Ahlgren, A. (1991), *Science for all Americans*, New York: Oxford University Press.
- Scheaffer, R. L., Watkins, A. E., and Landwehr, J. M. (1998), "What Every High-School Graduate Should Know About Statistics," in *Reflections on Statistics: Learning, Teaching and Assessment in Grades K–12*, ed. S. P. Lajoie Mahwah, NJ: Lawrence Erlbaum, pp. 3–31.
- Snell, L. (2002), "But How Do You Teach It?" *International Statistical Review*, 70, 45–46.
- Steen, L. A. (2001), *Mathematics and Democracy: The Case for Quantitative Literacy, USA*, Washington, DC: National Council on Education and the Disciplines.
- Stromberg, A. J., and Ramanathan, S. (1996), "Easy Implementation of Writing in Introductory Statistics Courses," *The American Statistician*, 50, 159–163.
- Utts, J. M. (1996), *Seeing Through Statistics*, Belmont, CA: Wadsworth.
- Wagner, D. A., and Stites, R. (1999), "Literacy Skill Retention," in *Literacy: An International Handbook*, eds. D. A. Wagner, R. L. Venezky, and B. Street, Boulder, CO: Westview Press, pp. 199–202.
- Wallman, K. K. (1993), "Enhancing Statistical Literacy: Enriching Our Society," *Journal of the American Statistical Association*, 88, 1–8.
- Watson, J. (1997), "Assessing Statistical Literacy Through the Use of Media Surveys," in *The Assessment Challenge in Statistics Education*, eds. I. Gal and J. Garfield, Amsterdam, Netherlands: IOS Press/International Statistical Institute, pp. 107–121.
- Wild, C. J., and Pfannkuch, M. (1999), "Statistical Thinking in Empirical Enquiry," *International Statistical Review*, 67, 223–256.