

Educational Products of Official Statistics Agencies: A Landscape View

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1. Background: The Internet and Statistics Education

The Internet is increasingly used to provide access to educational resources in the mathematical sciences, and attention to its use in support of statistics education is rapidly increasing as well. This paper focuses on a unique topic related to this development - the characteristics of educational products of official statistics agencies.

Possibilities for using web resources in statistics instruction at all educational levels are broad and broadening. Garfield, Hogg, Schau, & Whittinghill (2002) reported survey results showing that many college teachers use the Web to enable students access to data sets, diverse types of applets, and discussion groups. Students can become familiar with the collection of official statistics as part of the CensusAtSchool project promoted in a number of countries, and can access many types of official statistical data for use in classroom projects. Several internet-based programs were developed to illustrate statistical principles and processes such as sampling. These and other important resources, such as specialized guides and project ideas for teachers and students, are discussed in various sources (e.g., Mulekar, 2000; Phillips, 2003).

The rapid maturation of internet-based resources for statistics education is also manifested in scholarly writing and research. Review articles are appearing (e.g., Mills, 2002, on simulation programs) suggesting that a sufficient number of materials has already accumulated to enable an overview in certain subareas. Attention is also being given to the need to develop evaluative criteria (Belli, 2003) and assessment tools (Garfield, delMas & Chance, 2003). Utts, Sommer, Acredolo, Maher & Matthews (2003) recently examined the impact of a hybrid course using both class-based and internet-based modes of instruction, which was developed in light of the need to rethink and adapt learning processes to diverse students and to increasing enrollment numbers.

Internet-based resources for statistics education are being developed by diverse actors, primarily initiatives of educators in schools or colleges, or of research groups based in academic institutions and in nonprofit R&D organizations. Some resources have been created by professional associations or by governmental bodies interested in education. This paper focuses on educational products created by *official statistics agencies*, often also called *national statistics organizations*. Below we first present a rationale for why educational researchers and practitioners should be interested in educational products and services of official statistics agencies. Next, we report preliminary results from an exploratory study of such products in several such agencies in the USA. Finally, we discuss conclusions and implications.

2. Statistics Agencies and their educational products

Official statistics agencies are responsible for conducting a variety of data-gathering, analyses, and dissemination activities on a national or international basis. Some examples are U.S. Bureau of the Census, Statistics Canada, Australian Institute of Health and Welfare, or UNESCO Institute of Statistics. Such agencies may be responsible for conducting and reporting a nation's census or for producing official statistics in designated thematic areas of social and economic importance, through ongoing and specialized surveys.

Statistics agencies were established primarily to provide information to policy-makers, public officials, and politicians. However, they increasingly attend to other user groups, such as businesses and employers, administrators, researchers, students, and citizens at large (Murray & Gal, 2002). In order to serve the information needs of such diverse users, agencies produce many services and products, primarily statistical indicators (e.g., the Consumer Price Index), executive summaries, full reports, press releases, aggregate tables, and data files. Yet, over the last two decades, numerous statistics agencies have also invested in *dedicated* products for educational purposes that are mainly accessible through the Internet. These are the subject of the present paper as their nature and scope have hardly been explored.

Educational products from statistics agencies are of importance to the statistics and mathematics education communities for five reasons: (1) they are created and disseminated by *official* bodies using *public* funding, yet these agencies operate outside formal educational systems and hence bring new, independent resources into the educational arena; (2) Statistics agencies offer long-range continuity as they are stable organizations, unlike research groups and individual developers who may divert their energies to other areas as time goes by; (3) Statistics agencies offer users access to products based on up-to-date data collected through explicit and credible methodologies; (4) the data available to statistics agencies cover a very wide range of topics that reach far beyond what students themselves can collect through classroom based efforts; (5) The data and associated reports address topics of social relevance, hence can engage students with meaningful statistics on current issues, and this has motivational benefits.

General products of statistics agencies, although not designed with educational uses in mind, can be used by educators and students as well. Some applications have been described, such as by Gelman, Nolan, Men, Warmerdam, and Bautista (1998) who explored the use of press releases, and Gal (2003a, 2003b) regarding press releases and executive summaries. Yet, such general products can be used for statistics education, only *if* a teacher (a) can locate those relevant to his or her needs from among the many hundreds that exist on each agency's website, *and* (b) has a clear conception for *how* to incorporate such general materials (most of which are created for trained users who are familiar with some statistics and with the subject matter) into classroom activities, taking into account local needs and students' characteristics. However, locating and adapting such general materials to local circumstances are complex processes (Gal, 2003b). The present study therefore focused on dedicated educational products, i.e., those designed *specifically* for teachers or students learning statistics.

Dedicated educational products may take diverse forms. For example, they could include lesson plans describing general issues in learning statistics and explaining how they can be taught by using data related to the special thematic areas of the agency. They could suggest ways for using any of the agency's general products for statistics education, such as how to use available tables as part of students' projects; they could include specialized datasets with accompanying documentation created expressly for educators, and more. While these examples do not cover all possible types of dedicated educational products, they suggest that many variants are possible.

3. Method

Given that little is known about educational activities of official statistics agencies, we conducted an exploratory study using a multiple-case-study approach to examine the nature of dedicated educational products offered by statistics agencies. Such an approach is an accepted way to aid the formulation of research directions and questions in an uncharted area.

Sites. In the United States, there are ten federally-funded Principal Statistics Agencies (1. Census Bureau, 2. National Agricultural Statistical Service, 3. National Center for Health Statistics, 4. Economic Research Service, 5. Energy Information Administration, 6. Bureau of Economic analysis, 7. Bureau of Transportation Statistics, 8. Bureau of Justice Statistics, 9. Bureau of Labor Statistics, 10. National Center for Education Statistics). Each agency is autonomous and collects, compiles, and reports data and findings within its designated area. Yet all agencies, together with several other statistical units and organizations, are members of the Interagency Council on Statistical Policy, and all can be accessed via the FedStats portal (www.fedstats.gov/agencies). The present study focuses on these agencies because they operate within a single national and cultural context and relate to the same general educational marketplace, hence their educational products can be more easily compared.

Procedure and instrument. Internet sites of all ten agencies were accessed in March 2004 and analyzed from the point of view of a teacher who is looking for materials that can support statistics learning by students from elementary school to college levels. A semi-structured protocol was developed with a focus on two areas: content and accessibility. *Content* relates to the nature and topics of the specific products designed for learning statistics. We examined the presence and features of three types of products, *lesson plans*, *project suggestions*, and *data sets*, and whether these are designed for students, teachers, or both. *Accessibility* relates to features of a website that affect the degree of ease with which users can find relevant products. We examined three aspects: *Positioning and Navigation* (apparent complexity of locating educational products or of using the site), *Terminology* (the clarity and meaning of the language used to name parts of the website, or to label products), and *Search options* (facilities for finding products or information on specific statistics topics).

4. Results

A first analysis of the websites of the ten agencies was conducted in Fall 2003 and showed that five of them carried dedicated educational products focused on learning statistics. However a re-analysis of the same sites in March 2004 showed that only three (U.S. Census Bureau, National Agricultural Statistical Service, National Center for Health Statistics) still carried such products and these are discussed below. The remaining seven agencies did not post on their websites such educational resources, although some did carry other products geared for educators or students but unrelated to statistics learning, such as quizzes or lesson plans on topics related to the thematic areas with which the agency or its parent department (ministry) are involved. It appeared that the changes and redesign of websites from the first point of analysis to the second were intended, as explained on some sites, to increase usability and respond to user suggestions.

Overall, the websites of the three agencies chosen for further analysis differ substantially in the range and number of materials dedicated to statistics education, as well as in how they are accessed. Table 1 presents observations regarding one aspect of Accessibility, the location of resources aimed at teachers, as well as observations regarding the content and format of Lesson Plans. These aspects do not cover of course all topics subsumed under content and accessibility,

yet help to sketch the nature of dedicated educational products created by statistics agencies and can point to areas of interest for future research and development.

Table 1: Descriptions of selected aspects of Accessibility and Content for three websites.

Agency	Location and organization of teacher materials	Lesson plans
U.S. Census Bureau	Available via homepage, under "For teachers". About 5-6 lesson plans and activity suggestions for teachers in each of three grade groupings: K-4, 5-8, 9-12, as well as for English as Second Language and Adult learners, and for teachers in certain US territories such as American Samoa and Puerto Rico.	Lesson plans focused on "Census at School" theme. Designed to help students understand how the census operates and its uses and contributions. Some lesson plans touch on sampling and data collection topics, using maps for planning sampling, and more. Lesson plans have uniform format.
National Agricultural Statistical Service	Available under "NASS Kids" on agency homepage. <i>Note:</i> the NASS Kids section also provides brief explanations geared for young students about the activities of statisticians and about some graphs and charts.	Most lessons plans deal with agriculture and span grade levels K-12 - no obvious connection to statistics. Links point to few outside resources: two lessons related directly to statistics (on Chi-square, descriptive statistics), not created by NASS itself and not focused on agriculture-related issues or using NASS-specific data. Another link points to an online statistics book, HyperStat.
National Center for Health Statistics	No link visible directly on homepage. However, under "Publications and Information products" one can find "Training materials" which describe a course, based on a video tape and workbook, designed for college students learning about health statistics, and for field personnel in health departments or community agencies. <i>The course itself is not online.</i> A separate path, via Site Index, leads to the label "Education", which links to a self-study online course on Finding and Using Health Statistics offered by the National Library of Medicine.	No lesson plans are offered on the NCHS site, only links to an elaborate online course (see left). <i>Note:</i> The National Center for Health Statistics is part of the CDC (Centers for Disease Control). CDC also operates a separate site called EXCITE which carries a collection of teaching materials designed to introduce students to public health and epidemiology, including some aspects of bio-statistics. However, EXCITE is not mentioned at all on the NCHS site.

In addition to the above aspects of the three websites, many other issues related to accessibility and content could be observed. Some examples follow:

- Search engines are usually generic for the whole agency and not specific to the educational section (if such existed), hence it is difficult to identify educational products via search engines.
- The technical terminology and information used to describe various types of educational products is somewhat fuzzy. For example, sites do not make an explicit distinction between "activities", "projects", or "lesson plans", nor do they distinguish between materials aimed at teachers and at students.
- Virtually none of the websites offer any datasets (e.g., as a spreadsheet in Excel format) that teachers or students can download and analyze as part of learning statistics.
- No suggestions could be found as to where on the website teachers or students can find general datasets, tables, graphs (i.e., which are part of the general products of the agency) that can be used to support learning of statistics.

5. Discussion and conclusions

Overall, statistics agencies can play a unique role in helping to improve the statistical literacy and statistical knowledge of a range of users, including not only K-12 and college students, but also adult learners who are outside the reach of formal educational systems. This unique role stems in part from agencies' ability to support learners in examining and interpreting statistical data in meaningful contexts related to their diverse thematic areas. Internet-based educational products of statistics agencies carry additional promise for educators looking to use technology in statistics education, as well as for educators who lack access to print-based resources.

Our preliminary findings suggest that at this point the potential of statistics agencies to enhance learning of statistics is only partially fulfilled. While some of the agencies give saliency to educational materials by placing them on their homepage, content and ease of use vary. Materials are sometimes organized according to criteria (e.g., grade, level), but not introduced and annotated in ways that can help teachers or students those materials most suitable to their needs (e.g., in terms of the type of statistical concepts, graphical representation, or methods used). Hence, finding specific classroom activities necessitates some trial and error. In addition, educational materials offered by statistics agencies seem to make surprisingly little use of the general products found on the same site such as press releases, executive summaries, or tables, graphs, and datasets, even though these could be used for educational applications (Gal, 2002).

As an exploratory research that used a semi-impressionistic approach, our observations and conclusions are obviously limited and should be taken as tentative. Nonetheless, several implications for future activities of official statistics agencies and researchers emerge, such as:

- Improvements in the design of existing interfaces are needed, to facilitate access and use of available products dedicated to statistics education. In light of the situation faced in the present study and explained in the opening of the Results section, it is hoped that design changes will be infrequent, in order to stabilize the environment which users encounter.
- Collaborations between different statistics agencies can enable them to pool resources and allow expansion of the educational offerings by linking and cross-listing dedicated products available on websites of different statistics agencies.
- Research efforts will be needed to examine the extent to which dedicated educational products satisfy the needs of different user groups, and also to study the impact of such products on desired outcomes, such as on students' statistical knowledge, statistical literacy, or dispositions towards official statistics.

While the websites surveyed appear to have room for improvement in regard to their dedicated educational products, it must be remembered that the primary focus of official statistics agencies is *not* on education. Thus, materials that can promote statistics education are not expected to receive much attention or investment from such agencies. Their current scarcity, organization, or content cannot be viewed as a problem, but rather as representative of a stage in an evolutionary process that statistics agencies are undergoing. We believe that educational researchers and teachers interested in statistics education can take part in informing future changes in this regard.

The basic infrastructure for creating a rich and productive network of products that can support statistics education is already in place in several agencies and can be adopted by other agencies. Existing collections of lesson plans and activity suggestions can be expanded, and linked to annotated datasets and general products from statistics agencies. Such changes can increase the return on investments by official statistics agencies in dedicated educational products focused on statistics learning, and make such products useful and accessible to diverse types of educators and students interested in developing their statistical knowledge and statistical literacy.

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