Introductory Statistics Education and the National Science Foundation

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Abstract

This paper describes 27 National Science Foundation supported grant projects that have innovations designed to improve teaching and learning in introductory statistics courses. The characteristics of these projects are compared with the six recommendations given in the Guidelines for Assessment and Instruction in Statistics Education (GAISE) College Report 2005 for teaching an introductory course in statistics. Through this analysis, we are able to see how NSF-supported introductory statistics education projects during the last decade achieve the GAISE ideals. Thus, materials developed from many of these projects provide resources for first steps in implementing GAISE recommendations.

1. Introduction

For many years, statistics educators have been concerned with reforming undergraduate education, especially the introductory course in statistics. Throughout this article, introductory statistics refers to Joan Garfield's definition: the "non-calculus based, often terminal, introductory applied statistics course" for students not majoring in the subject (Garfield 2000, p.2). The latest efforts to address this first course have evolved for some time and have resulted in the Guidelines for Assessment and Instruction in Statistics Education (GAISE) College Report 2005 which sets the introductory course in statistics. Like other groups, the GAISE College Report 2005 has addressed undergraduate statistics education by funding many projects aligned with statistics education standards; George Cobb (1993) reviewed 12 such projects, lending inspiration to this report. Following Cobb's lead, this article reviews the GAISE recommendations and supporting literature, describes the NSF programs used to support this reform, and examines 27 NSF projects, funded from 1993 to 2004, which address the introductory statistics course. By comparing these projects with the GAISE recommendations, we are able to see how NSF has supported GAISE principles over the past decade.

2. Guidelines for the Introductory Statistics Course

2.1 Evolution of GAISE

As statistics has made its way into the undergraduate curriculum over the past century, the introductory course has undergone numerous changes. Always at the forefront of reform is the effort to improve teaching and student learning in this course (GAISE 2005). In the early 1990’s, George Cobb organized a focus group to set up guidelines for teaching this course. This group produced a paper called "Teaching Statistics" that set forth three recommendations: 1) emphasize statistical thinking; 2) more data and concepts, less theory and fewer recipes; and 3) foster active learning (Cobb 1992). Toward the end of the decade, the launching of the Undergraduate Statistics Education Initiative (USEI) drew more attention to the introductory course through a paper calling for increased attention to statistical thinking. That article also reported that teachers of statistics were already increasing their use of technology and active learning in the classroom (Garfield, Hooge, Schau, Whitminshull 2002). These publications are just two examples of the work done in statistics education reform that has helped lead to the production of the Guidelines for Assessment and Instruction in Statistics Education (GAISE) College Report 2005.

2.2 GAISE Recommendations

The GAISE College Report (2005) was developed by a group of statisticians/statistics educators with funding from the American Statistical Association (ASA). On May 17, 2005, the ASA approved this document which provides six primary recommendations for teaching introductory statistics: emphasize statistical literacy and develop statistical thinking, use real data, stress conceptual understanding rather than mere knowledge of procedures, foster active learning in the classroom, use technology for developing conceptual understanding and analyzing data, and use assessments to improve and evaluate student learning.

2.2.1 Emphasize Statistical Literacy and Develop Statistical Thinking

The common thread throughout introductory statistics education reform efforts is the emphasis on statistical thinking and literacy (Cobb 1992, Snee 1993, Garfield et al 2002, MAA 2004). Instructors of introductory level courses want their students to understand statistical terms, symbols, graphs, and fundamental ideas, which the GAISE authors consider to be statistical literacy. Along with literacy, students in these courses should be able to think statistically, meaning they should understand the need for data, the importance of data production, the omnipresence of variability, and the quantification and explanation of variability (GAISE 2005). Rumsey (2002) adds to this definition the ability to make informed decisions, while Chance (2002) wants her students to see the big picture and think of statistics in terms of the whole process, rather than isolated techniques. Furthermore, since statistics are present everywhere in the media it is important for citizens to be able think critically about the information thrust upon them (Rumsey 2002; Sullivan 1993).

2.2.2 Use Real Data

Because statistics is about understanding data (Hakeem 2001), students should have access to and experience with real data. The use of real data in introductory statistics courses provides authenticity, helps address issues of data production and collection, gives real-life context to a problem, and can increase student interest in the course (GAISE 2005). There are three kinds of data which can be used to meet these goals, each with advantages and disadvantages. Class generated data can provide meaningful connections for students because they participated in its production; unfortunately, it can also be toy-like and shallow. Archival data gives students experience with real-world statistics and can be complex and rich in nature; however, students’ excitement may be compromised since they were excluded from the production process, and variability can be hidden. Simulated data emphasizes variability well and allows the instructor more control, but it is not real (Cobb 1993). Regardless of the type, real data used in context can motivate and engage students in the statistical process without being burdensome thanks to technological advances (GAISE 2005)

2.2.3 Stress Conceptual Understanding Rather Than Mere Knowledge of Procedures

Like Cobb (1992), the GAISE authors believe that topical coverage can be sacrificed for conceptual understanding and suggest paring down the course syllabus. "If students
don’t understand the important concepts, there’s little value in knowing a set of procedures,” (GAISE 2005, p. 10). Experts in other disciplines, such as biology professors Udovic, Morris,Dickman, Postlethwait, and Wetherwax (2002), agree that deep understanding of fewer concepts is better than shallow understanding of many. This has been a principle part of the undergraduate statistics education reform movement, as more instructors are focusing on concepts in their courses (Garfield 2009). The Mathematical Association of America (2004) also endorsed this recommendation for statistics courses in their Committee on the Undergraduate Program in Mathematics 2004 Curriculum Guidelines.

2.2.4 Foster Active Learning in the Classroom

There are many advantages to incorporating active learning in the introductory statistics course. It allows students to discover concepts, engage in the statistical process, communicate in statistical language, and work in teams, as well as provides instructors informal methods of assessment (GAISE 2005). Active learning ideas can be traced back to Socrates and are found in the work of Dewey, Piaget, and Lewin (Zeichner & Lutcher 1988). In a study of student learning styles in English, chemistry, mathematics, and psychology courses, August, Hurtado, Wimsatt, and Dev (2002) found that 91% of students felt they learned better from in-class activities and 85% found lecture-only classes boring. McConnell, Steiger, and Owens (2003) found that active learning techniques in geology courses increase student participation and that students who have engaged in active learning perform better on exams and logic thinking tests than those in traditional settings. To foster active learning, activities should focus on conceptual understanding and discovery learning and can be group work, laboratory activities, or class discussions (GAISE 2005).

2.2.5 Use Technology for Developing Conceptual Understanding and Analyzing Data

Technology, a resource which has been transforming statistical research for many years, has also been a major component of statistics education reform (Moore, Cobb, Garfield, & Meek 1995, Garfield 2000). This remarkable tool can be used in the introductory statistics course to analyze data, simulate concepts, or provide alternative assessments, while motivating and exciting students (GAISE 2005, Schenone-Stevens 1999). However, there are some cautions teachers should heed when exploiting technology’s benefits. When used for its own sake, technology has no redeeming educational value (Schenone-Stevens 1999); rather than replace human interaction, technology should enrich teaching styles and techniques (Moore, Cobb, Garfield, Meek 1995). When used correctly, technology can greatly enhance student learning (GAISE 2002).

2.2.6 Use Assessments to Improve and Evaluate Student Learning

It is understood that students are concerned with how they are assessed; therefore, assessment techniques should place value on learning objectives and understanding key ideas (GAISE 2005). High quality assessments should be aligned with national standards, should measure what matters for improvement, and should be learning experiences themselves (Cobb 1993; Caudell 1996; Chance and Garfield 2002). Such instruments drive curriculum, reflect student learning, and have real-life context (Caudell 1996). Examples include formative evaluations, written reports, portfolios, experiments, essays, speeches, projects, and activities (Caudell 1996, McConnell, et al 2003; GAISE 2002).

2.2.7 Interconnection of the GAISE Recommendations

These recommendations made by the GAISE authors do not stand alone. Each can be met by materials or techniques intended to address another. For instance, a teacher may implement technology in order to convey a particular concept, an activity may involve student collection of data, or a group project may be used for assessment. Furthermore, all of these can move students toward being statistically literate or employing statistical thinking. In any case, statistics educators need not approach these guidelines as six separate techniques to master and implement, but as one complete way to help students become good statistical citizens in an information age.

2.3 GAISE in Other Disciplines

These approaches to teaching are not limited to introductory statistics or any statistics course. The ideas of scientific reasoning, active learning, conceptual understanding, use of technology, and appropriate assessments are present in biology, geology, business, engineering psychology, and other disciplines that depend on statistics (Bolker-Dolinsk, Qualters 1994; Craddock 1998; Bass, Rosenzwig 1999; Dakeem 2001; McConnell, et al 2003; McCormick, Mackinnon, Jones 1999; Udovic, et al 2002). Some National Science Foundation (NSF) projects described in this paper meet GAISE recommendations by addressing introductory level statistics through courses in these disciplines.

3. NSF Division of Undergraduate Education Programs

The NSF has supported undergraduate education since its inception in 1950. In order to take a more central role in reform efforts, NSF established the Division of Undergraduate Education (DUE) (NSF 1996). The following programs are or were supported by DUE and have had an impact on introductory statistics courses.

The Instrumentation and Laboratory Improvement (ILI) program of NSF DUE began in 1988 in order to encourage and support improvement in laboratory curricula for science, technology, engineering, and mathematics (STEM) education institutionally and nationwide. Projects funded through this program helped create and equip laboratory facilities, upgrade equipment for laboratory instruction, develop laboratory exercises that demonstrate basic principles, and stimulate interest in STEM courses by making them relevant and understandable. The program accepted its final proposals in fiscal year 1998 and transitioned into the Course, Curriculum, and Laboratory Improvement (CCLI) program (NSF 1998).

The main objectives of the Course and Curriculum Development (CCD) program, which ran from 1988 until 1998, were to improve undergraduate STEM teaching, increase student understanding of and attitudes toward STEM, and to place greater value on teaching and scholarship through the development and adaptation of courses, curriculum, and educational materials (Eisenman, Fairweather, Rosenblum, Britton 1998). Grants funded through this program often produced textbooks, manuals, or course materials or created courses or sequences of courses. Like ILI, CCD was finally assimilated into CCLI (NSF 1998).

Established in 1998, the Course, Curriculum and Laboratory Improvement (CCLI) program combined properties of CCD and ILI, funding proposals for curricular development and purchase of instructional laboratory equipment. The initial four tracks of CCLI were intended to stimulate creative teaching and pedagogical scholarship among faculty (NSF 1998). The Educational Materials Development (EMD) track aimed to encourage and support the development of quality instructional materials that enhance student learning in STEM, while the Adaptation and Implementation (AI) track assisted in integrating exemplary materials, laboratory experiences, and educational practices at other diverse universities (NSF 2003a, NSF 2003b). By sponsoring faculty development opportunities, the National Dissemination (ND) track of CCLI promoted the introduction of exemplary materials, practices, and techniques to large numbers of colleges and universities nationwide (2003a). Finally, the Assessment of Student Achievement (ASA) track developed effective assessment tools associated with student learning in STEM and supported the adaptation, implementation, and dissemination of such tools (NSF 2003c). These four tracks were phased out in 2006 to make room for a cyclical model of knowledge production and improvement with five supporting components: teaching and learning research, learning materials development, faculty enhancement, innovative materials implementation, and assessment of learning innovations (NSF 2005a).

Another program that was integrated into CCLI was the Undergraduate Faculty Enhancement (UFE) program, which operated from 1988 to 1998. UFE sought to provide faculty with opportunities to experience new and exciting developments in undergraduate education such as new content, teaching methods, experimental techniques, and technology. Funded projects conducted workshops, short courses, seminars, and other such activities to promote these developments. The program supported more than 500 projects and over 750 workshops during its lifetime (Marder, McCullough, Perkins 2001). Another program for educators was the Collaboratives for Excellence in Teacher Preparation (CETP) program founded in 1993. The goal was to increase the number and quality of future pre-Kindergarten through 12th grade teachers, emphasizing subject area competence, effective pedagogical techniques, and national standards for math and science. This program was redesigned, and from 2003 to 2005 was the Teacher Professional Continuum (TPC) program (NSF 1999; Prival 2008b). Currently, components of this program are interwoven with the Discovery Research K-12 (DR-K12). (Prival 2008a)
The National Science, Technology, Engineering, and Mathematics Digital Library (NSDL) program supports the collection and organization of educational materials into a national online digital library through projects that develop and enhance collections as well as implement digital library services. Projects can support existing resource providers, maintain material currency and selection criteria, select existing materials for inclusion, or fund workshops promoting the library (NSF 2005).

4. NSF Projects Meeting GAISE Recommendations

4.1 Overview

As noted above, any given educational technique, practice, or set of materials need not be isolated to one specific GAISE recommendation. Often, by setting out to meet one recommendation, educators end up meeting several at a time. By searching NSF's Award Search Webpage (www.nsf.gov), we were able to find 110 projects affecting introductory statistics funded between 1993 and 2004. Of these, 95% met at least one GAISE recommendation, while 65% met more than one. The NSF funded projects that follow are described in terms of one GAISE recommendation, but that does not mean they meet only that recommendation. Projects were selected to exemplify the qualities of a particular recommendation, even if they meet more than one, as many do. Furthermore, we do not claim that this list is exhaustive of NSF projects that meet GAISE guidelines. If you participated in an NSF project that fits the nature and scope of this article and is not discussed or listed in the Appendix, we extend our apologies for the omission.

4.2 Projects that Emphasize Statistical Literacy and Thinking

Projects that address the first guideline are targeted at helping students become statistically literate, critical thinkers, and informed statistical citizens. The Electronic Encyclopedia of Statistical Examples and Exercises (ESEE; http://www.whfreeman.com/cesee/cesee.html) and the Data and Story Library (DASL: http://lib.stat.cmu.edu/DASL/) are online resources of full real datasets, case studies, and other materials for use in statistics classes. In order to enhance these two resources, project investigators Paul Velleman, William Notz, Elizabeth Stuny, and Dennis Pearl led "Interactive Video Resources for Learning Statistics" (#9555073, #9555233). This project added video resources of current events found on the news and other television programs to help students think critically about statistical applications in real world events (Notz, Pearl, Stuny 1996).

Another project focused on current events that utilizes the ESEE and DASL is "Change: Current Studies of Current Chance Issues, Phase II," (#9354592) by Laurie Snell. Chance is a quantitative literacy course designed to turn students into informed critical readers by basing the course on statistical concepts found in current events. Students read articles from Chance Magazine and other journals, critiquing the statistical methods used. Topics covered include probability concepts, descriptive statistics, design of experiments, sampling, correlation, and exploratory data analysis. Online and printed materials are available to help instructors teach such a course (Snell 1994; http://www.dartmouth.edu/~chance/).

Additionally, a workshop called "Chance Workshop" (#9653416) was conducted to teach educators how to use current events to teach probability and statistics concepts (Snell 1997). Other workshops have been conducted to help teachers with little or no statistical training learn better ways to teach statistical literacy. Two examples are George Cobb and Mary Parnes’s "Statistical Thinking and Teaching Statistics" (#9255847) and its successor "STATS: Statistical Thinking with Active Teaching Strategies," (#9554621) led by Allan Rossman and Thomas Short. These projects supported numerous weekend workshops emphasizing statistical thinking through real data, conceptual understanding, active learning, software, and assessments, thus touching all components of GAISE (Cobb and Parker 1998; Rossman and Short 1999).

Students in other disciplines also benefit from statistical literacy and thinking skills. To help biology students appreciate statistics and improve their quantitative reasoning skills, "IBASE: Integrating Biology and Statistics Education," (#9309751) byJames Watrous, Deborah Lurie, and Denise Ratterman, created two courses, biology and statistics, to be taken simultaneously. In the biology course, students collected data from experiments completed in the lab and then analyzed the data in the course statistics. Thus the students were able to learn real-world applications in a relevant situation, reducing anxiety toward statistics and providing better understanding (Watrous, Lurie, Ratterman 2003).

4.3 Projects that Use Real Data

Real data is often easiest to collect in other disciplines that use statistics on a regular basis. For example, the American Sociological Association, partnering with the University of Michigan, sponsored "Collaborative Project on Integrating Census Data Analysis into the Curriculum" (#0088715, #0089006) led by William Frey, Carla Howery and Felice Levine. This National Dissemination project attempted to revise the sociology curriculum at numerous schools by emphasizing the use of real data from the US Census Bureau. The project investigators called for proposals from other universities to take part in this project in order to have widespread impact (Frey 2001, American Sociological Association 2002). The natural sciences are another area with easy access to real data. "Service Learning in Chemistry: Lead in Soil From Vehicle Emissions" (#0410151) by Hal Van Ryswyk incorporated data analysis into introductory chemistry classes. Students sampled and tested soil for lead, analyzed their own data, and prepared written and oral presentations. The students in these courses also collaborated with students in probability and statistics courses as well as local elementary schools (Van Ryswyk 2004). For those educators without such easy access to real data, there are other ways to find it. For example, James Albert designed an introductory statistics course based entirely on baseball statistics through "Development of Sports Statistics Modules for Introductory Statistics Classes" (#0088703). Data came from baseball cards, the Internet, and simulation. Students were able to understand concepts and analyze real data in an interesting context (Albert 2002).

Analyzing data can be difficult without computer access and appropriate software. Robert Gould and Mahtash Esfandiari’s goal for "A Statistics Undergraduate Computing Laboratory" (#9981172), funded in 2000, was to establish a computer laboratory for statistics courses, where students could analyze real data, teaching the value of statistical thinking and deeper intuitive understanding of the entire data analysis process. The project investigators believe real datasets can help students confront important basic problems in statistics without the datasets being huge and messy (Gould, Esfandiari 2003).

4.4 Projects that Stress Conceptual Understanding over Knowledge of Procedures

In order to place a deliberate emphasis on conceptual understanding versus theoretical background, educators often employ real data, active learning, and technology. The "Rice Virtual Laboratory in Statistics" (#9751307) by David Lane, Joe Austin, David Scott, Keith Bagggerly, and Miguel Quinones is a web-based resource for students and teachers of statistics. The site (http://onlinestatbook.com/rvl.html) houses the HyperStat Online textbook, case studies, simulations, and some basic analysis tools. The intended progression is for users to explore a statistical concept demonstrated in a case study, which will link them to explanatory material from the online textbook, leading them through a serious of questions, then conduct simulations to see if they were correct, and then answer the questions again (Lane, Scott, Guerra, Hebl, Osherson 2004). Beth Klingner and Nira Herrmann make use of Lane’s online course in their project, "Enhancing the Mathematical Foundation of Students through Online Course Modules" (#0311016). They adapted the materials into computer modules to teach quantitative and statistical skills in relevant contexts (Klingner, Herrmann 2003). For those with little or no computer access, "Laboratory Lessons for Discovery-Based Statistics" (#9650581) by Richard Scheaffer produced hands-on, student-directed lessons that teach fundamental concepts like randomness, sampling distributions, confidence, and significance, which can include, but do not require, computer use (Scheaffer 1996).

4.5 Projects that Foster Active Learning

Many projects that involve active learning do so through computer laboratory modules, activities, or course-long projects. These activities are designed to help students practice the scientific process while gaining deeper conceptual understanding. Both "Fostering Conceptual Understanding Using a ‘Hands-On’ Approach in Undergraduate Statistics" (#9452320) by Danuta Bukatko and Patricia Krameter and "A Statistical Laboratory for Active Learning" (#9550891) by Richard Scheaffer created interactive, hands-on computer module activities that help students learn statistical concepts using graphing and analysis (Bukatko, Krameter 1994; Scheaffer 1995). "An Activity-Based..."
4.6 Projects that Effectively Use Technology

It would be very tempting to say that any project that implements some type of technology meets the technology recommendation; however, technology for the sake of technology is not what this guideline recommends. Utilizing technology means providing access to hardware or software that enhances the learning of statistics, especially computational or simulation software. For instance, Roxy Peck and James Duly’s “Studio Environment for Introductory Statistics” (#9750663) established a laboratory classroom so that students could complete lab activities, projects and simulations to help them learn statistics (Peck, Duly 1997).

Simulation software is useful technology for teaching statistics. Sampling SIM, software developed by Joan Garfield, Robert delMas, and Beth Chance through “Tools for Teaching and Assessing Statistical Inference” (#9752523), helps students with conceptual understanding by allowing them to make and test predictions. The simulation software provides instructional materials and is available freely over the web at http://www.tc.umn.edu/~delmas01/stat_tools/ (Garfield, delMas 2000).

A larger software program focused on data analysis was developed through “A Data Analysis Exercise Server for Introductory Statistics Courses” (#9980973) by Todd Ogden and Webster West and “DeStat.com: A Web Site for Educational Data Analysis and Assessment” (#0226097) by Webster West and James Lynch. “StatCrunch,” initially called “WebStat,” is low-cost online computational software found at http://www.statcrunch.com. This Excel compatible software allows students to upload their own data and perform descriptive statistics, hypothesis testing, confidence intervals, regression, ANOVA, categorical or quantitative graphing, and more (West, Wu, Heydt 2004). A project utilizing StatCrunch is “Visualizing Statistics – A Online Introductory Course” (#9950671) by Alexander Kugashev and CyberGnostics, Inc. This online course offers explanatory text, applets, real data, testing, and “StatCrunch” analytical software (CyberGnostics 2005).

4.7 Projects on Assessment

Determining if you are meeting your instructional goals for your students is difficult without proper assessment instruments. Two projects have been funded which provide access to statistical assessments. The “Web-based ARTIST Project” (#206571) by Joan Garfield, Beth Chance, and Robert delMas consists of an assessment builder of over 1,000 items varying by format, level, and statistical topic as well as project ideas, article critiques, group work options, and scoring guidelines. References of works published on assessment topics are also available on the site, https://app.gen.umn.edu/artist/ (Garfield, Chance 2004). “Statistical Concepts Inventory (SCI): A Cognitive Achievement Tool in Engineering Statistics” (#206977) by Ten Rhoads, Teri Murphy, and Robert Terry is a multiple choice exam intended to measure the ability of engineering students to apply statistical concepts to real-world situations. This assessment tool includes questions related to statistical topics important in engineering such as designing and conducting experiments and analyzing and interpreting data. It is available at http://onlinestatbook.com/vrls.html (Rhoads, Murphy 2005).

4.8 Projects that Address All Recommendations

Many of the projects previously described meet more than one recommendation. However, few projects meet all GAISE recommendations. One such project that reaches across the discipline of statistics to touch students and teachers at all levels is "CAUSEweb: A Digital Library of Undergraduate Statistics Education" (#0333672) led by Dennis Pearl and supported by the Consortium for the Advancement of Undergraduate Statistics Education (CAUSE). This digital library, found at http://causeweb.org/, includes a resource section which provides descriptions and/or reviews for statistics education materials. Students and teachers can search for resources by material type, audience level, math level, application area, or statistical topic (Green, McDaniel, Rowell 2002).

5. Conclusion

The GAISE College Report recommendations are the result that evolved from many years of work by the statistics education community to determine the best standards for teaching and learning introductory statistics. With so many NSF-funded projects achieving the ideals described in GAISE, it is apparent that the NSF supports the implementation of these recommendations. NSF-supported resources described in this paper provide a good starting place for introductory statistics teachers to find ideas to help them implement one or more of the GAISE recommendations. The Appendix includes additional “information” on over 100 NSF-supported projects in introductory-level statistics education. Additional information about these projects can be found by using the NSF Awards Search webpage (http://www.nsf.gov/awardsearch/) and entering the award number in the “Search Award for” dialog box.

Appendix: NSF Projects

| Award Number | Title | PI | Start Date | NSF Program | Award Amount | Institution |
|---------------|-------|----|------------|-------------|--------------|-------------|
| 9950494       | Computer Enhanced Mathematics Instruction | Addison Frey | June 1, 1999 | A            | $25,429      | Alfred University |
| 9950161       | An Interactive Learning Environment in Statistics: Integrating Multimedia Laboratory Exercises and Courseware into the Statistics Curriculum | Deborah A. Nolan | July 1, 1999 | A              | $99,238      | U. California Berkeley |
| 9950509       | High-Tech.. Project-Based Beginning Algebra and Statistics Course for Two-Year Colleges | Sue E. Stodley | August 1, 1999 | A            | $32,847      | Spartanburg Tech. Coll. |
| 9950628       | Beyond Mapping and Reporting: Improving Students/ Skills in Science and Analysis for Geography, Environmental Studies, and Ecology | Robert Werner | August 1, 1999 | A              | $42,200      | Univ. of St. Thomas |
| 997494        | Integrated Statistics and Computer Application Courses | Melissa A. Holt | August 1, 1999 | A            | $87,577      | Texas Women's Univ. |
| 9950229       | Quantitative Reasoning and Informed Citizenship: Implementing an Activity-based Laboratory Course | Kay Somers | September 1, 1999 | A          | $79,412      | Moravian College |
| 9950586       | New Laboratory and Integrated Course Materials to Improve the Psychology Curriculum | Scott Ottaway | September 1, 1999 | A          | $86,276      | West. Washington U. |
| 9980995       | Using the LaCEPT Model to Reform an Elementary Statistics Course | Frank Neubranden | January 1, 2000 | A          | $74,063      | LSU, A&M Coll. |
| 9952560       | Development of Laboratory and Field Experience Based Course in Asphalt Technology for Civil Engineering Undergraduate Students | Rajiv Mallick | February 1, 2000 | A              | $31,479      | Worcester Poly. Inst. |
| 998172        | An Active Undergraduate Computing Laboratory | Robert L. Gould | March 1, 2000 | A            | $69,181      | UCL San Diego |
| 987680        | A Multifunctional Technology Classroom for the Teaching of Data-Intensive Statistics | Steven C. Patch | January 1, 2000 | A            | $49,450      | UNC, Asheville |
| 0080016       | Development of an Integrated In-Person Curriculum in Psychology | Richard Tinkerson | February 1, 2001 | A              | $201,134     | Florida Inst. Off Tech. |
| 008177        | Political Analysis in an Experiments/ Collaborative Setting | Allan McBride | March 15, 2001 | A            | $45,642      | Univ. Southern Miss. |
| 988122        | Adaptation and Implementation of Computer Technology into the Undergraduate Statistical Science Curriculum | T. Len Miller | July 1, 2001 | A            | $93,011      | MSU |
| 012685        | An Activity-Based Statistics Course for Engineers | Steven E. Butt | January 23, 2002 | A            | $52,139      | Western Michigan U. |
| 012694        | Integrating Mathematics and Statistics into the Biology Curriculum | Eric Murland | March 1, 2002 | A            | $159,583     | Appalachian S.U. |
| Project Title                                                                 | Researcher(s)                      | Start Date  | End Date  | Funding Agency | Funding Amount  |
|------------------------------------------------------------------------------|------------------------------------|-------------|------------|----------------|----------------|
| Promoting Undergraduate Research through the Development of Two Interdisciplinary Research Methods/Statistics Courses and Increased Support of Student Research | Kathy Silagis                       | July 1, 2002 | AI         | $197,975       | Will. Patterson Univ. |
| BIASE: Integrating Biology and Statistics Education                           | James W. Batz                      | July 1, 2003 | AI         | $89,188        | St. Joseph's Univ.  |
| Enhancing the Mathematical Foundation of Students through Online Course Modules | Beth Klinkner                      | August 15, 2003 | AI        | $164,985       | Pace University, NY |
| Implementing Activity-based Cooperative Learning and Technology (ACT) Curricula for Statistics Courses for Non-majors and K-12 Preservice Teachers | Carl M. Lee                        | September 1, 2003 | AI        | $177,052       | Central Michigan Univ. |
| Collaborative Research: Adapting and Evaluating Online Materials for Undergraduate Statistics using LON-CAPA Technology | Jennifer G. Boldry                 | September 1, 2003 | AI        | $47,125        | Montana State Univ. |
| Service-Learning in Chemistry: Lead in Soil from Vehicle Emissions           | Hal V. Ryswyk                      | September 1, 2004 | AI        | $41,227        | Harvey Mudd College |
| Integrating Data Analysis into the Curriculum: Responding to the Scientific Literacy Gap Among Undergraduate Students in the Social Sciences | Esther Wilder                      | September 1, 2004 | AI        | $175,000       | CUNY, Herbert Lehman |
| The Web-based ARTIST Project                                                  | Joan Garfield                      | August 15, 2002 | ASA        | $551,094       | UMN, Twin Cities   |
| The Statistical Concepts Inventory (SCI): A Cognitive Achievement Tool in Engineering Statistics | Teri R. Rhodes                     | September 1, 2002 | ASA        | $499,999       | University of Oklahoma |
| A Modular Laboratory and Project-Based Statistics Curriculum                  | Joseph D. Petruccelli               | January 1, 1993 | CCD        | $165,000       | Worcester Poly. Inst. |
| Realizing the Power of Computers in Business: A Training for Next Step        | Ronald Tracy                       | February 1, 1993 | CCD        | $60,029        | Oakland University |
| Developing Statistical Understanding through Interactive Computing/Graphics    | Leo Breiman                        | March 1, 1994  | CCD        | $166,637       | U. California Berkeley |
| Constructing Knowledge of Statistical Concepts through Modern Technology     | Dennis D. Wackerley               | May 1, 1994    | CCD        | $99,992        | University of Florida |
| Change: Current Studies of Current Chance Issues, Phase II                   | J. Laurie Snell                    | July 1, 1994   | CCD        | $209,914       | Dartmouth College   |
| A Probability/Activity Approach for Teaching Introductory Statistics          | Michael Bean                       | September 1, 1997 | CCD         | $180,001       | University of Michigan |
| Probability and Surprise: Animations and Simulations                         | Susan P. Holmes                   | January 1, 1998 | CCD        | $99,970        | Cornell University |
| Teaching for and Assessing Statistical Inference                             | Joan B. Garfield                  | February 1, 1998 | CCD        | $100,021       | UMN, Twin Cities   |
| Intersection of Population Biology and Mathematics                          | Jane Gallagher                    | June 1, 1998   | CCD        | $150,000       | CUNY               |
| Science Education for Tomorrow                                               | Elizabeth Boylan                  | September 1, 1998 | CCD        | $196,132       | Barnard College     |
| Probability and Surprise: Animations and Simulations                         | Susan P. Holmes                   | January 1, 1999 | CCD        | $62,048        | Stanford University |
| A Probability/Activity Approach for Teaching Introductory Statistics          | James Albert                      | January 1, 1999 | CCD        | $50,000        | Bowling Green Univ. |
| Revitalizing Introductory Statistics for Engineering by Capitalizing on Interdisciplinary Cooperation and State-of-the-Art Technology | Panucik N. Palett                 | August 1, 1995 | CCD        | $57,866        | Virginia Tech       |
| Revitalizing Introductory Statistics for Engineering by Capitalizing on Interdisciplinary Cooperation and State-of-the-Art Technology | Panucik N. Palett                 | January 1, 1996 | CCD        | $140,975       | Ohio State University |
| Interactive Video Resources for Learning Statistics                          | William I. Neto                   | March 1, 1996  | CCD        | $183,701       | Ohio State University |
| Synergistic Learning in Biology and Statistics (SLIBS)                        | Robert V. Bylstone                 | June 1, 1996   | CCD        | $246,336       | Trinity University   |
| Interactive Video Resources for Learning Statistics                          | Paul F. Vellamen                  | June 1, 1996   | CCD        | $51,598        | Cornell University  |
| An Audio-Tactile Curriculum to Support Visually Impaired Statistics          | Nancy Zornoff                     | January 1, 1997 | CCD        | $22,800        | Kennanw State U.     |
| Revitalizing the Study of Probability through Applications, Technology, and Collaborative Learning | Michael Bean                       | September 1, 1997 | CCD         | $180,001       | University of Michigan |
| Integrating Pedagogical and Curriculum Theory with Teaching Practice          | Edward Dubinsky                   | March 1, 1998  | CCD/CEP    | $100,000       | Georgia State Univ. |
| Visualizing Statistical Analysis - An On-Line Introductory Course            | Alexander Koenig                  | October 1, 1999 | EMD        | $260,484       | CyberGenetics Inc.   |
| Development of an Interactive Tutorial on Statistical Design and Analysis of Experiments | John O'Haver                      | February 1, 2000 | EMD        | $79,898        | University of Mass. |
| A Data Analysis Exercise Server for Introductory Statistics Courses         | R. Todd Ogden                      | May 1, 2000    | EMD        | $75,000        | USC, Columbia       |
| Development of Sports Statistics Modules for Introductory Statistics Classes | James H. Albert                   | January 1, 2001 | EMD        | $67,258        | Bowling Green Univ. |
| Online Statistics Education: An Interactive Multimedia Course of Study       | David M. Lane                     | February 1, 2001 | EMD       | $401,990       | Will. Marsh Rice Univ. |
| Case-Based Reasoning for Engineering Statistics                             | George C. Ringer                  | December 1, 2001 | EMD        | $74,622        | Arizona State Univ. |
| Teaching Psychological Research Methods with Online Examples                 | William Maki                      | April 15, 2002 | EMD        | $102,147       | Texas Tech University |
| Developing Data Analysis and Assessment                                       | Robert A. West                    | June 15, 2002  | EMD        | $130,002       | USC, Columbia       |
| Stem and Trend: Vertically Integrated Statistics Laboratories                | Andrew Poge                      | January 15, 2003 | EMD    | $74,836      | CUNY Staten Island  |
| Improving the Quality of and Access to Undergraduate Statistics Education    | Fred Speed                        | January 1, 2004 | EMD        | $74,826        | Texas A&M Univ.     |
| An Audio-Tactile Curriculum to Support Visually Impaired Statistics          | Karen Gourgey                    | February 15, 2004 | EMD    | $30,032      | CUNY, Baruch        |
| UFIE: Teaching Computer-Intensive Resampling Techniques                      | Aner. Stat. Assoc.                | February 15, 1996 | EMD/UF     | $60,000       | Aner. Stat. Assoc. |
| Behavioral Sciences Computer Laboratory                                       | James Raymondo                    | July 1, 1992   | ILI        | $25,280        | Union College       |
| Data Analysis Statistics Modules for Introductory Statistics Courses        | Loren Haskins                     | April 1, 1993  | ILI        | $32,355        | Carleton College    |
| Elementary Statistics Computer Laboratory                                    | Louis M. Friedler                 | April 1, 1993  | ILI        | $19,259        | Beaver College      |
| An Interdisciplinary Laboratory for Data Acquisition, Analysis, and Modeling | Dwight Kleiberg                   | April 1, 1993  | ILI        | $49,560        | Bethel College       |
| Discovering Statistics: A Laboratory Approach                                | Richard L. Scheaffer              | June 1, 1993   | ILI        | $25,000        | University of Florida |
| Computational Classroom Facility for Rayonet Courses                         | Charles F. arschl                | June 1, 1993   | ILI        | $40,000        | Cornell University   |
| Technology for: Improvements of Mathematical Concepts and Initiative to Professional Tools | Katia Foss                       | June 1, 1993   | ILI        | $35,000        | Pellissipoli STCC    |
| Instrumentation for Novel Laboratory Instruction in Undergraduate Statistics Curriculum | Walter R. Pirie                  | June 1, 1993   | ILI        | $52,646        | Virginia Tech        |
| A Computer Lab for Biological Statistics                                     | Daniel E. Wujek                  | July 1, 1993   | ILI        | $26,887        | Central Michigan Univ. |
| Novel Laboratory Instruction in Undergraduate Statistics Curriculum          | Panucik N. Palett                | August 1, 1993 | ILI        | $90,227        | Virginia Tech       |
| Multidisciplinary Statistics Curriculum and Computing Laboratory             | Chris Noble                      | June 1, 1994   | ILI        | $38,560        | Lawrence University |
| Interactive Computerized Statistics Classroom                               | Louise Hambone                    | June 1, 1994   | ILI        | $70,072        | CUNY, Brooklyn       |
| Developing a Computer Lab for the Technology Enhanced Teaching of Undergraduate Statistics | Judith Treat                    | August 1, 1994 | ILI        | $55,000        | U. California, Irvine |
| Joseph D.                                                                         | Joseph D.                                                                         |
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