Classroom Experience in Using the Net for Teaching

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Abstract

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The constructivism learning theory suggests that people learn better by actively participating in the process of learning. In order to involve students into the participatory learning process, the interaction among students, and between students and instructor in a classroom setting becomes very critical. The Internet technology can play an important role in increasing this interaction, in addition to distributing instructional material or well defined data sets. The idea behind is to create a learner-focused environment for students to participate in the process of learning. This participation is usually conducted at a local level. Through the interactive online hands-on activity system, students and instructors can actually conduct their activities locally and shared globally. A Web database is developed to gather the data collected from local classroom hands-on activities. Classes from different institutions can participate in the same hands-on activities and share the locally collected data through the web database. These will include activities using data from the Bureau of Statistics and various in-class hands-on activities. The database will continue to grow. The data collected will be useful for undergraduate students to conduct some longitudinal studies to compare students' responses on these activities along the years.

Introduction

Little motivation and low expectation are two very serious problems among students in college education. The situation is even more serious for mathematics and statistics subjects due to the level of difficulty and the fact that most students think that they need the subjects only to fulfill the competency or requirement. As a consequence, students typically come with the attitude *'I do not think this course has anything related to my career. All I want is to get a passing grade.'* The traditional lecture and note-taking teaching strategy worsens this attitude (Lee, 1999).

In recent years, statistics educators have developed a variety of innovative strategy for teaching statistics (e.g., Gnanadesikan, Scheaffer, Watkins, & Witmer (1997), Rossman & Chance (2001), Cobb, Witmer & Cryer (1997)). One may refer to Moore (1997) for a review of the literature and a discussion of a new pedagogy for teaching statistics and quantitative literacy. These new pedagogical approaches have made a great deal of improvement using real world data as the major motivation to help learning. However, there seems to be a lack of enthusiasm of adopting these new strategies. The change is very slow. The lecture and note taking approach continue to dominate. Students are still passively receiving the knowledge, rather than actively participating in the process of constructing their knowledge. The existence of these new strategies heavily depend on the instructors' own characteristics. The enthusiasm of adopting these new strategies is unclear. Partly because the expense of dissemination and the time and effort needed to make the change are far beyond their regular teaching load. Partly because these new teaching strategies are implemented at local class room setting, rather than at global setting.

The use of Internet for Statistics Education

Fuller (1999) gave three main areas where statisticians use the Internet: Intra- & Inter-professional communication, access to data and information, and statistical education & training. Due to the quantitative

nature of statistics, the use of information technology for communication and data access do not seem to be an issue in statistics profession. The transition from traditional computational technology to a much more diverse use of modern technology, however, is not as smooth in statistics education and training. The traditional use of computing technology for easing computation is well suited within the lecture-note taking pedagogy. While the modern diverse information technology opens a variety of different instructional pedagogy, which shifts the focus to active learning and to learner-centered teaching pedagogy. This is a fundamental change for teaching statistics, where the instructor is not only giving lectures, but also facilitate learning by designing environments in which students are supposed to engage in learning activities that help them to go through the process of constructing the knowledge.

The Difficulty of Using Online Official Statistics for Teaching Statistics

Technology has opened a wide variety of new ways for engaging students in their learning. There are a huge number of statistics education related web sites on the Net available for instructors. However, the efforts required digging out appropriate material seems to outweigh the potential benefit. Individual web sites tend to be developed for a local classroom purpose. In most cases, they do not meet another instructor's local classroom needs. When look for real world data, it is not easy to find a real-time data that are ready for class activities, although one can easily locate a large variety of data from government agencies such as Bureau of Census, Center for Disease Control. In fact the web site at http://www.fedstats.gov/ is a very thorough gateway that links to over 100 USA federal agencies with statistical programs. The gateway to the complete list of European Union statistics is at the EUROSTAT web site (http://www.europa.eu.int/comm/eurostat/).

Common difficulties when using any of these official statistics for teaching include (1) overwhelmed amount of data and (2) the data format has never been designed for educational use. As a consequence, it takes a great deal of time to find and to manipulate the data before they can be of useful for classroom activities.

Some Activities of Using Online Official Statistics for Introductory Statistics

Although it is not easy to use online official statistics directly for teaching, the abundant of these statistics is certainly a great resource. The following table describes 10 official statistics data sets extracted from USA Bureau of Census. Some are the 2000 USA census data and some are a collection of census historical data. These data sets include income, poverty level and population. They are organized for use in introductory statistics. Some activities of using the data along with these data can be found in the STAT_ACTION web site at http://www.cst.cmich.edu/users/lee1c/stataction/.

Table 1: Data Sets of Official Statistics Extracted from the USA Census of Bureau

Table H-11	Household Median and Mean Income and Household Size from 1967 to 1999 for (a) All household, (b) White Household, (c) Black Household, (d) Hispanic Origin household, (e) Asian American, (f) White, But non-Hispanic Origin
Table H-8	Median Household Income by State for years from 1874 to 1999.
Table POV-21	Number and Percent of Individuals Live under Poverty Level for each State from 1980 to 1999.
Table POP-4	1990 and 2000 Census of Resident Population with Ranks by State and Region
Table POV-13	Number and Percent of Families Below Poverty Level from 1959 to 1999
Table POV-17	Distribution of Poor by Region from 1959 to 1999
Table POV-4	Poverty Status of Families Below Poverty Level by Race from 1959 to 1999
Table MOT-9	Gasoline Average Retail Prices from 1973 to 2000
Table POV-9	Poverty Status-Individual Below Poverty Level for each US Region from 1959-1999
Table POP-1	USA Population from 1790 to 2000 for Each State

A variety of activities can be developed based on these data sets. For example, for the Household Income Data, on could ask questions such as

Based on your observation of the median and mean household income, what is the distribution shape of household income?

Is median a better summary or mean for describing income level?

Name a variable other than income that most likely has its distribution skewed-to-the-right, a variable that is skewed-to-the-left, and a variable is most likely symmetric.

Graph a box-plot of household median incomes for each ethnicity group. Based on the plot, can you make a comparison of the median incomes among the ethnicity group?

Data Sources and Interactive Online Demonstration and Simulation Tools

The Internet technology enables sharing of locally developed activities for global distribution. Other than the highly discussed distance learning on the net, there are certain advantages for teaching statistics using the net resources, especially the data sets, the hands-on activities, demonstration and simulation tools. The following table lists a few selected net resources that I find to be quite useful. For example, the Data Story at StatLib, the Chance Data Sources and News, the Data archive maintained at the Journal of Statistical Education are among very useful resources. The Java applets and other online demonstration and simulation tools are very useful tools for students to experience the process of constructing a certain concept. The GSAP maintained by University of South Carolina, the SIIP maintained by Arizona State University and the Java Applets library maintained by Virginia Ploytech. State University have a good collection of online demonstration and simulations that I find very helpful for students. However, the obstacle is the issue of motivation. These sites are usually provided in the syllabus. Students are asked to go online to conduct simulation themselves at their own time. It is common that students do not take the advantage of such a learning opportunity since there is no assessment based on these activities. These activities help students to understand the subtle concepts, and will eventually help them to do better in their learning. However, most students are only motivated to study or conduct activities that are directly related to tests or projects. Developing a direct assessment activities that will assess students' engagement of conducting these online learning simulation activities is a task that needs to be addressed.

A Selected List of Data Source on the Net for Teaching

The number of web sites increases exponentially everyday. A quick search using key phrase 'statistics education' through Google search engine resulted more than 12,9000 sites. The following is a short selected list of sites that provide either more links or more data sets that are designed for teaching introductory statistics. It is clear that this is just a few sites that I have come across and found useful data for my teaching. This list can be found at the STAT-ACTION site at http://www.cst.cmich.edu/users/lee1c/stataction/ .

Table 2: A list of Selected Internet Sites where One May Find Useful Data Sets for Teaching

URL that contains Data Sets or Activities	
http://www.starlibrary.net	http://lib.stat.cmu.edu/DASL/
http://lib.stat.cmu.edu/datasets/	http://www.mth.yorku.ca/SCS/StatResource/
http://www.dartmouth.edu/%7Echance/index.html	http://www.stat.ucla.edu/teach/
http://www.stat.ufl.edu/vlib/statistics.html	http://www.amstat.org/publications/jse/
http://www.helsinki.fi/~jpuranen/links.html	http://www.mathcs.lander.edu/statproject/
http://it.stlawu.edu/~rlock/tise98/onepage.html	http://www.stat.psu.edu/%7Eresources/index.htm
http://www.exploringdata.cqu.edu.au/	http://www.maths.uq.oz.au/~gks/webguide/
http://www.cst.cmich.edu/users/lee1c/stataction/	http://www.amstat.org/

Interactive Online Demonstration/Simulation	
http://www.public.iastate.edu/~stat/compguide/interactivetools.html	http://neyman.stat.uinc.edu:80/~stat100/cuwu/index.html
http://acad.cgu.edu/wise/	http://www.stat.sc.edu/rsrch/gasp/)
http://research.ed.asu.edu/siip/ .	http://www.statnet.net
http://www.ruf.rice.edu/~lane/hyperstat/index.html.	http://www.stat.vt.edu/~sundar/java/applets/
Online Resources for Official Statistics	
http://www.fedstats.gov/	http://www.europa.eu.int/comm/eurostat/
http://www.www.bea.doc.gov	http://www.ojp.usdoj.gov/bjs
http://www.census.gov	http://www.bls.gov
http://www.bts.gov	http://www.eia.doe.gov
http://www.ers.usda.gov/	http://www.epa.gov/
http://www.irs.ustreas.gov/prod/tax_stats/	http://www.ed.gov/NCES/
http://www.cdc.gov/nchs	http://www.ssa.gov/policy/
http://www.lib.umich.edu/libhome/documents.center/frames/statsfr.html	http://www.cdc.gov

Conclusion

Modern technology and Internet have begun to change the teaching philosophy and pedagogy for statistics education. The impact will become deeper and wider in the future. It is no longer a static use of data or distributing instructional material online. Advanced technology makes the contructivism learning (Garfield, 1995) practical and Learner-centered learning possible. However, as mentioned in this article, there are various difficulties faced when adopting and integrating the net resources for teaching statistics. These obstacles include (a) the overwhelmed amount of data available. How one can properly select the useful information will become more critical, (2) most of data sources are not designed for global resource sharing for educational purpose. This is especially difficult when using official statistics. There is a need of a site to reorganize these data into a useful and applicable resources for education, (3) dynamic real-time data collection tools have been used by industries and business companies, but it is yet to be developed for education. The cost of such a web database is an obstacle for educational institutions in the development of dynamic real-time global hands-on projects. As the web database technology is becoming mature with reasonable costs, such a development of taking local classroom activities to the global level will soon become reality.

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