Teaching Statistics with Electronic Textbooks

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Abstract. In the first part of this paper, we will provide a general overview on electronic "Introductory Statistics" textbooks and summarize their individual strengths and weaknesses. Examples of such electronic textbooks are the CD–ROM–based ActivStats, the Web–based CyberStats, and the CD–ROM– and Web–based MM*Stat,

In the second part of this paper, we will present our experiences from teaching an undergraduate "Introductory Statistics" course at Utah State University, using CyberStats. We compare this Web–based course with similar textbook–based courses and report student and instructor viewpoints.

Keywords. ActivStats, CyberStats, MM*Stat, Introductory Statistics

1 Introduction

Learning statistics requires students to develop a variety of skills including quantitative and graphical insights along with mathematical and analytical abilities (Härdle, Klinke & Marron 1999). In addition, it is sometimes difficult for students to relate statistical concepts presented in class to real world problems and everyday situations. Therefore, introductory statistics courses are commonly considered difficult and intrinsincly boring by students.

The idea to use computers for statistical teaching dates back to times before the Web became widely popular and before everyone had almost immediate access to a personal computer equipped with a CD–ROM drive. Snell & Peterson (1992), for example, state that "the computer can be used profitably in almost any elementary mathematics course, but it is especially helpful in teaching probability and statistics. [...] We have identified three broad areas in which the computer is helpful: reducing the need for lengthy manual calculations, facilitating graphical data analysis, and illustrating statistical concepts by means of simulation experiments." As it turns out, modern electronic textbooks, combined with an underlying statistical software package, show some of their strengths in exactly these fields. Interactivity, hands–on exercises, colorful applets, well–documented real–life examples, and the possibility to analyze even larger data sets quickly and effectively may be the most attractive features of statistical teaching software (or teachware).

An increasing level of computer literacy among students and the availability of necessary equipment in classrooms have stimulated developing and using statistical teaching software in introductory statistics courses. Using statistical teachware in introductory statistics courses has almost become a standard over the past years. Using software when teaching statistics varies from occassional interactive exercises and in–class software demonstrations to completely Web–based courses without any use of "traditional" teaching tools or even pen and paper, as in Kent L. Norman's courses (`http://cognitron.umd.edu/cognitron.html`).

Chromiak & Rossman (1992) describe how to use HyperCard, a tool that was freely available for Macintosh computers, to teach statistics. Their ideas

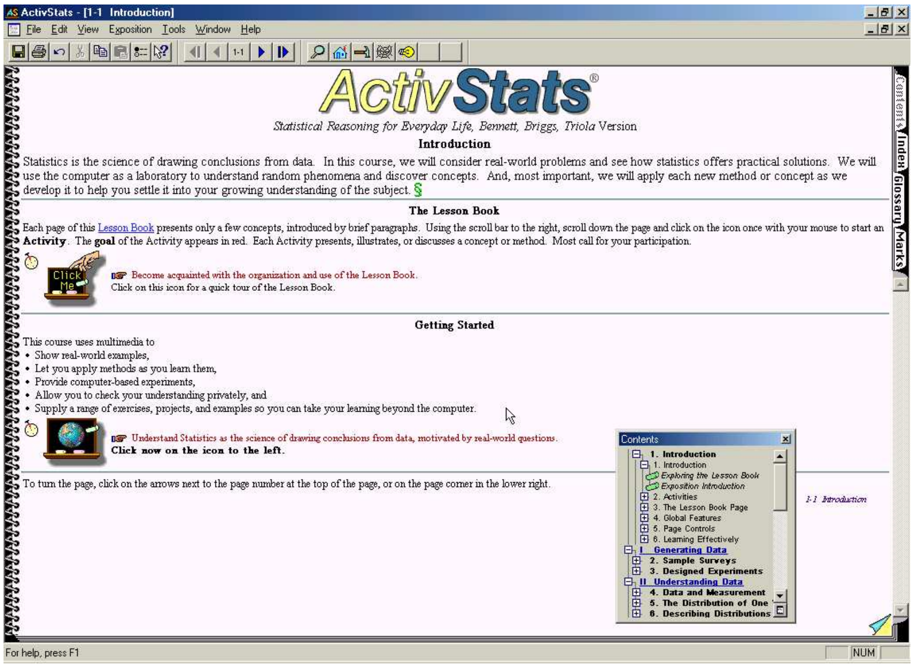

Fig. 1. Contents Page of ActivStats.

are to get the students involved, give students immediate feedback, present the same idea in many different ways, and focus on concepts rather than on calculations. Lock (1997) provides a general overview on Internet resources for teaching statistics. Currall (1997) and Rönz (1997) discuss general ideas of computer–aided teaching in statistics. Symanzik (1998) summarizes additional resources related to Web–based teaching.

The two main purposes of statistical teaching software can be identified as follows:

1. A teaching software should enable better and easier understanding of (rather abstract) underlying statistical concepts through interactive examples and exercises.
2. Using teaching software should provide a more interesting and active learning environment. Engaging into hands–on activites can help capturing attention and interest especially of weaker and less motivated students.

There are many statistical teachware packages and electronic textbooks available. Some of them are freely accessible via the Internet, such as the GASP educational procedures (West, Ogden & Rossini 1998, West & Ogden 1998*a*), accessible at `http://www.stat.sc.edu/rsrch/gasp/`, Hyperstat by David M. Lane (Lane 1999), accessible at `http://davidmlane.com/hyperstat/`, and the UCLA Statistics e–book by Jan de Leeuw (de Leeuw 1997), accessible at `http://www.stat.ucla.edu/textbook/`, to mention only a few. Others such as Seeing Statistics (`http://www.seeingstatistics.com/`) or CyberStats (`http://www.cyberk.com`) are commercial packages that al-

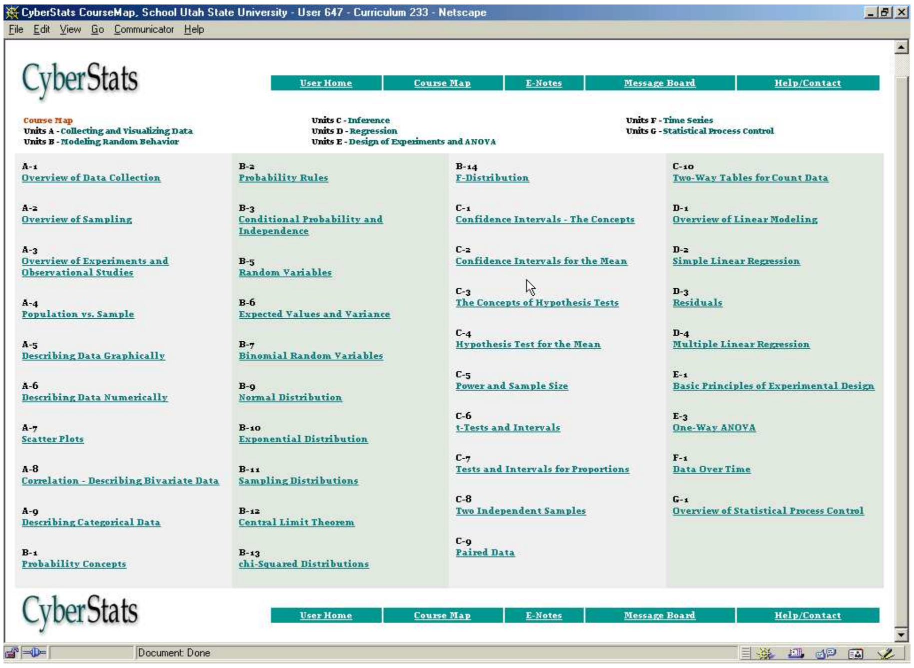

Fig. 2. Contents Page of CyberStats.

low Internet access upon registration. Some of the commercial teachware packages are distributed on a CD–ROM in addition to Internet access e.g., MM*Stat (`http://www.quantlet.com/mdstat/mmstat.html`), or on a CD–ROM only, e.g., ActivStats (`http://www.datadesk.com/ActivStats`).

In the first part of this paper, we have comparatively reviewed three popular commercial electronic textbooks: ActivStats, CyberStats, and MM*Stat. In the second part of the paper, we report about our own experiences in teaching an introductory statistics course to undergraduate students at Utah State University in the Fall 2001 semester using CyberStats.

2 Comparative Review: ActivStats, CyberStats, and MM*Stat

The three electronic textbooks ActivStats, CyberStats, and MM*Stat are commercial products that can be purchased by students and organizations. All three packages exist for several years and have been actively used at a variety of schools.

The oldest package is ActivStats by Paul Velleman, whose first version was released around 1996 by Adison Wesley, Inc. and Data Description, Inc. The current version of ActivStats (2001–2002 release) is available for purchase at a price of $51 and $225 for individual and commercial users, respectively. New releases of ActivStats appear for each academic year to keep up with advances in software and operating systems and to add new material. The package is distributed on a CD–ROM accompanyed by a 30–page "User's Guide" booklet. Macnaughton (1998) and Maatta (1999) provide thorough

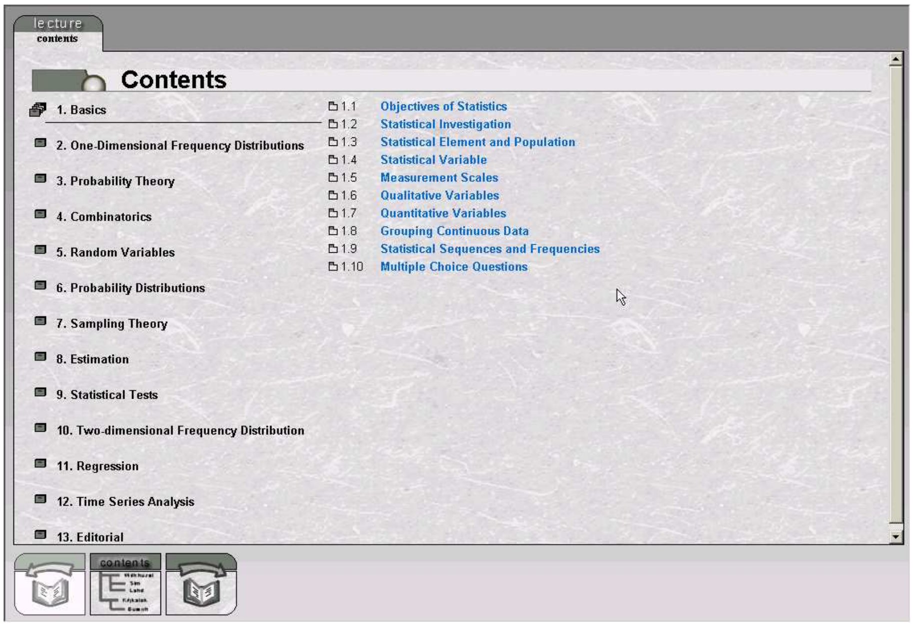

Fig. 3. Contents Page of MM*Stat.

reviews of ActivStats.

CyberStats is a product of CyberGnostic, Inc. The first version of CyberStats appeared around 1999 and was released to interested individuals free of charge exclusively for test purposes. Since January 1, 2001, CyberStats 2.0 has been offered as a commercial product. CyberStats is a fully Web–based package and access is granted for about one semester upon registration and payment of $30 per individual user.

The multimedia project MM*Stat (Rönz, Müller & Ziegenhagen 2000, Härdle, Lehmann & Rönz 2001, Rönz 2001) has been developed at Humboldt–University at Berlin and has been released as a commercial product in 2001. The German version of the package is distributed by Springer–Verlag on a CD–ROM accompanied by a short manual booklet at a price of EUR 17.20 and can be ordered from `http://www.springer.de/cgi-bin/search_book.pl?isbn=3-540-14893-0`. The English version and other foreign language versions of this package are Web–based and are currently freely accessible at `http://www.quantlet.com/mdstat/mmstat.html`. The German version was previously also available on the Web from a password protected site. The MM*Stat developers are closely collaborating with Springer–Verlag in Germany, a major publisher of electronic books. It is planned that in the near future, readers/users will gain access to the Web–based version of MM*Stat and other electronic books after payment of an access fee.

All three packages can be considered complete electronic textbooks. They possess all the features of a traditional statistics textbook: coverage of statistical concepts with text, graphics, and exercises, including interactive table of contents, index, glossary, and self–assessment tools. In addition, CyberStats provides all tools necessary for complete course management, such as instructor's and students' course Web pages, electronic submission of homework assignments, a message board, and a chat room for students.

Both ActivStats and CyberStats target undergraduate students, especially non–science majors, and emphasize concept understanding, data vizualization, and data analysis. Less emphasis is put on formulas and mathematical components of statistics. Figure 1 shows the start page of ActivStats with the opened content window. In ActivStats, the sequence of topics follows closely the "standard" sequence for introductory courses set by one of the currently most popular introductory textbooks (Moore & McCabe 1999): data and variables, univariate distributions, regression and correlation, probability and randomness, random variables, sampling distributions, and statistical inference. ActivStats is a multimedia package that, in addition to "traditional" examples and exercises, also contains narrated lectures and mini–videos that enormously influence students' perception of the topic. Each of the 24 lectures includes several activities in form of interactive exercises, data analysis exercises, and concept–review exercises. Also, each lecture is followed by a set of homework questions and a set of projects in which students have to actually collect data and analyze them using the built–in data analysis package.

In CyberStats, the course content is divided into seven major units: collecting and visualizing data, modeling random behavior, inference, regression, design of experiments and ANOVA, time series, and statistical process control. Each unit is divided into several subunits, as presented in Figure 2. Each subunit represents a separate lecture that begins with a "Summary", followed by a set of motivational questions related to the topic ("Think first"). The actual lecture is presented in form of "Three Keys": "Basics", where the basic concepts are presented and illustrated by real–life examples and interactive exercises; "Uses", where a student has a chance to work through a set of examples and exercises; and "Warning", where potential dangers of wrongly used statistical concepts are discussed. Each of these three keys is accompanied by plenty of examples and exercises. An additional set of exercises is provided in "Examples", that is followed by a self–assessment test. In each exercise set, a student can submit the answers to the system, which are automatically recorded on the CyberStats server and can be accessed by the instructor. A student actively aquires knowledge of the topic by following the pages step–by–step and doing the interactive exercises.

As opposed to ActivStats and CyberStats, MM*Stat targets students in science and engineering, using a more abstract level of presentation and a different order of topics. Although it contains many real–life examples and interactive exercises, the emphasis is on definitions, formulas, and underlying mathematical concepts. The topics include: basics, one–dimensional frequency distributions, probability theory, combinatorics, random variables, probability distributions, sampling theory, estimation, statistical tests, two–dimensional frequency distributions, regression, and time series analysis, as shown in Figure 3. Each topic is divided into several subtopics that are presented as separate lectures. The text of each lecture appears on the screen in a scrollable format. Additional information and detailed examples can be accessed by clicking on the corresponding icons at the bottom of the screen. "Interactive" icons provide access to interactive exercises based on XploRe quantlets. A student can open several windows, or "cards", at the same time. Each topic ends with a set of multiple choice questions. Student's answers can be evaluated with or without indicating errors.

Each of the three electronic textbooks is tightly linked to a data analysis software package that can be used from inside the textbook for an immediate presentation of examples and interactive exercises, but also for analyzing one's own data. The data analysis package integrated into ActivStats is the award–winning Data Desk 6.1 (Data Description, Inc.). ActivStats is also available in versions that teach JMP, Minitab, SPSS, and Excel. CyberStats is equipped with Data Tools, a clone of the popular WebStat software (West et al. 1998, West & Ogden 1998*b*). MM*Stat incorporates the well–known XploRe software (Härdle, Klinke & Müller 2000). In terms of using the data analysis package, ActivStats seems to be most convenient, because the data analysis software is tightly integrated into the package and is directly accessible from the CD–ROM. If a student clicks on an activity or exercise that uses Data Desk, Data Desk is automatically launched and loaded with step–by–step instructions and the data set to be analyzed. On the other hand, CyberStats and MM*Stat lack a direct integration of the data analysis software. The accompanying software must be loaded from the server, which is very time demanding and might be disturbing for a student when the Internet connection is slow.

3 Teaching Experiences with CyberStats

In the Fall 2001 semester, Utah State University (USU) ran two sections of its introductory statistics course "Stat 2000". One section was a regular textbook–based section, using Moore & McCabe (1999). The other section was a Web–based section based on CyberStats. Students had a choice which section they wanted to attend. The regular section had 17 students and the Web–based section had 14 students. One student that was initially enrolled in the Web–based section changed to the regular section within the first few lectures, claiming that he did not want to participate as a guinea pig in an untested version of this course. There were 42 lectures at 50 minutes each.

The reason to run two sections of this course (instead of just the Web–based section) where usually only one section has been offered had practical reasons — the largest available computer classroom could not hold the expected number of students for this course. Although the results described below are only the outcome of an observational study and not of a controlled experiment, we have made some interesting observations. These may be of interest not only for instructors using CyberStats but also for instructors interested in working with other electronic textbooks.

Table 1 shows the grade distribution (in full letter grades) for the regular and Web–based sections in relation to some of the previous offerings. No major difference can be noticed for the A, B, C, and D grades. The relatively high percentage of A grades (5 out of 14, i.e., 36%) in the Web–based section can be easily explained by chance, recalling that there were only 14 students in that section. However, the lack of any F grades in both sections is noticeable. Confounding factors such as smaller class size (previous offerings had between 32 and 48 students in a section), closer interaction between instructor and students, and overall higher attendance may lead to this outcome.

Grade	Text (Fall 1999)	Text (Spring 2000)	Text (Fall 2001)	Web (Fall 2001)
A	25%	22%	18%	36%
B	31%	38%	47%	29%
C	25%	16%	35%	29%
D	9%	5%	0%	7%
F	9%	19%	0%	0%

Table 1. Grade distribution during different offerings of Stat 2000.

Due to the different arrangement of lecture topics in Moore & McCabe (1999) and CyberStats, it was not possible to provide identical exams for the two sections. However, about 50% of the questions in all exams were identical for both sections. There was no significant difference in the performance between the two sections.

Homework assignments (a maximum of 300 points) consisted of textbook/ CyberStats questions, old exam questions, and other questions. There was a noticeable difference in homework performance in both sections as shown in the following summary statistics:

```
Summary: Regular Section
   Min.  1st Qu.  Median  Mean  3rd Qu.  Max.
   196    290      299     289    300     300
Summary: Web-based Section
   Min.  1st Qu.  Median  Mean  3rd Qu.  Max.
    38    269      290     262    299     300
```

Students from the regular section did far better in homeworks than students from the Web–based section. A breakdown of the homework questions of the Web–based section into CyberStats and non–CyberStats questions reveals some interesting results. Students from the Web–based section did similarly well for the CyberStats questions (which had to be submitted electronically) as the students from the regular section for the textbook questions. But the weaker students from the Web–based section often did not turn in the non–CyberStats questions (which could be e–mailed, faxed, or turned in during class).

3.1 CyberStats Course Material

Prior to teaching the Web–based section of "Stat 2000", it was planned to cover material that is also covered in the regular section. This would have been units A–1 through A–8, B–1 through B–9, B–11, B–12, C–1 through C–4, C–6, and D–1 through D–3 in CyberStats (see Figure 2). Additional material to be discussed in both sections covers use and misuse of statistical graphics, scatterplots and the idea of linked and geographic scatterplot brushing, micromaps, and mosaic plots.

However, it was not possible to discuss all material that was previously planned in CyberStats. Units B–11, C–1 through C–4, C–6, and mosaic plots have not been discussed in CyberStats. There are several reasons for these omissions:

– Interactive teaching using the Web in class requires considerably more time than teaching the same material on the board. The instructor has to make sure that each student arrives at the intended Web page that contains the interactive applet that is being used in class. At the beginning of a class, it often took 5 to 7 minutes before each student arrived at a designated Web page (going to CyberStats first, logging on, navigating from the main menu to a unit, and finding and starting the interactive in a unit).
– Technical problems, related to the USU computer system (and not to CyberStats) required some spontaneous reorganization of lectures. During four lectures, the instructor's computer was not able to access the Web, during another four lectures, students did not have Web access (instructor's computer and student computers were differently routed). This considerably affected the flow of those eight lectures, having to work on the board and demonstrating the most useful interactives in a future lecture.
– Incompatibilities between different settings with respect to Web browsers and Data Tools/WebStat caused major delays in class. Due to the restricted availability of the computer classroom, it was not possible to

test all features of CyberStats in the classroom. Instead, a laptop and the instructor's office computer have been used for testing. Usually, everything worked as expected. Unfortunately, long delays occured in the classroom because features for incorporating data (copy/paste, load from URL, etc.) worked differently (or did not work at all) under Netscape and Internet Explorer for Data Tools and WebStat. After a complete failure in one lecture to load data, it took half of the next lecture before every student was using the correct Web browser and the correct approach to incorporate the data.
- Additional depth of some of the material in CyberStats compared to the regular textbook resulted in more time spent on some of the topics than previously planned.

Overall, working with CyberStats requires a careful reevaluation what can be taught in one semester due to unavoidable delays when using technology in class and problems with computers, Web access, and related technology that are likely to occur over the course of a semester.

3.2 Teaching Style with CyberStats

Regarding the teaching style, several alternatives have been tried. In the beginning of the semester, where topics such as data collection, sampling, experiments and observational studies had been discussed, the course format was mostly discussion–based (with no extra handouts), using examples and the self assessment questions from CyberStats as basis. Later in the semester, when talking about linear regression, a more hands–on approach was used, with some comments and sketches on the board and more work with the interactives and Data Tools/WebStat. There was little focus on hand–calculations and formulas, although formulas have been briefly explained. Eventually, topics such as variance/standard deviation, binomial random variables, and the normal distribution had been discussed using handouts adopted from the regular section and the interactives within CyberStats. The main task for an instructor when using CyberStats in a classroom setting is to integrate the given technology, in particular the interactives and Data Tools/WebStat, into the overall course material. Finding an optimal teaching style that incorporates technology probably requires more efforts than designing a good regular course.

Finally, it should be stated that the instructor should not expect that many students work on interactives prior to a lecture unless credit is given. When asking students to work on a particular interactive for the next lecture (without providing credit for doing so) with the intention of discussing the students' observations and results during that lecture, there was rarely any student that did the work prior to class. Eventually, all interactives worth discussing have been discussed in class or have been assigned as a homework assignment with credit.

3.3 Course Evaluation and CyberStats Extra Questionnaire

Sixteen students from the regular section and 12 students from the Web–based section filled out the official teacher/course evaluation during the last week of the semester. Based on a scale ranging from 6 (excellent) down to 1 (very poor), the "Overall quality of the course" obtained a mean of 4.3 (with a standard deviation of 0.86) in the regular section and a mean of 4.2 (0.83) in the Web–based section. The "Instructor's effectiveness" obtained a mean of 4.1 (0.81) in the regular section and a mean of 4.2 (1.03) in the Web–based section. Obviously, there is no significant difference in these two criteria between the two sections. When compared with the results from previous offerings of this course, the Fall 2001 results were identical to the median and also to the mean outcomes over the previous years. Also, none of the other 18 criteria on the official evaluation showed major differences between the two sections. The highest difference was observed for "Course organization" with a 4.6 (1.26) for the regular section and 4.0 (1.04) for the Web–based section. This difference may be attributed to the fact that it was not always possible to teach the intended material due to the reported problems to access CyberStats and the required reorganization of course material, which resulted in jumps from one topic to another.

In addition, students could comment on aspects of the teaching or content of this course that were especially good and suggest changes to improve the teaching or the content. In the Web–based section, four students listed CyberStats (and the interactives) and its combined use with handouts in a lecture format as "especially good". In the "changes" question, six students of the Web–based section had no suggestion at all. No suggested change was listed more than once and only one student suggested not to use CyberStats.

In addition to the official teacher/course evaluation, an additional questionnaire with extra questions related to CyberStats has been passed out in the Web–based section. Thirteen (of the 14) students answered this questionnaire. Note that some students listed more than one feature. The questions and most frequently given answers follow below:

1. *What did you like* **most** *in CyberStats?*
   Eleven students cited the interactives, three students liked the possibility to submit homework online, and two students liked the examples best, in particular the ones related to current problems such as AIDS and social issues. Five students listed different advantages of electronic books such as the self–assessment with answers to the problems, the glossary and the ease of finding definitions, and the overall user–friendliness.
2. *What did you like* **least** *in CyberStats?*
   Four students complained that CyberStats or the access to it often did not work. Two students stated that they had no computer access at home and therefore could not work on homework assignments at home. Two students did not like the time it takes to access CyberStats and find information and that it is impossible to mark information. Several other topics have been listed once, including the price. Only one student did not like CyberStats at all.
3. *Are there any particular problems you would like to see fixed in CyberStats?*
   Four students would like to see a fix of the timeout issue, such that they are no longer being kicked out of CyberStats after 15 minutes without reloading a new page. Three students would like to see fixes related to the speed of the server, internet access, or that they simply do not have to depend on the Web anymore. Several other topics have been listed once. Three students did not have any suggestions.
4. *Overall, did you enjoy working with CyberStats? Circle one of the answers:*
   - *Yes, a lot.* [5 students]
   - *A little bit.* [7 students]
   - *Not very much.* [0 students]
   - *No, not at all.* [1 student]

5. *What did you like* **most** *in the way this course was taught?*
   Five students liked the open book exams most, which allowed to use CyberStats during the exam and to look up definitions and examples within CyberStats. Four students mentioned the combination of CyberStats and additional handouts. Four students liked the fact that this course was taught by a good instructor (and not only through the Web without instructor) and using technology as a tool. A few other topics have been listed once. Only one student did not have any suggestion.
6. *What did you like* **least** *in the way this course was taught?*
   Three students liked least when CyberStats or the access to it did not work and that it was hard to do homework assignments with no computer access at home. Two students thought that there was too much emphasis on computers and did not like that almost everything was online. Otherwise, one student did not like the combination of CyberStats and additional handouts and would have preferred either CyberStats or handouts only. Three students had specific comments regarding exams. Three students did not suggest any topic they liked least.
7. *Do you have any suggestions how to improve the teaching of this course when using CyberStats?*
   While some suggestions have been given once, nine students did not suggest any improvements or just indicated that some of the problems with CyberStats encountered early in the semester have been worked out.
8. *Overall, what would you suggest for future Stat 2000 classes here at USU? Ultimately, we can either user CyberStats* **or** *a standard textbook, but we have to decide for one of these two options. Circle one of the answers:*
   – *Use CyberStats for all future Stat 2000 classes.* [6 students]
   – *Fix the problems mentioned before, then do another experimental class with CyberStats and only decide then whether to use CyberStats or a textbook.* [6 students]
   – *Do not use CyberStats and immediately decide to work with a standard textbook for all future Stat 2000 classes.* [1 student]

3.4 Discussion of Evaluation and Questionnaire

Even though there was no major difference in the overall course evaluation of the Web–based and the regular sections, it is obvious that the majority of students who took the Web–based section overall enjoyed it, in particular the interactives, the possibility to submit homeworks electronically, and the access to CyberStats during the exams. However, as previously stated, the comparison between the two sections was not a designed experiment because students could decide themselves which section to attend.

Problems that were mentioned all over again relate to the nature of a Web–based textbook only: problems to access it at all, slow access, problems to do homeworks if no computer is available at home, difficulties to find something in the electronic version, and no possibility to mark and highlight important facts in an electronic book. One of the cited problems was immediately fixed during the semester: students are no longer automatically logged out after 15 minutes of idle time.

Based on the experience with the Web–based section and the students' suggestions, one should definitely consider CyberStats (or any other electronic textbook) for future use in Utah State's "Stat 2000" class. However, it should be investigated how students who have not decided themselves to take the Web–based course react to an electronic textbook before permanently adopting this electronic textbook.

Even though the additional questionnaire suggests that CyberStats was popular among the students, it can be noticed that the overall performance of students and the overall course/instructor evaluation was within the range of previous courses. Only subjectively, students had the impression that CyberStats is better than a regular textbook. Nevertheless, as stated in the Introduction, electronic textbooks are important to better motivate students and teach statistical ideas and concepts in a more convenient manner.

4 Discussion

Textbooks that are available in non–standard form, i.e., on the Web or on CD, have considerable advantages but also disadvantages compared to a regular, printed textbook. For a Web–only textbook, the main disadvantage are access–related problems such as slow connections and servers that are down. Also, students that live further away from the university and do not have a computer at home have a clear disadvantage as they have to commute to the university to access the system and read the material and work on homework problems.

Not having a printed version of the textbook also turned out to be inconvenient for the instructor. It is very difficult to determine on the computer screen which exercises to assign, in particular when there is more than just one set of exercises for a unit or when a homework assignment consists of questions related to several units. Eventually, all exercises (and solutions) have been printed out to assign selected exercises. Also, looking up a definition or an example in a Web–only textbook is time consuming. Finding such information in a printed textbook (or on a CD) is much faster. Recently, a printed version of CyberStats has been made available upon request.

Clearly, a Web–based textbook has an immediate advantage: errors and typos can be fixed immediately. It does not take several months (or years) before the next updated edition of a textbook on CD or in print is being published. As experiences with MM*Stat show (Rönz et al. 2000), about 48% of the students prefers the CD–ROM version, 40% prefer the Web version, and 12% have no preference. The CD has the advantage that it is independent from a network connection and can be run on virtually any computer. Servers that are down, slow connections, a telephone line for a modem that is shared by three or four roommates — these are features the CD does not depend on.

Another main advantage of a Web–based textbook, compared to a CD or print version, is the possibility to upload homeworks to the main server and download the answers after the submission deadline. After some initial technical difficulties with timeout problems and the access to the server, the homework upload was well accepted among the CyberStats students. As described before, weaker students from the Web–based section used to work on the CyberStats questions but often did not turn in the additional homework exercises on paper. CyberStats offers a possibility to give students an entirely electronic exam: the "Test Bank" allows instructors to write electronic exams that include the instructor's own questions, CyberStats questions, and questions from other instructors who use CyberStats. A nice addition would be if each instructor could also add individual questions to the unit exercises and ask students to answer all questions electronically.

To summarize, the main advantage of electronic textbooks on the Web (or on CD) are the interactives and additional features such as narrative texts and videos. Also, the ability to work on homework problems on the computer and upload answers to a server from which they can be collected after the due date is a major advantage for students and the instructor.

Ideally, an electronic textbook (Web–based or on CD) should not be used alone, but accompanied by a printed book and optionally with the other electronic format. An additional printed textbook has several benefits. In particular, it is faster to "access" a textbook and find the desired information. The textbook can be read while commuting in buses or trains, it can be taken back home over the weekend, and it can be read during short breaks at the university when no computer lab is at hand.

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