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Reducing Student Writing Time and Instructor Grading Time of Laboratory Reports

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Abstract

A previous study by the authors demonstrated with 95% confidence that the synopsis laboratory report format, a brief, information-rich summary, provides students with an equally positive learning experience in comparison to the longer, introduction/results/conclusion "traditional" laboratory report format. This study examined the additional benefits of the synopsis laboratory report format; reduced student writing time and instructor grading time. A convenience sample of 56 Iowa State University industrial technology students was randomized into one of two groups that were required to write either five synopses followed by four traditional reports or four synopses followed by five traditional reports. The analysis of grading times using the paired-samples *t*-test revealed that synopsis reports required 4.5 to 5.8 fewer minutes to grade than traditional reports ($p < 0.001$). The analysis of student writing times using the paired-samples *t*-test revealed that synopsis reports required 32 to 44 fewer minutes to write than traditional reports ($p < 0.001$). The results of an end-of-semester exit survey revealed that students also perceived the difference in writing time ($p < 0.001$).

Introduction

Graduates who can write well are widely sought after in industry and programs of advanced study (Baren & Watson, 1993; Boiarsky, 2004; Doumont, 2002; Friday, 1986; Keane & Gibson, 1999; Lima et al., 2003; Nixon & Fischer, 2001; Plumb & Scott, 2002; Sageev & Romanowski, 2001; Williams, 2002; Wheeler & McDonald, 2000). In order to prepare graduates with strong written communication skills, professors in industrial technol-

ogy curricula might choose to assign laboratory (lab) reports as a *Writing in the Disciplines* (WID) type of writing exercise. WID is a strategy for teaching writing in the traditions specific to a discipline and is a part of *Writing Across the Curriculum* (WAC) (Brewster & Klump, 2004).

Traditionally, lab reports in industrial technology are written in the "introduction/results/conclusion" format, which are lengthy both for students to write and for instructors to grade. The synopsis format of lab report requires students to synthesize the lab experiment, the lecture, and the readings into a succinct, one page (maximum) report, which is similar to an executive summary in that it is written to an audience who is too busy to read a lengthy report that includes 'unimportant' details (Hoffa, 2006).

Hoffa and Freeman (in press) discovered that the synopsis lab report format provided students with an equally effective learning experience as the traditional report format in terms of comprehensive exam scores. A convenience sample of Iowa State University undergraduate industrial technology students were randomized into two groups (synopsis and traditional) and their exam scores were analyzed using the Latin-square design. Hoffa and Freeman (in press) determined that the mean exam score of synopsis writers and the mean exam score of traditional report writers were not significantly different ($F(1,93) = 0.0073$, $p = 0.932$, confidence interval = -5.14%; 4.71%). While it may seem obvious that a shorter paper will take less time for instructors to grade and for students to write, it is not known with any statistical accuracy how much time can be

saved by using the synopsis laboratory report format. Many authors including Kelly and LeDocq (2001), Miller (2001), and Wood (1998) have alluded to instructors' desires to minimize the amount of time spent grading. Although the literature does not support a need for reducing the amount of time students spend writing, justification for and reasons to adopt such a strategy are offered.

Purposes of the Study

This study had two purposes:

1. Statistically determine the difference in the amount of time required for students to write synopsis format lab reports versus traditional format lab reports.
2. Statistically determine the difference in the amount of time required for instructors to grade synopsis format lab reports versus traditional format lab reports.

Methodology

Population and Sample

The population of this study was undergraduate industrial technology majors at Iowa State University. The convenience sample contained the students who enrolled in ITEC 140, Electrical Fundamentals, in the Fall 2004 (30 students) and Spring 2005 (26 students) semesters, for a total sample size of 56 students. Each student was counted as one experimental unit and was randomized into one of two groups: Group 1 wrote five synopsis reports followed by four traditional reports and Group 2 wrote five traditional reports followed by four synopsis reports.

Data Collection

Each subject was required to perform nine lab experiments, which were designed to support and enhance the learning of the course content. After each experiment, subjects were allotted one week in which to complete and submit a report based on that experiment. To gather writing time data, each subject was required to report the "time to complete" their reports – specifically, they were required to report the time from the moment they began gathering their materials and thoughts in prepara-

tion for writing the paper, through the moment the paper was considered completed and ready for printing. To gather grading time data, the course instructor simply noted the time at the beginning and end of the grading process for each report. Additionally, an end of semester "exit survey" of attitudes and preferences was administered via *WebCT Campus Edition* version 4.1 (WebCT, 2005).

Assumptions and Delimitations

1. The participants worked to the best of their abilities on all lab experiments and lab reports.
2. The participants were representative of undergraduate industrial technology students at Iowa State University.
3. An abbreviated format of lab report that provides students with an equivalent learning experience is desirable to both educators and students in the field of industrial technology.
4. The times reported by subjects on their lab reports were assumed to be accurate.
5. Only students who enrolled in the Fall 2004 and Spring 2005 semesters of ITEC 140, Electrical Fundamentals, were invited to participate in the study.

Statistical Design

The statistical analyses were performed using *SPSS for Windows* version 11.0 (2001) statistical software. Since the synopsis format restricted the students to one side of one page of double-spaced text, it should have required less time for instructors to grade and for students to write than grading and writing traditional reports. To discover the differences in mean grading time and mean writing time between synopsis and traditional reports, the paired samples *t*-test was employed.

Reliability

The use of grading rubrics provided reliability by ensuring that every lab report with a similar grade has attained a comparable level of achievement. The course materials (lecture content, textbook, homework assignments, lab experiments, exam content, and other handouts), and the course structure

(rules, expectations and requirements, and weighting of graded materials) remained fixed for the duration of the study.

To control bias (positive or negative), every synopsis was graded anonymously by requiring the subjects to format their reports with their name in the upper header – when the reports were clipped into a clipboard for grading, the clip covered the names of the authors. Traditional reports, which had a cover page as a requirement of the format and the lab handout included as the results section, were impossible to assess anonymously.

Findings

Writing Time

A boxplot analysis revealed three outliers in the synopsis writing time data and two outliers in the traditional writing time data (one of which came from the same subject that provided an outlier in the synopsis group); in total, four rows of data were removed from the set, reducing the sample size for the paired samples *t*-test analysis to 52. Repeating the boxplot analysis revealed yet another outlier in the traditional report data, further reducing the total number of subjects to 51. The removal of these outliers did not significantly alter the outcomes of the study.

Table 1 and Figure 1 show that the mean time to write a traditional report was 89.16 minutes and the mean time to write a synopsis report was 50.81 minutes. The paired samples *t*-test revealed a statistically significant difference in mean writing time between synopsis and traditional lab reports ($p < 0.001$). The 95% confidence interval revealed that synopsis reports take between 32 and 44 fewer minutes to write. There was a strong, positive correlation (0.725, $p < 0.001$) between students' synopsis report writing time and traditional report writing time. This indicates that students who write at a certain pace in one style were likely to write at a similar pace in the other style.

Grading Time

A boxplot analysis revealed a single outlier in the synopsis grading time data, which was removed from the data set, reducing the sample size for the paired samples *t*-test analysis to 55. Table 1 and Figure 2 show that the mean time to grade a traditional report was 9.03 minutes and the mean time to grade a synopsis report was 3.97 minutes. The paired samples *t*-test revealed a statistically significant difference in mean grading time between synopsis and traditional lab reports ($p < 0.001$). The 95% confidence interval revealed that synopsis reports take between 4.5 and 5.8 fewer minutes to grade. There was not a significant correlation between synopsis report grading time and traditional report grading time ($-0.234, p = 0.074$). The lack of a significant correlation here is likely the result of the differing amounts of attention required by well-written reports versus poorly written reports. Well-written papers, regardless of format, took a minimal amount of time to read and assess; on the contrary, poorly written papers required much more time to analyze, critique, and assess.

Exit Survey

Forty-two of the 56 subjects involved in the study responded to the WebCT Exit Survey for a response rate of 75%. The results of the survey provided useful data about the subjects' preferences between the synopsis and traditional report formats. The respondents were asked to respond to the question on a 5-point Likert scale (strongly disagree [1], disagree [2], neither agree nor disagree [3], agree [4], strongly agree [5]). The survey contained one question regarding the students' perception of reduced writing time of the synopsis format, which read *Synopsis reports took less time for me to write than traditional reports*. For ease of interpretation, negative responses (1 and 2) and positive responses (4 and 5) were grouped together. Neutral responses (3) were ignored, which further reduced the sample size for the following analysis to 38. 15.8% of the respondents responded negatively, while 84.2% responded positively. The analysis of this

Table 1. Mean Times to Grade and Write Synopsis and Traditional Lab Reports

| Problem | Synopsis | | Traditional | |
|--------------|-----------|-------------|-------------|--------------|
| | Mean Time | Range | Mean Time | Range |
| Grading Time | 3.97 | 2.00-6.40 | 9.03 | 4.75-13.60 |
| Writing Time | 50.81 | 30.00-88.75 | 89.16 | 37.00-155.20 |

Figure 1. Histograms of the writing time data after the removal of outliers (in minutes).

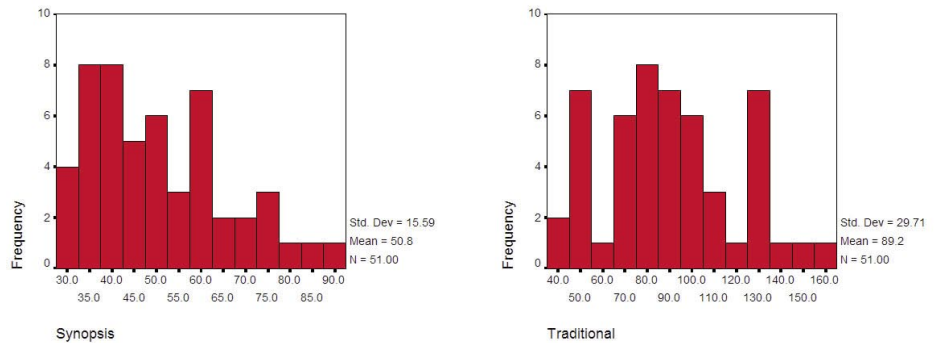
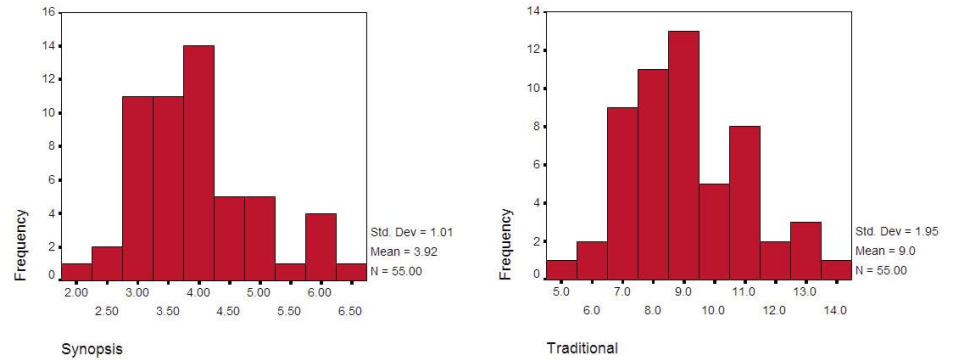


Figure 2. Histograms of the grading time data after the removal of the outlier (in minutes).



question with the Pearson Chi-square Test of Independence revealed a statistically significant difference in positive and negative responses ($p < 0.001$).

Implications

Findings

Since Hoffa and Freeman (in press) discovered that the synopsis lab report format has no negative impact on student learning in terms of comprehensive exam scores, the findings of this study have the following implications for faculty, students, and administrators

in industrial technology curricula:

The paired-samples *t*-test analysis of the difference in grading time between synopsis reports and traditional reports has revealed that the synopsis report format requires between 4.5 and 5.8 fewer minutes per report to grade. In semester-based terms – if a course requires ten lab reports from each of 30 students, its instructor could expect to spend at least 1,350 fewer minutes (over 22 hours) grading those papers if the synopsis format were used

instead of the traditional format. This represents a significant reduction in workload for course instructors (and/or teaching assistants responsible for grading papers), which becomes increasingly significant with class size. This reduction in grading workload could be used by busy professors to increase productivity in research, service, or improving other aspects of teaching, resulting in a better learning environment for the students.

The paired-samples *t*-test analysis of the difference in mean writing time between synopsis reports and traditional reports has revealed that students require between 32 and 44 fewer minutes per report to write in the synopsis format than in the traditional format. If a course instructor requires each student to write 10 lab reports, they could expect each student to spend a minimum of 323 fewer out-of-class minutes (over five hours) writing synopsis lab reports than traditional lab reports over the duration of the semester.

If the results of the writing time analyses are scrutinized strictly in terms of the effect of 'time on task', one could conclude that increasing the mean amount of out-of-class writing per curriculum unit from 51 minutes to 89 minutes per student had no effect on how well students learned the material or on their performance on the assignments for that curriculum unit.

The combination of reduced grading load on the instructor and reduced writing time for the students allows possibilities for additional readings, papers, or other homework assignments. An instructor could choose to develop additional assignments that target students with learning styles that may not promote success on writing assignments.

Recommendations for Future Studies

Repetition of this study at other universities, in other courses with a laboratory component, and with a larger sample size (to reduce the spread of the confidence intervals) is recommended to verify or refute the significance of these findings. It is also recommended that

the study be repeated in an engineering curriculum to confirm that engineering students respond in a similar manner.

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