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Pen or Printer: Can Students Afford to Handwrite Their Exams?

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Every December, as they prepare for their first experience with law school examinations, students inevitably ask their teachers, "Does it matter whether I handwrite or keyboard my exam?" Of course, what the students are really asking is the time-honored question of how to get a better grade, but with a new twist brought about by technology. They want to know whether the process by which a student generates an exam, handwriting or computer keyboarding, affects the final grade. Until recently, handwriting law school exams was the norm, although some students braved typewriters. In the last few years, however, technology has developed to allow law schools to give students the option of keyboarding their exam answers into personal computers. As law students in the typing era who handwrote exams, we (i.e., Augustine-Adams and Rasband) always suspected that those who typed had a certain advantage. Not only would their end product be neater and thus more easily read by the grader (particularly given our own idiosyncratic scrawls), but a proficient typist could convey more information in the allotted time, which plainly seemed an advantage on traditional first-year issue-spotting examinations. Those same advantages would seem to apply, but even more so, to students who use a computer.

As teachers, we have asked ourselves the same question, "Does the form of an exam answer matter?" In our six years of grading law school exams, we have been determined to count substance over form, to grade each exam thoroughly and fairly without attention to the relative effort required on our part to identify that substance. Nonetheless, our suspicion as law students that the form of the exam answer really did matter, continued to nag us as teachers. As we graded, we dreaded deciphering exams with poor handwriting when we could move so much more rapidly through keyboarded exams. Despite our commitment to grade fairly, it became increasingly difficult to tell our students and ourselves that the form of their answer did not affect the examination grade. Our students' perception was similar to our own perception as

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students: keyboarding, like typing, creates an advantage. But we were still operating in the realm of suspicion and anecdote, without hard empirical data.

In reviewing the literature, we could find no study of the impact of computer keyboarding or, more broadly, the quality of handwriting on scoring of first-year law school examinations. (Various law school advice books recommend to students that they type or word-process exams but do not provide any empirical data to support the recommendation.) Literature addressing the impact of typing or keyboarding on exam scoring more generally was also limited,[1] although a variety of research exists on computers and the writing process in nonexamination settings.[2] We decided to conduct our own empirical study based on data derived from first-year exams for students at our own school, Brigham Young University's J. Reuben Clark Law School. We did so with the help of Dr. Suzanne B. Hendrix of BYU's Department of Statistics.

Although various other issues of form may influence grading, we focused our study on the potential grade difference between computer keyboarded and handwritten exams. We did not differentiate among handwritten exams on the basis of relative legibility, although there is a significant body of research indicating that the quality of a student's handwriting affects her grade.[3] Interestingly enough, one study shows that the advantage afforded

1. One study of twelfth-grade essay examinations found that the highest mean grades went to those with neat handwritten essays, and that poor handwritten essays actually fared better than typewritten essays. See Jon C. Marshall & Jerry M. Powers, Writing Neatness, Composition Errors, and Essay Grades, 6 J. Educ. Measurement 97, 99–100 (1969). The authors of that study expressed surprise that good typewritten papers fared so poorly, but their data reveal one potential explanation. The authors investigated not only how neatness might influence a grader instructed to evaluate solely with respect to content, but also how spelling and grammar errors might influence the grader. For those exams without spelling or grammar errors, typed exams actually finished a close second to neatly handwritten exams and ahead of exams that were written in fair or poor handwriting. It was only when spelling or grammar errors were included in the exams that the typed scores were below those written with fair or poor handwriting. Although it is difficult to discern from the data presented, it may be that the grammar and spelling errors become more noticeable in a typed essay than in an essay written in fair or poor handwriting. See Elaine Peterson & Wei Wei Lou, The Impact of Length on Handwritten and Wordprocessed Papers, Educ. Resources Info. Center, Dep't of Educ. 12 (1991). Thus typed examinations may create a larger spread: they are more appealing when done well, but when they are done poorly, the flaws are more evident.

2. See, e.g., Claudia S. Dybdahl et al., The Impact of the Computer on Writing: No Simple Answers, 13(3/4) Computers in the Schools 41 (1997); Ronald D. Owston & Herbert H. Wideman, Word Processors and Children's Writing in a High-Computer-Access Setting, 30 J. Res. on Computing in Educ. 202 (1997); Sarah E. Peterson, A Comparison of Student Revisions When Composing with Pen and Paper Versus Word-Processing, 9(4) Computers in the Schools 55 (1993).

3. Even when directed to focus solely on content, graders tend to give higher scores to essays with neat and clear handwriting than to those with poor handwriting. See, e.g., Iris McGinnis & Charles A. Sloan, The Effect of Handwriting on Teachers' Grading of High School Essays, Educ. Resources Info. Center, Dep't of Educ. 6 (1978); Clinton I. Chase, The Impact of Some Obvious Variables on Essay Test Scores, 5 J. Educ. Measurement 315 (1968). It is possible (Chase makes this point) that differential grading based on penmanship would have been more pronounced earlier in the twentieth century. Because modern curricula give less emphasis to penmanship, poor penmanship will not appear to the grader as such a departure from the norm.

papers with high-quality handwriting disappears when the grader herself has poor penmanship.[4] Similarly, in our study, we did not differentiate among keyboarded exams on the basis of typos, spelling errors, or other aspects of form, even though errors of spelling and grammar can negatively influence a grader's view of content.[5]

Research also indicates that the order in which exams are read can affect the grade. One study found what it termed a "leniency effect" where "themes graded later received higher grades than themes graded earlier."[6] We did not develop any empirical data on this issue, but our own grading experience suggests that such a leniency effect is real and may be a useful area for further study. Our common experience in grading first-year issue-spotting exams is that we tend to grade the first few exams somewhat more rigorously than later exams.[7] Although we recognize the impact these additional variables may have on examination grades, our study attempted to isolate the handwriting versus keyboarding question.

Data Collection and Sample

To answer whether keyboarding instead of handwriting affected final examination grades, we studied data derived from first-year exams for students entering BYU Law School in fall 1998 and fall 1999. We collected the exams and respective grades for 2,588 exams given to first-year students in Torts, Civil Procedure, Contracts, Property, and Criminal Law during four semes-

4. See Schuyler W. Huck & William G. Bounds, Essay Grades: An Interaction Between Graders' Handwriting Clarity and the Neatness of Examination Papers, 9 Am. Educ. Res. J. 279 (1972).

5. See Marshall & Powers, *supra* note 1, at 100. But see Chase, *supra* note 3, at 315 (finding that spelling did not correlate significantly with scores on essay tests).

6. John Follman et al., Graphics Variables and the Reliability and the Level of Essay Grades, 8 Am. Educ. Res. J. 365, 371 (1971).

7. Several measures can be employed to combat this leniency effect. First, the teacher can regrade the first few examinations to see if there was indeed a pattern of underscoring. The regrading can continue until the point at which the underscoring pattern ceases to manifest itself. Second, where an exam has multiple essays, the teacher can grade each essay separately rather than grading the entire exam at one time. Then, in grading the additional essays, the teacher can reverse the order of grading or do some shuffling of the deck. Grading by essay rather than entire examination and then altering the order in which the exams are read should spread the impact of the leniency effect more randomly throughout the class. Third, because rescoring the initial exams is not particularly pleasant and is largely against self-interest, it is critical that we as teachers be introspective about the scoring decisions we make during the grading process. Although in some instances we may not be aware that we are becoming more lenient, our experience is that we often sense when we have begun to be more lenient. In such instances our obligation is to attempt to correct the disparity, either by restraining ourselves from scoring more generously or by rescoring the exams graded under a different criteria.

ters: fall 1998, winter 1999, fall 1999, and winter 2000.[8] This represented one year of law school study for each of approximately 310 students.[9]

At BYU Law School grades are given on a 4.0 scale in 0.1 increments. First-year courses have a mandatory median of 3.1, but no specific requirements for the 75th or the 25th percentile. The mean for first-year courses is typically between 3.1 and 3.2. Because the largest group of students tends to cluster around the median, a 0.1 difference in a student's overall first-year grade point average can make a significant difference in his rank within the class.[10]

Handwriting vs. Computer Keyboarding

Initial Analysis

After gathering our data, we calculated mean and median grades for handwritten and keyboarded exams for each course for each semester. The data appear in Table 1.

Table 1 demonstrates that in almost every first-year course in the four semesters, both mean and median grades for students who keyboarded were higher than mean and median grades for students who handwrote their exams.[11] For the 32 classes where students both keyboarded and handwrote exams, the mean of the mean grade differential was 0.13. Although this differential was statistically significant[12] and suggested that students who keyboarded their exams received higher grades on average than students who handwrote, we could not be sure that the grade differential was the result of keyboarding, the variable we wished to study, or simply that stronger students had chosen to keyboard rather than to handwrite. To make that determination, we performed three additional tests. We first made an effort to determine whether stronger students were indeed more likely to keyboard. We then compared pairs of academically similar students of whom one had

8. There were approximately 240 exams for which we were unable to obtain data from our colleagues. To maintain student confidentiality and privacy, students were never identified to us by name but only by the confidential exam numbers assigned to facilitate blind grading. We also maintained this confidentiality with respect to all other data collected for our study. When we gathered LSAT scores and undergraduate GPAs for other questions in the study, we had administrative staff who were not involved in our study substitute examination numbers for student names.

9. Our first-year curriculum also includes a legal writing course, which we did not include in our study because the legal writing grades were determined by several writing projects that had to be keyboarded rather than by an examination where keyboarding or handwriting was an option.

10. For example, for the 1999–2000 academic year, a GPA increase of 0.10 would have moved a student from a class rank of 73/148 to a rank of 53/148, from 97/148 to 77/148, or from 19/148 to 10/148.

11. The reliability of this 0.1 grade differential was diminished somewhat by the fact that several of the first-year exams have a multiple-choice or short-answer component. For those exams with an objective component, we examined the mean and median raw scores on the essay portion of the examination. That comparison yielded similar results. The mean and median raw essay scores were consistently higher for the exams that had been keyboarded.

12. The difference between the mean score of keyboarded and handwritten exams after controlling for year and course was statistically significant at $p<0.0001$.

Table 1
Mean and Median Grades by Course and Method

Course	*Number of keyboarded exams*	*Number of handwritten exams*	*Mean of keyboarded exams*	*Mean of handwritten exams*	*Median of keyboarded exams*	*Median of handwritten exams*
Fall 1998						
Torts § I	82	24	3.2	3.1	3.15	3.1
Torts § II	28	8	3.2	3	3.25	3
Civil Procedure § II	25	14	3.4	3.2	3.4	3.1
Contracts § I	81	33	3.25	3.1	3.2	3.1
Contracts § II	35	2	3.1	2.85	3.2	2.85
Property § I	85	24	3.17	3.07	3.1	3
Property § II	26	11	3.2	3.2	3.2	3.1
Winter 1999						
Torts § I	81	22	3.2	3.07	3.2	3.05
Torts § II	32	8	3.1	2.9	3.1	2.9
Civil Procedure § I	87	20	3.21	2.97	3.2	3
Civil Procedure § II	28	11	3.23	3.19	3.05	3.1
Contracts § I	80	33	3.26	3.07	3.2	3.1
Property § II	29	10	3.12	2.84	3.2	2.8
Criminal Law § I	51	17	3.15	3.18	3.1	3.1
Criminal Law § II	64	13	3.28	3.05	3.2	3.1
Fall 1999						
Torts § I	105	8	3.1	2.85	3.1	2.8
Torts § II	32	9	3.2	3.1	3.2	3
Civil Procedure § I	101	16	3.23	3.17	3.1	3.05
Civil Procedure § II	34	4	3.26	3.07	3.15	3.05
Contracts § I	98	24	3.21	3.07	3.1	3.1
Contracts § II	38	0	3.16	0	3.2	0
Property § I	98	18	3.18	3.16	3.1	3.05
Property § II	35	7	3.27	2.98	3.2	3
Winter 2000						
Torts § I	93	18	3.2	3.1	3.1	3.1
Torts § II	29	11	3.2	3.1	3.2	3
Civil Procedure § I	94	22	3.12	3.07	3.1	3.05
Civil Procedure § II	34	7	3.25	3.1	3.2	3.1
Contracts § I	87	33	3.24	3.13	3.2	3.1
Contracts § II	30	7	3.18	3.11	3.1	3.1
Property § I	88	26	3.2	3.13	3.15	3
Property § II	34	8	3.27	3.16	3.3	2.95
Criminal Law § I	55	11	3.26	3.19	3.3	3.1
Criminal Law § II	65	26	3.22	3.1	3.2	3.1
			Mean of means	Mean of means	Median of medians	Median of medians
Total	1,964	505	3.206	3.074	3.2	3.05

chosen to keyboard and the other to handwrite. Finally, we used a mathematical covariance model to control for other factors beyond keyboarding or handwriting, such as LSAT score, that might explain at least in part a student's overall first-year GPA. The three analyses revealed that although students with higher LSAT scores are indeed more likely to keyboard, when we controlled for that fact, keyboarders still on average performed about 0.1 better than handwriters.

Who Keyboards?

To test the hypothesis that stronger students chose to keyboard, we performed a *chi*-square test comparing keyboarders and handwriters with reference to their LSAT scores.[13] Although the LSAT is not a sure predictor of academic performance, it is the best measure available for discerning the relative academic strength, particularly with regard to expected first-year performance, of keyboarders and handwriters at the time they entered law school.[14] The results of the *chi*-square test are set forth in Table 2. The test sorted the 2,588 exams in our study by handwriting and keyboarding into four LSAT groupings: entering students who scored 163 or better (163 is BYU's 75th percentile); entering students scoring 160 to 162 (BYU's 50th to 75th percentile); entering students scoring 157 to 159 (BYU's 25th to 50th percentile); and entering students with scores below 157 (BYU's lowest quartile).

Table 2
***Chi*-square Test by LSAT Score and Method**

LSAT Score		*Keyboarded exams*	*Handwritten exams*	*Total*
163 +	Number of exams	674	118	792
	Percentage of total exams	26.04	4.56	30.60
	Row percentage	85.10	14.90	
	Column percentage	31.97	24.58	
160–62	Number of exams	625	103	728
	Percentage of total exams	24.15	3.98	28.13
	Row percentage	85.85	14.15	
	Column percentage	29.65	21.46	
157–59	Number of exams	363	100	463
	Percentage of total exams	14.03	3.86	17.89
	Row percentage	78.40	21.60	
	Column percentage	17.22	20.83	
120–56	Number of exams	446	159	605
	Percentage of total exams	17.23	6.14	23.38
	Row percentage	73.72	26.28	
	Column percentage	21.16	33.13	
Total	Number of exams	2,108	480	2,588
	Percentage	81.45	18.55	100.00

13. The *chi*-square test is a formula that determines whether two variables can be considered statistically independent. In performing the *chi*-square test, the observed frequency in each cell of a table is compared to the frequency that would be expected if the row and column classifications were indeed independent. If the calculated statistic is sufficiently large according to a predetermined significance level, typically 0.05, then the two variables are considered dependent. See Arnold Naiman et al., Understanding Statistics 159–60 (New York, 1972).

14. See Linda Wightman, The Threat to Diversity in Legal Education: An Empirical Analysis of the Consequences of Abandoning Race as a Factor in Law School Admission Decisions, 72 N.Y.U. L. Rev. 1, 31–32 (1997) (noting that the "median correlation coefficient for the LSAT alone [and first year grades] is .41, compared with 0.26 for UGPA alone" and concluding "[t]here has been and continues to be substantial statistical support for the claim of validity of the LSAT" for predicting academic success in the first year of law school). We decided to use LSAT scores rather than GPA because the LSAT is more applicable to the situations of other law schools around the country. Given the rather large numbers of BYU undergraduates who attend BYU Law School, judging academic strength with reference to undergraduate GPA would have made our study less relevant to other institutions.

As evidenced by Table 2, students entering BYU Law School with an LSAT score at or above the median keyboarded just over 85 percent of their exams.[15] In contrast, students with a score between the 50th and 25th percentile keyboarded 78.4 percent of their exams, and students with scores at the 25th percentile and below were the least likely to keyboard at 73.72 percent. These differences were all determined with more than a 99 percent degree of statistical confidence ($p<0.0001$). Because students with LSAT scores at or above the law school's median keyboarded more often than did students with scores below the median,[16] it remained possible that the observed grade differential in Table 1 was due simply to the fact that stronger students chose to keyboard. It thus would not be enough to rely on the mean grade differential in Table 1 to conclude that keyboarding improved students' grades: we had to find a way to control for the academic strength of the students. To do so, we performed two analyses discussed below.

Comparing Academically Similar Students

To help discern whether the 0.13 positive difference for keyboarders in the various first-year classes (see Table 1) was the result of keyboarding or of students' relative analytical abilities, we first paired students who had keyboarded all their exams with academically similar students who had handwritten all their exams. To pair students who were academically similar we looked to LSAT scores and undergraduate GPAs. We believed these were the best available measures for pairing students with a similar likelihood of success in the first year of law school without respect to the particular method they chose to complete their exams. Our hypothesis was that if similarly situated students exhibited the same grade disparity between keyboarding and handwriting that existed in the class as a whole, the difference could not be attributed to the fact that stronger students are more likely than weaker students to keyboard.

We gathered the academic credentials for each student who entered the law school in fall 1998 or fall 1999 and then developed a protocol to identify and pair handwriting and keyboarding students whose likelihood of academic success was similar.[17] Applying the protocol to our particular sample, we were able to pair each handwriting student with a keyboarding student whose LSAT score was identical or within one point and who had a similar undergraduate GPA.[18] Overall, we identified 33 pairs of similar students, 20 for 1998–99 and 13 for 1999–2000. For any particular course, however, the number of pairs was

15. Students between the median and the 75th percentile and students above the 75th percentile were almost identical in the percentage of exams they keyboarded, 85.85 and 85.10 percent respectively.

16. In addition to the *chi*-square test, Hendrix performed a *t* test comparing mean LSAT scores for keyboarded and handwritten exams. It showed that the mean LSAT score for students who keyboarded was 160.28 and the mean LSAT scores for students who handwrote was 159.21. This mean difference of 1.07 was statistically significant at $p<0.0002$.

17. The complete protocol is on file with the authors.

18. We used the undergraduate GPAs provided by LSDAS, which are standardized to the same scale (A = 4.0, A- = 3.67, B+ = 3.33, etc.) but are not corrected for grade inflation at different institutions and between particular majors.

lower because we only paired students who had the same teacher in the same year and thus took the same final exam.

Having collected the data, we performed a *t* test on the paired sets of first-year students.[19] Table 3 presents the results.

Table 3
The Means Procedure

Course	*Number of pairs*	*Mean difference between keyboarders and handwriters*	*Standard deviation*	*t value*	*Pr > |t|**	*Number of pairs necessary to determine 0.1 grade differential with statistical confidence*	*Number of pairs necessary to determine 0.2 grade differential with statistical confidence*
Torts (fall)	20	0.1350000	0.5659412	1.07	0.2994	129	33
Torts (winter)	20	0.1550000	0.5266328	1.32	0.2037	111	28
Civil Procedure (fall)	20	0.1450000	0.5103920	1.27	0.2192	105	27
Civil Procedure (winter)	20	0.2250000	0.5408327	1.86	0.0784	117	30
Contracts (fall)	19	0.1263158	0.4964788	1.11	0.2820	99	25
Contracts (winter)	19	0.0947368	0.4390314	0.94	0.3594	78	20
Property (fall)	19	0.0631579	0.5639253	0.49	0.6313	128	32
Property (winter)	19	0.1105263	0.5342645	0.90	0.3791	115	29
Criminal Law (winter)	14	0.1857143	0.5332875	1.30	0.2152	114	29
Overall GPA	33	0.1198485	0.4299282	1.60	0.1191	74	19

*This column reflects the probability that the mean difference between keyboarders and writers can be attributed to chance. For example, with respect to Torts (fall), if there were no substantive difference between keyboarders and handwriters, we nonetheless would expect the 0.13 mean grade difference reflected in the third column to appear 29.94 percent of the time. Likewise, with respect to overall GPA, if there were no difference between keyboarders and handwriters, we would expect to see the 0.1198 mean difference 11.91 percent of the time. In other words, approximately 88 percent of the time we would not expect to see a mean difference of 0.1198 unless the keyboarding mean was actually higher. For the mean difference to be statistically significant, statisticians typically demand that the mean difference would be present by chance only 5 percent of the time. Nevertheless, the fact that the 0.1198 grade differential would only show up 12 percent of the time if there were no difference between keyboarders and handwriters did give us some confidence (prior to performing the covariance analysis discussed *infra*) that the grade differential was not happenstance.

Table 3 reveals that the mean grade in each course was again higher for the students who keyboarded. The mean differences range from 0.06 to 0.22 with the overall GPA exhibiting about a 0.12 advantage for keyboarding. Unfortunately, the table also illustrates that our sample size of 33 pairs was too small to determine with the normally acceptable level of statistical confidence (95%) that keyboarding improved first-year law students' grades by 0.12 on average in comparison with students who handwrote. Our data only determined the approximately 0.12 mean differential at an 88 percent degree of confidence. To get the number of additional pairs necessary to definitively determine whether keyboarding improves grades on average by 0.12 would probably take another five to ten years of data collection, particularly given the relatively small and declining number of students at BYU who choose to handwrite all of their law school exams.

19. The *t* test examines the observed mean in a data sample in comparison with a theoretical distribution. See Naiman et al., *supra* note 13, at 133–34. Specifically, in this case the *t* test examines the observed mean difference between pairs in contrast with the mean distribution one would expect in the absence of any difference between keyboarding and handwriting.

Covariance Analysis

Because the *t* test revealed the possibility that keyboarding provides a 0.12 overall grade advantage, even controlling for students' analytical abilities, but did so with a sample size too small to confirm that inference at an acceptable degree of statistical confidence, Hendrix developed a covariance model to control for other factors besides writing or keyboarding that might affect grades. Specifically, we first controlled for LSAT score, undergraduate GPA, and LSDAS index.[20] Then, to make the model more complete, we also controlled for year, course, gender, and minority status.[21] Essentially, the covariance model mathematically equalized the handwritten and keyboarded exams relative to LSAT score, undergraduate GPA, LSDAS index, course, year, gender, minority status, and method, and allowed us to separate out the impact of handwriting versus keyboarding on overall first-year GPA. Even after controlling for these other factors, we found that the mean GPA of keyboarded exams was 3.18 while that of handwritten exams was 3.07. The probability that this 0.11 grade differential between keyboarders and handwriters was the result of chance was much less than 1 percent ($p<0.0001$). In other words, it was statistically significant. Thus, the covariance model confirmed the initial indications from the pairing test: the 0.11 mean GPA differential favoring keyboarders over handwriters is not due to the fact that stronger students keyboard more often than weaker students (as measured by LSAT score and LSDAS index), or to any of the other factors for which we controlled in the model.

Exam Length

If keyboarding, on average, provides an approximately 0.1 benefit in overall first-year GPA irrespective of the other factors examined in the model we used, the question remains: why? One possibility is legibility and the ease with which the grader may read the exam. The importance of legibility is certainly indicated by the research on the impact of handwriting quality on grades. Another possibility, however, is that proficient keyboarders may gain an advantage by simply being able to say more. We gathered additional data on this latter question.

The examination software used by the law school calculates the number of characters for each keyboarded exam. We collected the data and plotted the

20. The index is derived from a formula that combines a student's undergraduate GPA and LSAT score. It is designed to predict first-year performance more accurately than either indicator alone. Each law school has an individual index derived from a formula provided to it by the Law School Data Admission Service. Each year, LSDAS gets from participating institutions the LSATs and undergraduate GPAs of all entering students as well as the first-year grades of those students. Based on those three pieces of data, LSDAS tells each institution what combination of LSAT score and undergraduate GPA would have best predicted first-year law school performance. That combination is represented in a formula that each law school can then use to develop the "index" which predicts the performance of its entering class based on years past. The higher the index, the better the predicted law school performance.

21. All of these factors except gender significantly related to overall first-year GPA at BYU Law School. Undergraduate GPA, however, was not significantly related to overall first-year law school GPA after index was added to the model.

relationship between exam length (number of characters keyboarded) and exam grade in Figures 1 and 2.

Figures 1 and 2 reveal that those who wrote longer exams tended to receive better grades. There were exceptions, of course, particularly in those instances where students repeated portions of their answers by using the cut-

Figure 1
Mean Character Count by Grade

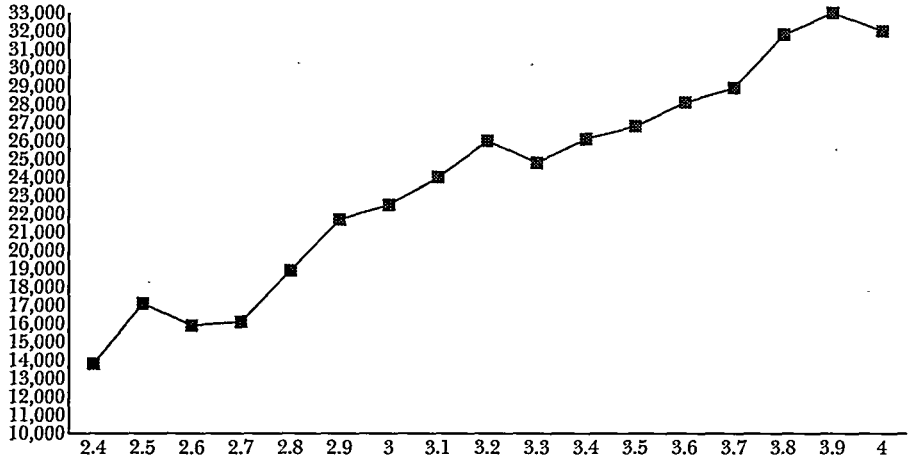
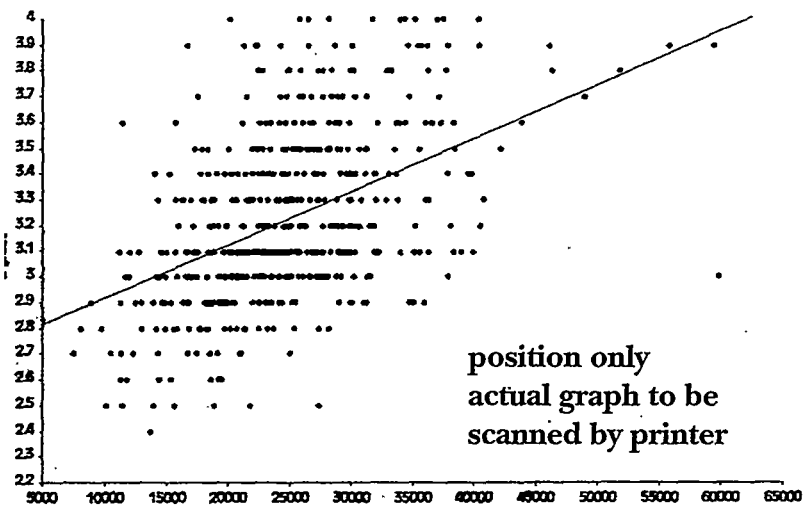


Figure 2
Grade by Character Count



and-paste function of their word-processing programs.[22] Nevertheless, for the keyboarded exams, exam length correlated positively with higher exam grades at a statistically significant level ($p<0.0001$). Specifically, in Figure 2, the slope of the line representing the relationship between grades and character count is 0.021, indicating that an exam grade is expected to improve by approximately 0.021 for each additional 1,000 characters typed.[23] In other words, given that most students keyboarded between 10,000 and 60,000 characters per exam, if we were to compare keyboarded exams with 15,000 characters and keyboarded exams with 30,000 characters, we would find on average that the exams with 30,000 characters received a grade 0.315 higher.

The number of characters in any particular exam probably reflects a combination of the student's knowledge of the course material, ability to recognize and analyze the various legal issues, and keyboarding/handwriting speed. Although we did not count characters on handwritten exams, our experience has been that there also appears to be a positive correlation between exam length and exam grade for those who handwrite.[24] It may be the case, nonetheless, that because keyboarding speed is likely to be faster, it may give a greater advantage than handwriting speed. Proficient keyboarders should be able to say more than proficient handwriters.[25] Accordingly, if exam length positively affects performance on first-year examinations, and if two students have similar knowledge and similar analytical abilities, the one with proficient keyboarding skills may do better simply because she can say more.

* * * * *

In the future, when first-year law students ask us whether it matters if they keyboard or handwrite, we will answer that keyboarding *on average* provides an advantage over handwriting of about 0.1. Of course, our data do not suggest that any particular student will receive a better grade if he keyboards—a point that will bear emphasis in our discussions with students. Indeed, BYU's top first-year student in the 1999–2000 year handwrote all of her exams.

The precise source of that 0.1 advantage is not clear. It may be that keyboarding allows similarly situated students to say more, which tends to be an advantage on issue-spotting examinations where exam length correlates positively with exam grade. On the other hand, in conformance with the literature on neat versus sloppy handwriting, it may be that keyboarded exams

22. In addition to those who cut and paste, there are, of course, always students who have a great deal to say about issues that simply are not presented by the fact pattern in the essay question. With perhaps some self-interested motives, we have cautioned our students that sheer volume is not the primary goal.

23. The 95 percent confidence interval for the slope of the line is 0.017 to 0.024.

24. Correlating exam length and grades for handwritten exams is a project for another time. Counting characters in handwritten exams involves questions of interpretation, whether one attempts to count directly from the handwriting or first transcribes the exam to computer text and then runs a mechanical count.

25. Michael Russell, Testing on Computers: A Follow-up Study Comparing Performance on Computer and on Paper, 7(20) Educ. Pol'y Analysis Archives (1999), available at http://olam.ed.asu.edu/epaa (visited November 6, 2000).

are simply more pleasing to a reader who may be tired, or perhaps a bit cranky, after plodding through a stack of first-year exams.

In any event, if a first-year student is a proficient keyboarder, it is probably in her interest to keyboard her exams. If she does not know how to keyboard, her time would in all likelihood be better spent studying the substance of the courses, rather than improving her keyboarding skills. If the first-year law student can keyboard, but only with about the same proficiency that she can write, her choice between handwriting and keyboarding is probably a toss-up. The student may want to consider the legibility of her handwriting, but if her handwriting is legible, she will probably want to make her choice based upon her comfort level with either method.

When advising students *before* their entry into law school, we will encourage them to become proficient keyboarders to gain the comparative advantage that keyboarding offers over handwriting exams. Even if all law students chose to keyboard their exams, thereby eliminating the comparative advantage over handwriting, keyboarding proficiency would still matter given the tendency for longer exams to receive higher grades.

Of greater concern, however, is the tendency of students with lower LSAT scores to keyboard their exams less frequently than students with higher scores. To the degree that the LSAT predicts first-year law school performance, these are the students whose grades could most benefit from the advantage keyboarding offers. Indeed, to the degree that standardized test scores correlate positively with socioeconomic status, it may be that those with lower LSAT scores keyboard less frequently because they are less likely to have had access to computer technology in their homes and schools.[26] To the extent keyboarding confers a grade advantage, it may not confer that advantage uniformly on all students.

Finally, in our own exam preparation, we will give further thought to our current approach that may overreward exam length. Although it seems likely that length most often reflects mastery of the material and possession of the analytical skills valuable to an issue-spotting exam, the fact that keyboarders can probably say more than academically similar handwriters gives us some pause, particularly in light of the fact that weaker, and perhaps socioeconomically disadvantaged, students are less likely to keyboard in the first instance.

26. See, e.g., Wightman, *supra* note 14, at 42–43 (noting a linear relationship between LSAT score and socioeconomic standing). Sometimes called the digital divide, the relationship between computer access and socioeconomic status has been much discussed. See, e.g., William E. Kennard, Equality in the Information Age, 51 Fed. Comm. L.J. 553, 554 (1999).