PC131 Does feedback improve lab reports? Wilfrid Laurier University

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Purpose

This analysis was performed to see if people who submitted both a draft and a final lab report got a significantly higher lab report mark than those who only submitted a final report. In addition, an attempt was made to determine whether any apparent improvement was actually just due to the fact that people didn't put as much effort into the draft mark knowing that they could improve it for the final.

Procedure

Refer to the *"Determining Revision Effectiveness"* document [1].

Introduction

In the PC131 lab [2], the first lab report handed in is usually submitted twice; a draft is submitted, which gets marked and returned to the students, who may revise it for a final report. The marking scheme for the labs states that if no final is submitted, the draft mark will be counted. If a final is submitted, then the final mark will be counted. In either case, only one mark is used

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in calculating a student's final grade; however, a mark of greater than 50% on the draft will result in the *weight* of the report in the final grade being higher. This measure is intended to provide incentive for students to hand in a draft report. This report investigates whether this revision process is worthwhile in the lab setting, using data collected in the fall of 2007.

Results

Raw data

Each mark was assigned to one of four categories:

- draft mark, where only a draft was submitted
- draft mark, where both a draft and a final were submitted
- final mark, where both a draft and a final were submitted
- final mark, where only a final was submitted

Where only a single report was submitted, whether it was considered a draft or a final was based upon when it was submitted; a report submitted early enough for feedback was considered a draft, whereas a report submitted after feedback was no longer possible was considered to be a final. The raw data are presented in Tables 1 to 3. The uncertainty in all of the lab marks is 1%[1]. Note that the number of people who submitted a single report was much less than the number who submitted both a draft and a final. The nature of the marking scheme is such that it is possible for a mark of zero to be obtained, although this is rare. There are two such cases in the data. While it may be tempting to consider these as cases where no draft was submitted, they still provided a great deal of feedback to the students involved on what was missing or incorrect, and so they are included in the group where both a draft and final were submitted.

[1] The decimal parts of some marks is related to the marking scheme. Even though normally numbers would be rounded because of the uncertainty, they have been left here as recorded originally so that they can be identified in the original data.

59	72	87	98	89
86	64	99	85	

Table 1: Marks for *draft only* reports

draft	final	draft	final	draft	final	draft	final
79	92.3	40	64	78.6	87.7	55	83.67
64	84	46	68	0	89	30	45
75	81	42.3	85.3	54	90	25	50.3
30	32	0	64	25	43	50	87
23	67.7	9.5	68	69	84.3	29	57
35	65	32	72.3	20	57	50.8	95
20	73	52	91	26	74	46	67
42	79.3	56	88	80	89	53	68
71	87	67	85	38	91	69	85
79	88	80	89	58	91	59	100
82	91	18	91	73	90	63	88
54	85	33	73	16	94	32	81
70	84	25	77	36	71	74	95
58	69	81	93	85	100	63	88
63	87	38	86	91	95	97	100
95	98						

Table 2: Marks for reports where both a draft and final were submitted

67	69	43.3	43
64	75	29	44
25	62	78	100
84	87	87	78
69	88	84	87
90	82		

Table 3: Marks for *final only* reports

Calculated results

Sample Calculations (for "draft only" reports)

$$\overline{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{59 + 72 + \cdots + 99 + 85}{9} = \frac{739}{9} \approx 82$$

and so

$$\begin{aligned} \sigma &= \sqrt{\frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n-1}} \\ &\approx \sqrt{\frac{(59-82)^2 + (72-82)^2 + \cdots + (99-82)^2 + (85-82)^2}{9-1}} \\ &\approx \sqrt{\frac{1597}{8}} \\ &\approx 14.1 \end{aligned}$$

thus

$$\alpha = \frac{\sigma}{\sqrt{n}} \approx \frac{14.1}{\sqrt{9}} \approx 4.7$$

Since all marks are given to the nearest 1, then the precision measure of the marks is assumed to be 1. Thus the uncertainty in the average is the bigger of 4.7 and 1, which is 4.7, which is 5 when rounded to one significant figure.

Thus,

$$\Delta\overline{x} = 5$$

and so

$$\overline{x} = 82 \pm 5$$

Summarized Calculation Results

Table 4 shows the averages with their uncertainties for all of the reports in each of the four categories. *The uncertainty in each average is the larger of the standard deviation of the mean and the uncertainty in the individual marks. Since the uncertainty in individual marks was 1, then in each case the uncertainty in the average was the standard deviation of the mean.*
The results are shown graphically in Figure 1.
A few other averages may be worth noting as well, and are shown in Table 5.

	draft only	draft both	final both	final only
average	82	51	80	70
uncertainty	5	3	2	4
N	9	61		22

Table 4: Average marks for all reports

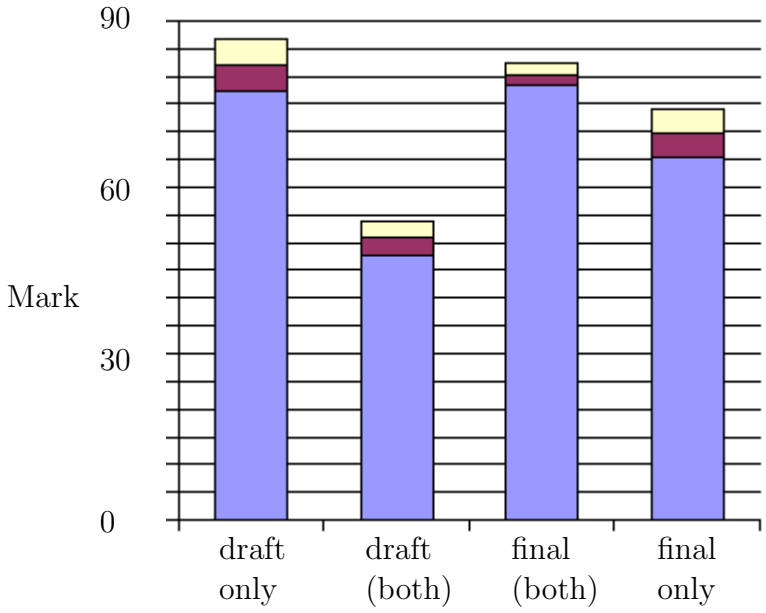

Figure 1: Averages for all reports (from Table 4)

	single report	all drafts	all finals
average	73	55	77
uncertainty	4	3	2
N	31	70	83

Table 5: Other pertinent average marks

Discussion

The average for people who only submitted a *single* report was 73 ± 4 and the final average of people who submitted *both* a draft and a final was 80 ± 2, so the two averages do not agree within experimental uncertainty[Q1]. People who submitted a draft and a final got a significantly higher mark than those who handed in a single report.

There is an apparent anomaly in Figure 1. There were two groups of people who submitted a single report; those who submitted only a draft and those who submitted only a final. For these two groups, the average (82 ± 5) for the "draft only" group was higher than the average (70 ± 4) for the "final only" group[Q3]. One might expect these averages to be similar, since they both represent the first reports submitted. However, the difference makes sense given that people who submitted a draft gave themselves the *possibility* of revising, even if a high enough draft mark would make a final unnecessary. Thus at least some of the people submitting only a draft probably did not submit a final simply because they considered the mark on the draft to be high enough. On the other hand, some people who submitted only a final may have received lower marks than they expected, but had no remaining option of improving, whether they wanted to or not.

Since the average of the "draft only" reports agreed within experimental uncertainty with the final marks for those who submitted both, it is clear that some students could produce a draft which was not in need of significant revision. However the size of that group relative to the group which submitted both, (9 vs. 61), suggests that most students benefited by the revision process.

Another point to note is that the average of the "final only" reports was significantly higher, (with a difference of 19 ± 8[2] marks), from the drafts submitted by people who submitted both. This suggests that people who knew they were creating a final report were more careful than those who expected to make revisions. A smaller difference of 15 ± 7 still exists even if all of the drafts submitted are combined. This confirms the idea that people expecting to revise are not as careful as those who know that they have no chance for revision. Some of the apparent improvement from draft to final is really just due to more effort being put into a report when it is known to be

[2]The uncertainty in differences may vary slightly from the sum of the uncertainties due to rounding.

"final".

The main result to emerge from the data is that the improvement between draft and final was significant. The average improvement was 29 ± 5 marks. This difference is large enough that the extra effort involved in a "final" report as compared to a draft is not sufficient to account for it. Thus the feedback received is helpful and accounts for a significant portion of the increase.

One question which remains is whether the improvement due to revision of a single lab report will carry over to subsequent lab reports. If the same checklist is used for all of the lab reports, it would be logical to expect that, if the revision process improves students' writing in general. It may simply improve the specific report involved. Further research is needed to establish whether or not the students' general writing skills are improved by revising a single report.

Conclusions

Here are several conclusions which can be drawn from this analysis:

- Some students can produce high quality reports the first time, as evidenced by the "draft only" average of 82 ± 5, compared to the draft mark for people who handed in both a draft and a final of 51 ± 3[Q2]. This is a
$$\left|\frac{82-51}{51}\right| \times 100 = 61\%$$
difference.

- The mark for those who only submitted a draft of 82 ± 5 agreed within experimental uncertainty with the *final* mark of 80 ± 2 for people who submitted both, suggesting that the people who only handed in a draft were content with their marks and so did not hand in a final report.

- The average for those who only submitted a final was 70 ± 4, while the average for all drafts was 55 ± 3. This is a
$$\left|\frac{70-55}{55}\right| \times 100 = 27\%$$
difference. The statistically significant difference between the "final only" average and the average of all drafts, (15 ± 7), suggests that students having the intention of revising may not produce draft reports as carefully as they would if the revision was not possible.

- A significant improvement was observed between draft and final marks for those who submitted both; from 51 ± 3 to 80 ± 2. This is a
$$\left|\frac{80-51}{51}\right| \times 100 = 57\%$$
improvement.

The last two points, taken together, suggest that even though people may work harder on something they think is "final", they will do better still with feedback on a draft report. Thus the results suggest that feedback is effective.

References

[1] Terry Sturtevant. Determining revision effectiveness sample lab. From PC131 web page, 2010.

[2] Terry Sturtevant. Pc131 lab manual. From PC131 web page, 2007.