Better Understanding through Writing: Investigating Calibrated Peer Review ™

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Abstract

Calibrated Peer Review (CPR) was initially developed by UCLA in the 1990s as a way to use technology to increase the opportunities for student writing assignments.[1] Writing about a concept has long been seen as one of the best ways to demonstrate student understanding. Unfortunately, it has always been true that more student writing assignments yields weekends lost in a sea of paper and grading schemes that ebb and flow in their accuracy. CPR applies the process of scientific peer review to education. Students perform research (study), write about their "findings", submit it for blind review (and act as reviewers themselves), and finally use peer feedback to improve their understanding. All of this is possible without intervention from the instructor using CPR.

This paper reports on part of a continuing study on the utility of CPR in engineering education. In this instance, CPR was introduced into a writing-intensive laboratory course in chemical engineering. Students worked in teams, but were required to submit individually-crafted executive summaries using the CPR system. Assessment was based on instructor inspection of student work related to previous semesters and a survey administered to the students.

Background

CPR was originally developed as a writing aid in large enrollment chemistry courses, but is now being used for various disciplines and subjects at over 300 schools and universities.[1] The underlying theory is based on the scientific writing process. Students research a topic, write an essay, report, or similar output, and then submit their work for peer review. They also participate as reviewers themselves. The final stage requires the students to review their own work after having seen their peers' writing. The process is illustrated in Figure 1.

While several other web-based peer review tools have been designed[2,3], the "calibration" stage is unique to CPR. When the assignment is created, the instructor/author must develop three examples of student work: one excellent, one average, and one poor. The instructor/author then creates a scoring scheme (rubric) and rates each of the sample texts. After a student has completed his or her own writing and prior to being allowed to rate any fellow students, the student is presented with these examples and asked to rate them. This rating is compared to the rating assigned by the instructor/author. The similarity between the student and instructor's ratings on the same text determines that student's *Reviewer Competency Index* or RCI. The RCI ranges from a low of 1 to a high of 6 and is used to weight the rating given by any particular

student. This mitigates the effect of poor student raters on the performance of other students. The tool is intended primarily to improve concept learning and secondarily to improve writing skills for future scientists through increased practice. The formula for deriving the RCI and other technical information is available at the CPR website.[1]

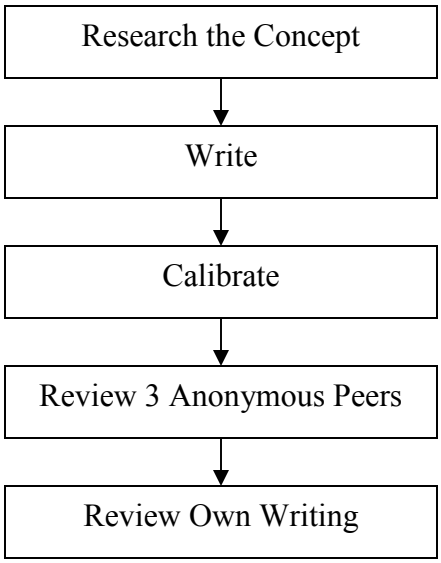

Figure 1. CPR Student Process

This paper reports on the application of CPR to a writing-intensive laboratory course in Chemical Engineering. The course covers, "Data interpretation and correlation from student-operated experiments on pilot-plant equipment… Individual written and oral technical reports."[4] CPR was introduced in order to increase individual writing opportunities, particularly in the writing of the executive summaries that accompany written lab reports. The course has historically made use of student teams to conduct experiments and then work collaboratively to develop the final report. In most cases, this results in a division of labor on the final report, with one student writing the summary, another student the introduction, another the findings, etc.

While an efficient means to an end, the problem is that, unlike real-world situations, the goal of the experiment is not generation of a report, but *learning* on the part of the students. Without constraints, the best way to approach this learning situation would be for each student to conduct the experiment and write his or her own report. Only in this way would each student be exposed to each part of the assignment and gain needed experience. This is, as we know, impractical for classes of any appreciable size. It is also important to allow the students to work in teams during their college years as part of the desired curriculum. A compromise is to have the groups conduct the experiments, but require each individual to do their own writing. In this situation, the instructor decided to require individually written executive summaries. The executive summary is different from an abstract or a general summary, and requires a different approach to be effective. Using CPR, each student was required to write an executive summary, then review

three summaries written by anonymous peers, and finally to review his or her own work. The course was made up of 36 students, all in their senior year of studies.

Design of the CPR Assignment

The goal of the assignment was presented to the students in the following manner:

> Presenting your work to managers and colleagues will be a part of your daily life when you go to industry, and how important it is cannot be overemphasized. Without [a] good presentation or report, your painstaking work would never be acknowledged properly. The most important part of the technical writing is the executive summary that you include on the first page. Very often, the readers (managers, colleagues, or employees) may be perilously close to a final judgment about your manuscript after reading the executive summary. Through the CPR process, you will learn how to write a good executive summary of the project you complete in the ChE407 Unit Operations Lab.

The assignment was implemented three times during the semester. This is unusual, as most CPR assignments are taken only once. It is possible that repeating the same assignment affected the results of this study and this should be kept in mind.

Results

Students were resistant at the beginning of the semester, but appeared to learn using the system. Initial resistance to CPR has been reported by other researchers and should be expected.[5,6] Furman and Robinson[7], in fact, report "substantial discontent" with the use of CPR. Regardless, many students showed improvement at the time of the second administration in both reviewing and writing skills, having "mastered" the reviewing process by the third iteration (Figure 2.). It should again be noted that this may be the result of completing the same assignment multiple times, and in fact some students reported that they had simply changed their answers on the third pass based on previous results.

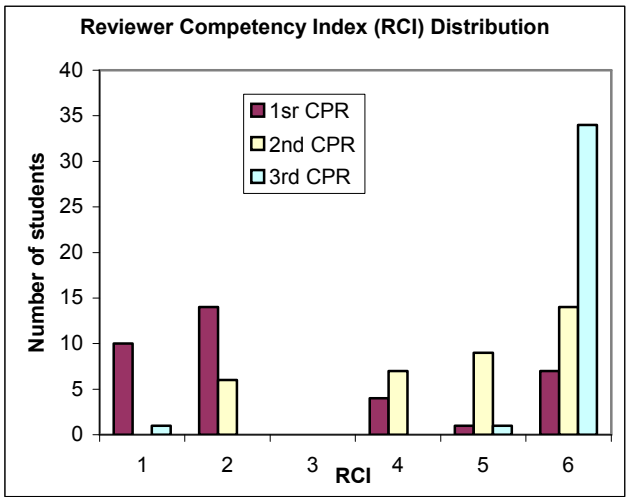

Figure 2. Change in RCI Over 3 Administrations

Students with high RCIs tended to also have high text scores, indicating that the two skills are related (Figure 3.).

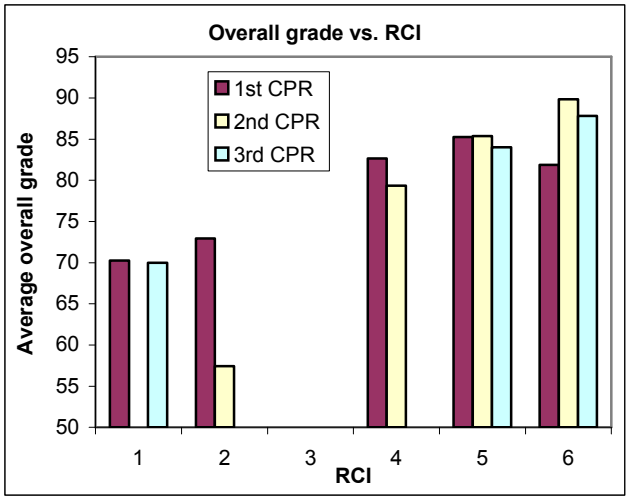

Figure 3. Relation of Overall Grade to RCI

Twenty-eight of the thirty-six enrolled students completed a voluntary survey administered by the course instructor. Taken as a whole, the class' executive summaries appeared to improve, and most students reported that they thought their writing skill had improved through the use of CPR (Figure 4, from 1 ("Not at all") to 7 ("A lot")), but this change was not independently quantified. A rubric will need to be developed in order to adequately measure these differences.

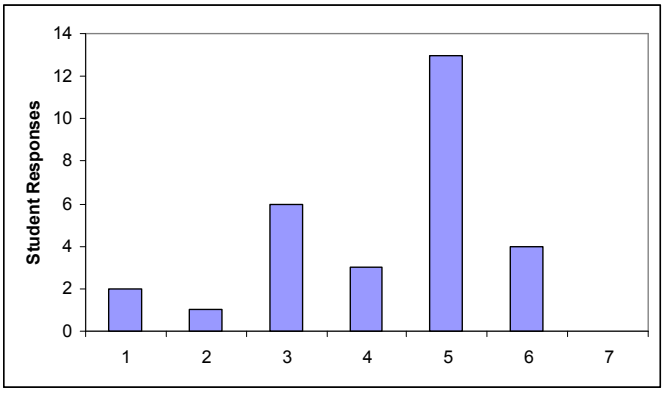

Figure 4. Survey Response - Did CPR Improve Writing Skill?

Students were also asked to rate whether or not CPR helped them find the important aspects of the experiment and differentiate them from experimental details. Figure 5 is a histogram indicating the student responses on a scale of 1 ("Not at all") to 7 ("A lot"). Fifty-seven percent (57%) reported CPR as being helpful in this respect. This is a positive finding in keeping with the objectives of this course.

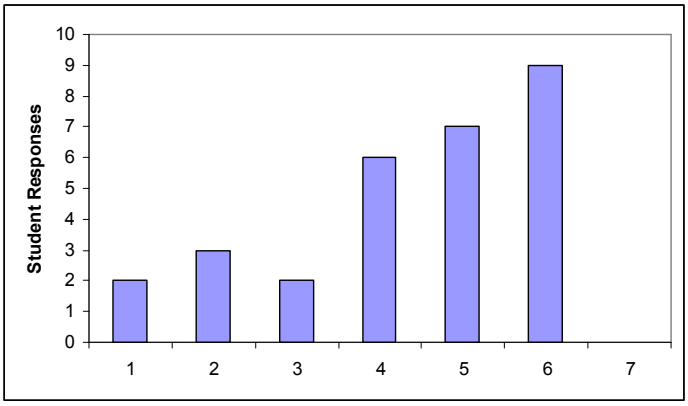

Figure 5. Survey Response - Did CPR Help Differentiate Important Aspects?

Conclusion

Calibrated Peer Review can be used in engineering laboratory courses to give students more experience in report writing. Some resistance can be expected, but students will be able to perform if given adequate support at the beginning of the process. Care should be taken if an assignment will be used more than once, as students will soon determine how to maximize their scores through the ratings they give each other. Balance needs to be found as well in the weighting given to CPR assignments in the grading scheme. A CPR assignment is not a trivial activity, so it should carry some weight; but it should not be such a large part of the grade that students are tempted to concentrate more on the grading than the process of improving their writing.

This paper reports on a qualitative study of the application of CPR in an engineering laboratory environment. Further study is needed in the effect of CPR on learning outcomes, such as concept understanding, retention, and transfer.

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Biographical Information

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John Wise is the Director of Engineering Instructional Services at Penn State's College of Engineering. He earned his B. A. in Liberal Arts from The University of the State of New York and his M.S. and Ph.D. in Instructional Systems from Penn State. He provides assistance to faculty members and teaching assistants in the areas of teaching, learning and instructional technology and educational assessment support for the College of Engineering.

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