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Enhancing Engineering Lab Report Writing Using Peer Review Assessment

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Abstract

This paper describes the educational experiences gained by incorporating a peer review component for evaluating formal lab reports in a Circuit Analysis Laboratory course. In this course students performed ten lab experiments, from which the instructor selected two to have individual formal written lab reports. The instructor dedicated about one hour at the beginning of the semester to talk about peer review and its importance. The instructor together with all students performed a mock peer review of a lab report so that students became familiar with the process and the rubric. The instructor emphasized the importance of providing meaningful feedback in the peer review process, and gave several examples of meaningful feedback. The peer review process was performed in class, and the instructor monitored the process to ensure students took their time to read carefully the reports, follow the rubric, and provide meaningful feedback to their peers. Results from implementing the peer review process in two semesters shown an increase in student's awareness about the importance of technical writing, and help them to pay more attention to their writing to ensure they can convey their ideas and experiences to their classmates and instructor. The instructor noticed a significant improvement in the writing at the last of semester formal lab report, indicating students incorporated peer recommendations.

Keywords

Peer review, engineering lab reports, technical writing.

Introduction

Peer review is commonly used in higher education to enhance student learning. It has been reported by many researchers [1,2] that peer assessment between students provides several benefits to the students; peer assessment provides feedback among peers and resembles professional practice, and in university environments also contributes to collaborative learning, that is something that the engineering students will perform in their real-life careers as long life learning skills. Peer assessment requires students to judge one another work by means of a particular criteria, and provide meaningful feedback. To gain some benefit from peer assessment, students should be engaged in the peer feedback process in well-organized settings, with strong and meaningful guide from the instructor. In a well guided peer review process, students reviewing the work of their fellow students will enhance their own learning process, not only reinforcing technical concepts, but also building up their grammar and writing skills. It is important to emphasize that lacking clear guidelines of the peer review process will result in students not performing a meaningful review of their peers' work.

Liu et al.[3] suggested that in order that a peer review process can provide learning benefits to students, peer assessment should not be correlated to grading with summative purposes. If students perceive peer assessment as part of their grade, the potential learning benefits will be greatly diminished. In [4,5] the authors have reported that if peer assessment is used for formative purposes rather than evaluative, it could yield to several potential learning benefits to students. Adachi et al.[6] indicated that peer assessment could provide opportunities for students to enhance "soft" and "transferable skills" such as communication, critical thinking, and collaborative/teamwork. Transferable skills are the ones that future employers demand of the graduates, and prepare them to be work-ready and life-long learners. Peer assessment also promotes active learning, because instead of being passive receivers of criticism on their work, students have the opportunity to play the role of active assessors. Another benefit reported in the literature is also that students will gain better understanding of standards and assessment.

In this paper the authors describes their experiences on how peer assessment was incorporated in the writing of lab reports in electrical engineering. Also the methods that were applied to ensure that students received some benefit from this experience are described. In particular the present paper describes the experiences and results that were obtained by applying peer assessment in Circuit Analysis Lab. In this course, students evaluated their peer's formal lab reports. This experience has provided opportunities to students to enhance their technical knowledge as well as their grammar and written skills.

Course Description

The Circuit Analysis laboratory is a course for sophomore/junior students in the electrical engineering program. The typical number of students taking this course is 35 to 40. The class is divided in two lab sections, and students work in teams of two. Students perform experiments in classical circuit analysis topics, such as mesh and nodal analysis, Delta-Wye transformations, Thevenin equivalent, maximum power transfer, resonant circuits, operational amplifier circuits, and passive and active filters. Each week, students perform a new lab experiment, and before coming to the lab session, students need to complete a pre-lab assignment that includes theoretical calculations and simulation using Matlab and/or MultiSim.

Design and Implementation of Peer Assessment

The peer assessment component was developed and implemented for the circuit analysis lab course during the Fall 2017 and Spring 2018. During the semester, students performed peer assessment on two formal lab reports. In the normal lab sessions, students worked in teams of two and each team shared the same experimental data, however the formal lab reports were written individually, encouraging each student to write on his/her own style. As a guide to prepare the formal lab reports a detailed rubric was provided to the students (Table I). In the following paragraphs, the process that was followed to implement the peer assessment is described in detail.

In the first class the instructor addressed the benefits of strong written communication in the engineering filed, and how in real-life engineers need to communicate constantly in oral and in written form with their supervisors, directors, co-workers, technicians under their supervision, etc. It is also explained how peer assessment resemble professional practice, and that all research manuscripts that faculty and students submit to conferences and journals, always go through a peer review process.

- Step 1. Mock peer assessment. Early in the semester, a lab report assessment exercise was performed in class so that students had a better idea of what type of assessment they had to perform in this class. In this exercise students were given a sample of previous semester lab report. Students together with the instructor, performed the assessment of the lab report following a detailed rubric (Table I). The main objective of this exercise was to familiarize students with the rubric and the procedures that are used to perform peer assessment. Of great importance is that students acquire a good sense of what is meaningful feedback, so that their peers can benefit from the peer review process, and enhance the quality of their technical report.

- Step 2. Students submit formal lab report. The instructor assigned which labs will require individual formal lab report. Students submitted the first formal lab report that will go through the peer review process.

- Step 3. Instructor assigns double blind reviewers. After the formal lab reports were collected, the instructor sorted the reports and assigned double blind reviews. In a double blind peer review the identity of both the author and reviewer is kept hidden.

- Step 4. Peer review is performed in class. The peer review process was performed in class so that the instructor was able to monitor the reviews, and ensure that students were focused on the review process, reading their peers' reports, following the peer review guidelines, and are not just rushing to finish the review. The instructor allocated 30-40 min to the students to complete the peer review assessment. Table II provides the guidelines that were given to the students to perform the peer assessment.

- Step 5. Instructor assesses the reviewers' feedback. The instructor assessed the feedback the students provided to their peers. The instructor provided scores to the reviewers based on the quality of feedback that was provided, and not to the authors.

- Step 6. Instructor meets with students. The instructor met with individually with the authors to discuss the written feedback given by their peers, and give recommendations to improve his/her formal lab report.

- Step 7. Final version of lab report. Students incorporated the feedback and recommendations provided by their peers and the instructor to improve his/her lab report. Students submitted the revised and final version of their technical report. This final version is the one that the instructor used to assign grade to that particular lab.

Figure 1 provides the schematic showing the peer review process that was followed by the instructor to perform the peer review process in the circuit analysis lab.

Results

Most of the written feedback that students provided to their peers was of the type product-oriented, this is that students addressed mainly the aspects of content and style, and not on the structure, or asking questions and proposing revisions (analysis). Table III provides some samples of peer feedback received. It is important to state that these samples are typical feedback that was provided by 75-80% of the class. There were some students (about 10-15%, who answered with shorter answers that did not provided relevant feedback to the authors to be able to improve their report. Around 10-15% of the students provided more meaningful feedback than the one that is provided in Table III.

There are some advantages and disadvantages that the instructor perceived as result of adding a peer review assessment as part of the formal lab reports. The advantages included that the peer review feedback process contributed to further student's judgment skills, encouraged student involvement and responsibility, and allowed students to see and reflect on their peers' work. Some disadvantages included the additional time that is needed to perform well organized peer review process, and taking time of actual laboratory work. Also, some students had a tendency to just give a type of yes no answers in the review, and not provide meaningful feedback that could be used by the authors to improve their reports. Therefore, the instructor has to spend time encouraging to improve the comments to their peers.

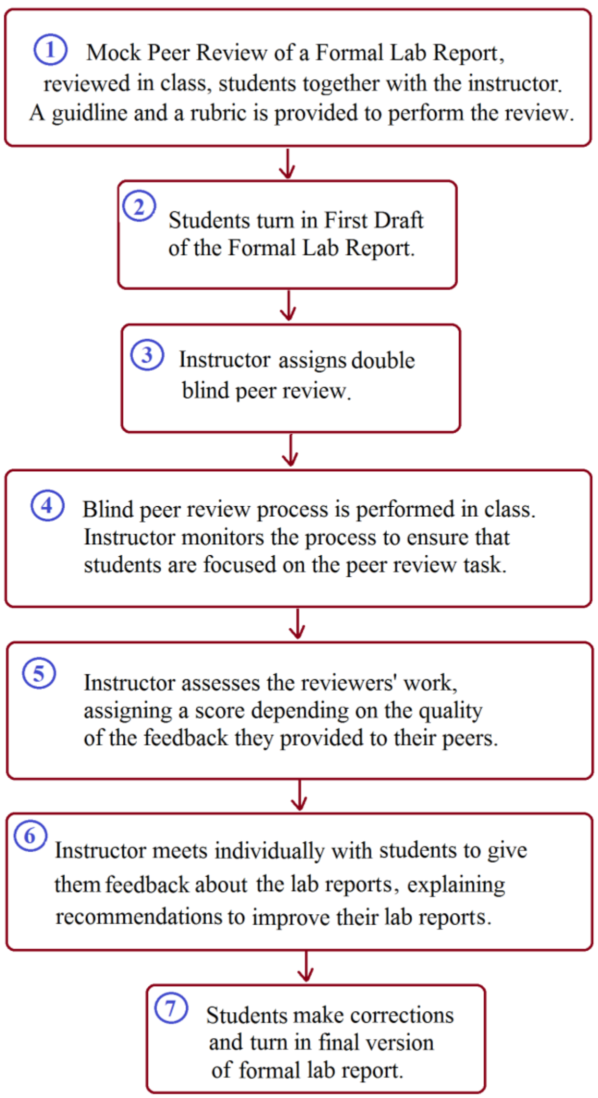

Figure 1: Sequence of the Peer Review Process

Table 1: Rubric for Measuring Effective Writing Skills

Write Technical Reports that Conform to Standard Engineering Terms and Formatting (SLO6: g1)					
Performance Indicators	**Exemplary 5**	**Proficient 4**	**Developing 3**	**Beginning 2**	**Introductory 1**
Abstract Communicating a clearly defined purpose	The abstract concisely covers the motivation, the problem statement and objectives, the methodology, results and conclusion. It is an insightful summary of the report.	The abstract covers the problem statement and objective, the methodology results and conclusions, but may lack some adequate description in some areas.	The abstract while present, does not include results and/or conclusions. Includes inappropriate content.	An abstract is included but does not include objective, methodology, and major findings.	An abstract is not included.
Theoretical Background. Organizing ideas and information consistent with purpose.	Introduction is complete and well written. Includes theoretical background, relevant equations, preview of topics and organization of report. Central hypothesis clearly defined. Objectives clearly stated. References included.	Introduction is presented and appropriate conveys theoretical background including equations. Central hypothesis defined but somewhat vague. Organized into sections and objectives clearly stated. References included.	Introduction contains some theoretical background but some major points are missing (background theory or relevant equations). Central hypothesis is very vague. Organized in sections and objectives stated. Not enough references.	A technical introduction is present but does not include theoretical background, relevant equations and/or includes incorrect information. Central hypotheses not clear. Objectives not clearly stated. No references.	Introduction is missing or does not outline the report. Central hypothesis is missing. No organization, no objectives included. No references.
Methods. Identifying, evaluating and selecting **credible evidence** or relevant examples.	Each section of report has supporting claim to advance central idea(s). Substantial amount of evidence and methods to support claim. Data clearly presented.	Each section of report has supporting claim to advance central idea(s). Expected among of methods and evidence to support claim. Data clearly presented.	Most sections of report have supporting claim to advance central idea(s). Average explanation of methods. Most data included.	Some sections of report have supporting claim to advance central idea(s). Very minimal evidence. Lack of required data recorded	Most sections of report do not have supporting claim to advanced central idea(s). Issues with data collection.
Discussion pursuing a substantial or compelling inquiry.	Insightful analysis of results, connecting it to theory, and reflecting on the physical significance of results. Completely supports the overall purpose.	Results summarized and adequate analysis and discussion. Some attempt at communicating physical significance. Discussion supports main purpose.	All results are summarized, but limited discussion. Discussion partially supports the main purpose.	Results summarized but are vaguely discussed and inconsistent with purpose.	No discussion or reflection present and/or not related to the results and overall purpose of report.
Demonstrating a good understanding of **audience**(s) and word choice.	Demonstrates an ability to write towards a specific audience and uses appropriate technical terminology.	Writes towards an appropriate audience and attempts to use correct technical terminology and word choices, minor lapses are present.	Writes towards an appropriate audience but fails to consistently use technical terminology and word choices.	An attempt to write towards an appropriate audience was made. Terminology and word choice mostly not appropriate.	Inappropriate or inconsistent audience and/or word choice. Technical terminology absent.
Adhering to acceptable **structural and format style** guidelines appropriate to the discipline and purpose.	IEEE style and format guidelines consistently (labeling figures/tables and proper citation of references). No spelling or grammar errors, professional report presentation.	IEEE style and format guidelines used throughout report (labeling figures/tables and proper citation of references) with few exceptions. Rare spelling or grammar errors. A neatly report.	IEEE style and format guidelines used in report including figures tables and references. A limited spelling or grammar errors exists affecting readability. Average report.	IEEE style and format guidelines attempted but inaccurate, or multiple style guidelines mixed. Variety of grammar and spelling errors, affecting readability. Poor quality report.	Lack of adherence or knowledge of IEEE style and format guidelines. Multiple spelling or grammar errors in most sentences. No references.
Using effective **visual representation** to enhance, focus and amplify written text.	Tables and figures used effectively to explain concepts and/or results; greatly enhances the written text. All tables and figures have meaningful captions that stand alone.	Tables and figures used adequately to explain concepts and/or results appropriately. Captions are adequate to help the reader.	Tables and figures used to support text appropriately, but presentation is distracting and/or some information may be incorrect. a	Tables and figures present but used inappropriately and/or visuals do not clearly convey information. Very general/poor captions.	Tables and figures not present /or poorly presented.
Provide comprehensive **conclusions.**	Conclusion overwhelmingly reinforced central hypothesis.	Conclusion reinforced central hypothesis as expected.	Conclusion adequately reinforced central hypothesis.	Conclusion did a poor job in reinforcing central hypothesis.	Missing conclusion or it did not reinforce central idea.

Table 2: Sample of feedback given by peer reviewers (refer to questions and rubric in Tables I and II)

Q1. Although it was not specifically cited as an introduction, the overview section given at the beginning was a good introduction. The conclusion section was short, and it is suggested to reword the conclusions in terms of what was said in the abstract but more focused on what was accomplished. There is no literature cited. Q2. I felt the titles used for the sections were described well the content. This made it easy to find needed information Q3. There was a logical flow in this lab report. It felt like the Appendix was added only as an after-thought. Q4. As a whole this lab report was well written grammatically, I could not find any errors Q5. The writer style was good, easy to follow. Q6. Nothing was said about maximum power load and this should be included as one of the finding in this lab. Q7. I felt the introduction/theory portion of the lab report was the best part. All information needed was there and helped to explain the lab. Q8. I believe that the lab report would be enhanced if a bullet point list with all the components is included. The circuit diagrams were of good quality and with enough information. Q9. Slightly more depth could have been given to the description of procedures. Q10. The equations are provided and I like how they are included. Q11. Results are given in a clear way. Figures and tables are labeled well. Q12. No discussion is included in the report, and it is needed. Q13. The conclusion was more of a discussion. More attention should be given to results. Q14. It was written in passive tense Comments: It was a well written lab report

Conclusions

The instructor teaching this course faced new tasks, which included the design of the peer review process and creating guidelines and rubrics that guided as clear as possible to the students in the process of reviewing their peers' written reports. The instructor also had to get more involved in supervising the peer review process, and creating an environment in which students felt safe in commenting on the performance of their fellow students. The main objective of the peer review process was to help students in the learning process by providing, as well as receiving feedback, and latter, hopefully, help them to apply the new gained skills, as peer reviewers, to his/her own future writing. An important outcome of adding the peer review component in the circuit analysis lab is that, students taking this course, can take advantage of their experience in evaluating their peers to improve their own reports for other courses, and improve their overall communication skills.

References

1 Ineke Van Den Berg*, Wilfried Admiraal, and Albert Pilot (2006), "Designing student peer assessment in higher education: analysis of written and oral peer feedback", Teaching in Higher Education, 11:2, 2006, pp. 135-147, DOI: 10.1080/13562510500527685

2 Daniel Jeffery, Krassimir Yankulov, Alison Crerar, and Kerry Ritchie (2016), "How to Achieve Accurate Peer Assessment for High Value Written Assignments in a Senior Undergraduate Course", Assessment & Evaluation in Higher Education, 41:1, pp. 127-140.

3 Ngar-Fun Liu and David Carless (2006), "Peer feedback: the learning element of peer assessment", Teaching in Higher Education, 11:3, pp. 279-290, DOI: 10.1080/13562510600680582

4 Min Yang and David Carless (2013), "The feedback triangle and the enhancement of dialogic feedback processes", Teaching in Higher Education, 18:3, pp. 285-297, DOI: 10/1080/13562517.2012.719154

5 Joanna Tai, Rola Ajjawi, David Boud, Phillip Dawson, and Ernesto Panaderome (2017), "Developing evaluative judgment: enabling students to make decisions about the quality of work", Higher Education, pp. 1-15, DOI: 10.1007/s10734-017-0220-3

6 Chie Adachi, Joanna Hong-Meng Tai, and Phillip Dawson (2018), "Academics' perceptions of the benefits and challenges of self and peer assessment in higher education", Assessment & Evaluation in Higher Education, 43:2, pp. 294-306, DOI: 10.1080/02602938.2017.1339775

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