Classroom Assessment Makes a Difference

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Abstract

Students need rigorous knowledge construction on the fundamentals of electric circuits and filters to progress onto more advanced courses in electrical engineering. Traditional assessment using mid-term, final examinations and quizzes is not adequate in guiding and measuring student learning on certain domains of learning necessary for workplaces with constant flux. Based on social interactionists' perspectives, the research project examined the interaction of student feedback, which was implemented as a classroom assessment technique, and faculty instruction, interactive teaching method, focusing on higher levels of learning. The study framed around the need to determine how student feedback affected an instructional design and student learning. The research instruments are both qualitative and quantitative: student feedback, video transcripts, stimulated-recall interviews, and final examination paper and results. Data collected from these approaches are also both qualitatively and quantitatively analyzed. The study yields important findings which confirm the positive effects of student feedback on student learning and faculty development.

Key words: classroom assessment, social interactionists' perspectives, higher levels of learning, stimulated-recall interviews, faculty development

Introduction

Students need rigorous knowledge construction on the fundamentals of electric circuits and filters to progress onto more advanced courses in electrical engineering. The main learning goal of this course, Electric Circuit Analysis and Filters, is to insure that students can firmly master the skills necessary for analyzing the majority of electric circuits encountered in later courses of an electrical engineering curriculum. In addition, the important objective of studying circuit analysis is in developing skills useful in circuit design. Moreover, the professional association monitoring engineers' licensure and ethics promotes assurance of quality. Thus teachers need to ensure student learning. Traditional assessment using mid-term, final examinations and quizzes is not adequate in guiding and measuring student learning on certain domains of learning necessary for licensure and workplaces with constant flux. A classroom assessment technique, student feedback, is a useful tool for teachers for checking how well students are learning and how to improve the quality of learning before it is too late when students fail in their mid-term and final examinations based on fact-based knowledge and algorithmic problem-solving.

 The philosophy of Interactive teaching method along with classroom assessment of Faculty Development Academy is based on Bakhtininan perspectives: dialogism and the theory of reciprocity. According to Nystrand's theory of reciprocity (1986, 1997), the interaction between or among conversants makes message communicative and social. The process of interaction is dialogic and reciprocal. While the teacher was giving a lecture on principles and assigned exercises, he reciprocally interacted with students by spending time questioning and discussing on the topics with students. At the end of the period, he asked students to write feedbacks to assess their learning and his teaching.

In Bakhtinians' view, divergent teacher assessment provides more opportunities for the teacher to teach in Vygotsky's 'zone of proximal development' (Vygotsky, 1978). The teacher had the information of what student learned or did not learn. Then he redesigned his instruction to clear the muddiest points to establish mutual knowledge so that he could proceed on sharing new knowledge with students. Once the muddiest points were clear, student learning fulfilled the teacher's expectation and students' expectation that they wanted to understand. Both of them achieved their goal of teaching and learning and communication.

This is in accord with what Bakhtin stated, "Communication between or among conversants requires that the message mediate their mutual knowledge and fulfill their expectations." This study presents the implications of this principle of reciprocity for teaching advanced knowledge in electrical engineering and implementing classroom assessment for communication.

This study sets out to assess the academic improvement of the second year engineering students majoring in electrical engineering on knowledge construction in electric circuit analysis and filters. The research questions are as follows:

1. How does a classroom assessment make a difference?

2. What is the role of Bakhtinian perspectives in improving teaching and learning an advanced course in electrical engineering?

3. How is an instructional design affected by a classroom assessment based on Bakhtinian perspectives?

4. How do students evaluate the lesson and assessment technique based on Bakhtinian perspectives?

Research Context

The head and faculty members of the School of Electrical Engineering, Institute of Engineering realized that a sizable number of students who enrolled in Circuit Analysis and Filters course made low academic achievement. They wanted to reduce the number of failing students while maintaining graduate quality to the standard set by the professional association. The Circuit Analysis and Filters course is fundamental to more advanced courses in electrical engineering. More than 85% of students enrolling in this course usually earned grades C-F so it reflected their background knowledge in electrical engineering. This could affect their academic achievement of the more advanced courses. The classroom assessment technique used as a part of interactive teaching method aimed at improving student academic achievement.

Faculty Development Academy (FDA) offered consulting and classroom observation to monitor teaching and learning process. Besides interactive teaching method used instead of conventional lecture across 4 sections, a classroom assessment technique, students' feedbacks, was also introduced to students in Section 1.

Literature Review

Research studies on successes of classroom assessment techniques have been conducted and reported (Davies, Ann, 2003). The primary aim of classroom assessment is course improvement because it gives both teachers and students useful feedback on the teaching and learning process. Angelo et Cross () presented fifty classroom assessment techniques in their book entitled *Classroom Assessment Techniques: A Handbook for College Teachers*. The one we selected to use in our class was "Feedbacks." We applied the technique to serve our teaching and learning style we designed based on Bakhtinian Perspectives.

For Bakhtin (1986), all languages and all thoughts - appear dialogic. This means that everything anybody ever says or will say always exists in response to things that have been said before and in anticipation of things that will be said in response. We never, in other words, speak in a vacuum. Words are "half ours and half someone else's" and they are tightly interwoven with one's own words. People manipulate and orchestrate words to achieve their goals. As a result, all ideas which language contains and communicates are dynamic, relational and engaged in a process of endless re-descriptions of the world. Once the students gave feedbacks, the teacher realized what the trouble source was. The teacher would get engaged and redesign his instruction to establish mutual knowledge.

Generally, the teacher who was also an expert in electrical engineering had the structure of schema which was based on his experienced. He represented his knowledge in circuit analysis differently from the second- year students who were novices in electrical engineering. He could also adjust his schema to the increasingly complicated circuits which

analysis demanded. When he knew the confusing points most of the novices were facing from the classroom assessment technique, it enhanced his instructional design to elaborate the trouble parts students indicated. Instead of re-teaching the same topic, he used the interactive teaching method by engaging students in a Socratic discussion.

Nystrand (1986) stated that elaborations were carefully keyed to the trouble parts which were critical to student comprehension. Any point in the communication or teaching and learning which endangers or disrupts the established frame of reference is a choice point for the teacher. At each choice point, which is a potential trouble-source for students, the teacher has a variety of options all of which involve elaboration of some sort to maintain the term of reciprocity. In other words, the elaboration enhances students' understanding and enables them to construct mutual knowledge.

At the end of each session we asked students to write a quick response to one question, for example, "What was the muddiest point in today lesson?" We gave students a chance to vent out the trouble-source. Students' feedbacks were relative to the topics of the lesson. There were 60 students in our class. Instead of retrieving all 60 feedbacks, we collected only 10 feedbacks from 10 study groups we formed. These study groups usually spent 2 extra hours outside class to study and complete assignments together. Each study group had its own group leader who earned higher achievement in prerequisite courses: Electric Circuit 1 and Electrical Engineering Mathematics. They sat and worked together on problems during class session in an interactive teaching and learning style in Vygotsky's zone of proximal development.

In this teaching, learning and assessment style, the teacher, individual students, and their group peers formed a dyad of learners and teachers. This dyad facilitated the zone of proximal development in which the students could develop higher mental functioning. Vygotskyclaims that this higher mental functioning has its origins in social activity, i.e., communication. The students' cultural development towards becoming an electrical engineer started in an inter-psychological category. The social activities of inter-psychological category are a long process. To mention only few salient points relative to the class, namely: the teacher assigned a complicated electric circuit for the study group to analyze; students talked and helped each other analyze it; they came across the trouble-source which all group members could not solve; they also talked in their study groups discussing the muddiest points of the day and wrote them; each study group handed their muddiest points to the teacher. It was very efficient because we could better handle muddiest points from 10 study groups. These muddiest points resulted from what they worked on together in class and still came up with some points the whole group was not clear including the group leader. They wrote down all their muddiest points of the day and handed them to the teacher at the end of each session. These steps were then internalized within novices as an intra-psychological category. The students developed the culture of how engineers worked together.

The teacher used these feedbacks for his instructional design for the following session. The important role of the teacher as an expert in this social interaction was to "orchestrate" the novices' muddiest points and presented them in class for the novices' participation. In redesigning his instruction partially based on muddiest points, the teacher who was a veteran for 14 years was receptive and reciprocal.

Methods

The method used in conducting this study is a participant approach. The interactive teaching method with classroom assessment technique and study group strategy was implemented after the mid-term examination. The level of complexity of topics of the course was similar before and after the mid-term examination. Several methods were implemented in collecting the data on reciprocal interaction between the teacher and students who anonymously gave feedbacks. The redesign and practice of instruction to accommodate the issues revealed in the feedbacks was captured on video tape and transcribed to provide an insight into the features of discourse strategies and practices the teacher employed differently from the first time he introduced the topic. The analysis of the feedbacks and the redesign of

the instruction yielded the strategies by which the teacher modified their instruction based on student feedbacks.

The results of mid-term and final examinations were quantitatively compared and triangulated against the student evaluation on teaching and interviews. For the stimulated-recalled interviews, the students in this section were divided into three groups based on their academic performance on the final examination: High (A-B), mid (C) and low (D-F) and were randomly selected from each group. We used their student evaluation and their grades on the examination as key to the line of questions.

First, the examination items and the student performance were analyzed relative to the feedbacks. The students' evaluations on teaching relative to their academic achievements and interviews were analyzed.

For an interview with the teacher, he watched the videotape especially the parts he redesigned his lesson in response to the feedbacks and talked about his instructional redesign and how the feedbacks helped him learn about his student learning.

Results and Discussion

1. How does a classroom assessment make a difference?

The primary goal of this project is to enhance students' academic achievement by reducing the number of failing students in this course. The interactive teaching method and study group strategy were implemented after the mid-term examination with students in this section in the third quarter of the academic year 2009, 3/2009. Compared with the cohort from the previous year, 3/2008, 107 out of 208 students or 51 % failed whereas only 39 out of 203 students or 19% of this 3/2009 counterparts failed. Our effort was not in vain. There were 56 students enrolling in this section taught by our co-researcher and only 9 students or 16 % failed whereas 36 or 52% out of 69 students enrolling in this course the previous year. This course, Circuit Analysis and Filters, had been taught by the same teacher with same content and to students with similar background in Electrical Engineering Mathematics and Electric Circuits in 3/2008 and 3/2009. Only the difference was in the teaching method; it was traditional lecture style vs. interactive teaching method with classroom assessment technique and study group. The outcome was beyond our expectation.

2. What is the role of Bakhtinian perspectives in improving teaching and learning an advanced course in electrical engineering?

: The study yields primary findings, namely: the students who attended class regularly gained higher academic achievement when mid term and final examinations were compared. Upon interviewing students with low and high academic achievement, they reported that they liked the instructional style because they had a chance to interact in the class with the teacher and with peers in his group working on the problems using the concept the teacher lectured. This helped them better construct the knowledge and master the skills of circuit analysis. The theory of reciprocity worked well in the interaction when the group leaders tried to elaborate the point which their peers needed help.

3. How is an instructional design affected by a classroom assessment based on Bakhtinian perspectives?

When the teacher gave students an opportunity to give feedbacks of what they did not understand, students took the chance and expressed that they needed more explanation. The teacher elaborated by giving more examples and explained the important points in details with a Socratic discussion. Since the teacher had already taught the topic once but when he received the feedback he redesigned the instruction for the same topic reciprocally.

For example, when students as a study group gave a feedback "current flows in dot and flows out dot: we did not get it, not so sure," the teacher redesigned the instruction. Instead of explaining the concept of dot conventions again, he raised some problems for the students to work in group. He showed the circuit with dots and let the students analyzed it as shown in Figure 1. He facilitated their analysis by guiding them with discussion and questions, for example, "What is the sign of the given circuit?"
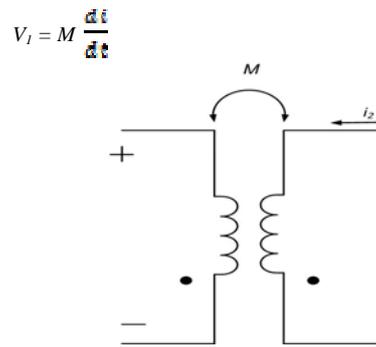
$$V_1 = M \frac{di}{dt}$$

Figure 1 Example illustrating how to apply the dot convention.

If the students could give the correct answer to the sign that it was positive then they knew how the voltage should be analyzed as a part of the circuit. Then they continued the discussion until students could analyze it.

Another study group had the similar question on classification of passive filters, "How to consider types of filters from a given circuit: How do we do that?" The other group wrote in their feedback paper that, "Still we cannot classify passive filters which one is low or high or band passive filters?" The teacher realized that the first time he taught the classification of passive filters, he introduced all types and matched each against its circuit. This might get them confused and could not differentiate their types. When he received feedbacks from two groups, he redesigned his instruction by giving definition and its circuit one at a time to make sure that they would not mix them. He gave the circuit which is connected in a series manner shown in Figure 2. The output was measured across the series inductor and capacitor so at the particular resonance frequency, the output was shunt by the series resonance. Thus the students should be able to figure out that this type of passive filter was considered as a band stop filter.
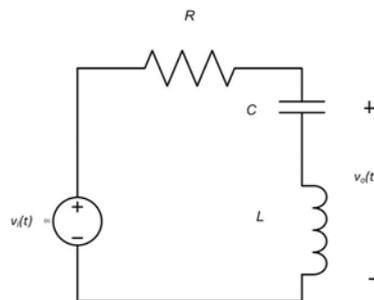

Figure 2 A bandstop filter.

4. How do students evaluate the lesson and assessment technique based on Bakhtinian perspectives?

The groups that submitted feedbacks responded positively. They appreciated the interactive teaching method with classroom assessment technique and study group strategy based on Bakhtinian perspectives which we used. It made them understand more although it took longer time to work in group in class. They even said to have only 30 minute lunch break and spend time working in group to solve problems was well worth it. Some wrote, "We learn and laugh; we have fun and we are happy." "We work together in class; it is better because when we get it wrong we always have our teacher to coach us what is right and why. We can

get it right and not to imprint a wrong solution." Group 6 wrote, "This method of teaching encourages us to be bold and have confidence in demonstrating how we analyze a circuit." "Excellent! It is because we can understand a lot, sir."

We started this interactive teaching method with classroom assessment technique and study group strategy after the mid-term examination. A lot of students failed in their mid-term examination so we asked them to write feedbacks on the exam especially on question 4. A lot of students did not complete the exam and skipped No. 4. The students said they wasted too much time on other questions so they did not have enough time to do No. 4. Two hours for 4 questions with sub-items was not enough. "Puzzled, confused and lost!" "Difficult questions!" "Never practice in class how to solve such problems with superposition." "We do not have a strong background on electric circuits so we cannot complete the examination questions in time."

All in all, the interactive teaching method with classroom assessment technique, feedbacks, and group study strategy was a two-way communication between the teacher and students. It is very beneficial for Thai students because they are usually not very advocative.

On comparing students' academic achievements before and after midterm when the interactive teaching method with classroom assessment technique and study group strategy was implemented, students with low academic achievements on the mid-term examination gained higher ones on the final examination. During interviews on their evaluation on teaching, students appreciated the creative teaching method consisting of interaction, group work and classroom assessment technique.

However, it is interesting that in the other section with 46 students, the academic achievement of the students was also impressive although the teaching method was traditional lecture style with study group strategy.

Conclusion

Interactive teaching method with the classroom assessment technique and study group strategy based on Bakhtinian Perspectives on Dialogism, zone of proximal development and theory of reciprocity makes a difference on students' academic achievement beyond our expectation. The way the students interacted in class confirmed the cultural development of engineering community as intra-psychological category in them. More studies on interactive teaching method with classroom assessment techniques in other disciplines are recommended.

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