122nd ASEE Annual Conference & Exposition
June 14 - 17, 2015
Seattle, WA
Paper ID #13979

Improvement In Learning Experiences By Adopting Student Centered Teaching Practices

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Abstract

The objective of this article is to emphasize the need to establish a strong first impression in the classroom for students' successful learning experience and their retention in the curriculum. Teaching is an art that every instructor should master in order to help students learn efficiently and apply that knowledge in real world applications. Undergraduate students are very enthusiastic and eager to learn new concepts in a well-structured learning environment. In this paper, the authors investigate a freshman course of "Introduction to Metals and Metallurgy" as a baseline model in order to identify the need for making the connection with students on day one and providing guidelines to new engineering educators to successfully implement teaching practices that include use of modern technology, course redesign, grade distributions, and pedagogical techniques. The authors also report improved student evaluations and performance data, and correlate them to the continually improved teaching practices adopted by a new faculty member, who was mentored by a senior faculty member and the department chair. The percentage of DFW grades earned by students were improved from 60% for Fall 2013 to 24% in Spring 2014 and further to 8% in Summer 2014. The midsemester feedback and suggestions received from the students are also presented in this paper. The outcomes of this study over a period of three semesters emphasize: (1) connecting early with students, (2) using adequate modern technology to assist classroom teaching, (3) giving timely feedback to students, and (4) identifying clear expectations. In addition to the aforementioned measures, the new faculty member made extra efforts by meeting with students struggling in the course and assisted them with one-on-one tutoring. Authors believe that the findings of this study will help new engineering educators identify the Do's and Don'ts of best teaching practices.

Keywords: new engineering educators, best teaching practices, feedback, course redesign

Introduction

Teaching is an art that every instructor must master in order to enhance students' learning experience. There have been several studies on the Dos and Don'ts for new engineering educators entering into academia with very little or no teaching background. Apart from having the requisite educational qualifications and strong research experience, the instructor should also know how to effectively communicate with students of various backgrounds and academic preparations.

Roberts et. al. studied and presented observations from three different instructors promoting student learning paradigm and soft skills that were balanced with syllabus. They observed that syllabus needs to be accompanied by real-world examples and the most important

lessons such as teamwork, leadership, initiative critical thinking and problem solving learned by students were not in syllabus. [1] Swartz has reported recommendations for college level engineering instructors implementing the flip classroom technique based upon his experiences and anecdotal evidence. The key to success was found in increasing student participation in class, building a rapport with students, defining clear objectives through a well-structured content.[2] Dringenberg et. al. reported reflections from faculty regarding their motivation and experiences in the one week workshop. Authors also proposed several recommendations for developing reflective practices to new educators. Authors propose SAID (Situation, Affect, Interpretation, and Decision protocol for new faculty reflection.[3] Shepard et. al. published their experiences from early faculty years and suggested how to handle several academic and student related issues.[4] Variawa et. al. studies a program Prospective Professors In Training (PPIT) over a period of six years explaining student development and improvements.[5]

Bedekar et. al. formulated a pilot program to mentor a postdoctoral associate and a Ph.D. student on modern teaching techniques, pedagogical techniques, student engagement and connection of dots between classroom and real world.[6] Bilen-Green et. al. presented their study on involvement of mentors for three years of early faculty career in order to help them through formal as well as informal meetings.[7] Meredith helps the instructor understand to prepare a fair, and balanced test of correct length. Authors also identify the program and ABET outcomes such as students' increased ability to take tests.[8] Wilding et. al. presents study on organized workshops for new faculty over two years and training them on inquiry based learning with peer reviewed teaching methods. Authors claim that these seminars helped new engineering educators in fostering excellence in teaching and learning.[9] Caldwell et. al. reports on a pilot study of an online accelerated statics course with intensive video delivery that helped students reflect, practice, and create personal relevancy for the learning process.[10]

Many of these studies emphasize on faculty mentoring and the use of pedagogical techniques of teaching including the use of engineering words, body language, speech, and delivery. Communication skills are extremely important in order to become a successful teacher and an effective mentor. "Introduction to Metals and Metallurgy" being a freshman course, demands certain expectations from the instructor teaching this course. He/she must have Materials Science (for this course) background and the ability to effectively communicate with freshman students who are just out of high school. Modern day teaching methods include use of textbooks, multimedia, online lectures, and classroom interaction.

An instructor needs to use some or all of the above tools to enhance students' classroom learning experience. However, to the authors' best knowledge there is not much literature available on how soon an instructor should connect to students in order to help them succeed in their course and academics. In this article, effects of the disconnect between the instructor and students are elaborated and their consequences are quantitatively monitored using the overall class performance and teacher evaluations. Students' specific feedback on external websites was also used as a tool in order to design a teaching strategy for the remaining two semesters explained in this study. Students also used *Desire 2 Learn (D2L)* on-line course management tool for accessing the notes, slides, submitting homework assignments and lab reports. Students also receive online feedback for each of their submission on D2L.

Semester One: Fall 2013

The lead author of this article, a first year tenure-track faculty member, was assigned to teach four sections of "Introduction to Metals and Metallurgy" in Fall 2013 to freshman undergraduate students. Two sections would meet for lectures two days per week in the mornings and the remaining two sections would meet on same days for lectures in the afternoons. Due to unavoidable circumstances, the instructor could not report to teaching for the first two weeks of classes. He was assigned a Graduate Assistant (GA), who taught the course during this period in the absence of the instructor. He was in constant contact with the GA and extensively discussed the semester plan for the course with him. They had multiple telephonic conferences in order to finalize the schedule for classes. Primarily items discussed were assignment of chapters, topics, preparation materials, schedule of laboratory exercises, laboratory equipment and homework assignments.

On day one, the GA started with the introduction of the course, explained the syllabus, textbook, laboratory exercises, and instructor information. He did his best to explain why the instructor could not be available for the first two weeks of classes. The laboratory exercises immediately followed the lectures where the GA demonstrated safety orientation and safety training. Homework was assigned at the end of week one based upon the introductory chapter from the textbook. Since Introduction to Metals and Metallurgy was a freshman course, the instructor had to establish the expectations from students on day one.

It is extremely important to establish a common ground on what is expected from instructor and from students in order to plan the semester well. Due to the lack of interaction and conversation with students, the faculty instructor was completely disconnected with students. He did receive progress feedback from the GA based upon the lectures and labs; however, student feedback or perspective was missing from those updates. It is our finding that missing out on the first week of classes led to such a disconnect between the instructor and students. The GA did his best to introduce the course and cover the first two chapters; however, when the faculty started teaching in the third week of classes, students were used to GA's teaching style and probably could not cope with instructor's teaching style quickly. One of the three feedbacks on an online external website highlighted this disconnect – "The first 2-3 weeks were taught by the GTA and I wish he had taught the course instead. I felt like I was doing fine until Dr. Bedekar showed up!"[11]

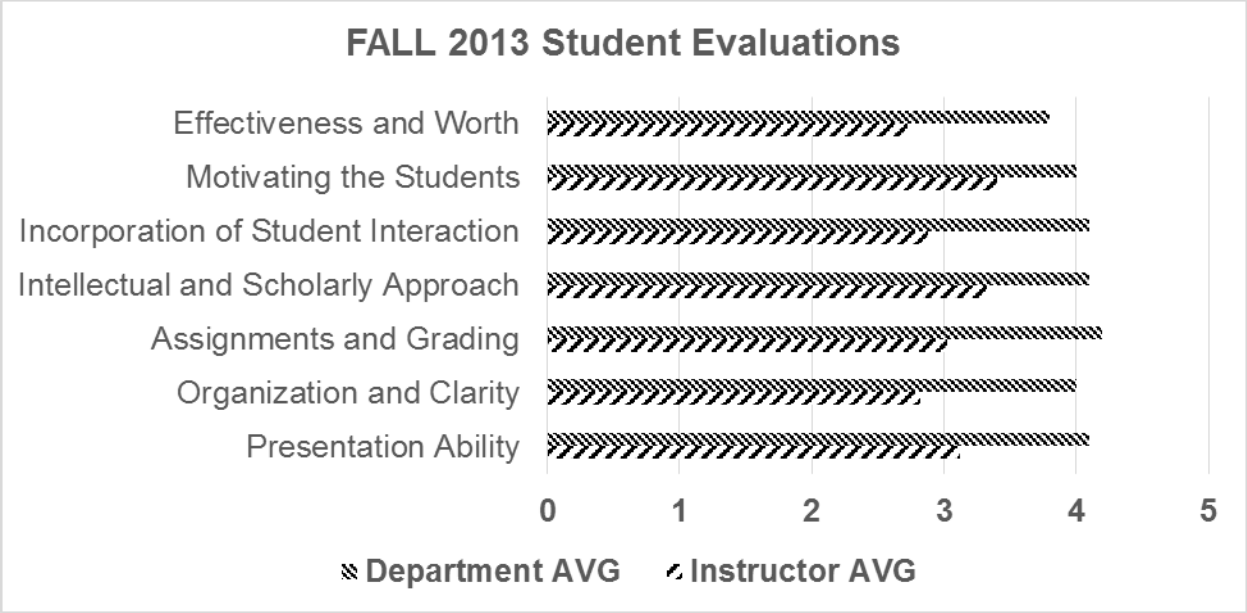

Figure 1: Student Evaluations for Fall 2013

The instructor covered 80% of the course material over the next 11 weeks but struggled to establish a bond with the students. It was found that the percentage of students earning DFW grades was much higher than usual. This could be attributed to the disconnect between the instructor and students in the beginning of the semester. We found that students get adapted to a particular teaching style of the instructor in first 2-3 weeks and it becomes very difficult for them to cope with an entirely new instructor later on. The student evaluations of instructor's teaching are shown in Figure 1. In comparison with the department, his ratings were consistently lower for teaching, innovation, course management, feedback and likability of course. Hence, a detailed self-review was necessary for him in order to improve his teaching and enhance students' learning experience. The low ratings could be attributed to the disconnect between the instructor and students, lack of clarity on expectations on both sides, and to the fact that not all students learn at one single pace nor using one single learning technique.

Semester Two: Spring 2014

On day one of the semester, the instructor distributed the updated syllabus which had details on lectures, topics covered, laboratory experiments, homework assignment schedule, exam schedule, and detailed grading policy. He thoroughly explained each aspect of the grade distribution and elaborated on expectations from the students in the course. This helped him establish a strong understanding with the students, and he also advised them on how much additional time they were required to dedicate in order to be successful in the course. Several steps taken by the instructor to improve his teaching techniques included planning, course management, pedagogical techniques, lecture delivery, providing prompt feedback and diligently working with students. Some of his efforts are summarized below:

1. Identified students who were not consistently attending lectures and/or labs, and emails were sent to them encouraging them to schedule a meeting. One on one meetings were scheduled to help struggling students.

2. Make-up exams were scheduled for students who had other prior academic commitments or emergency situations.
3. Instructor was available outside of the classroom during extensive office hours and through appointments so that students could get extra help and guidance on the course regarding classroom material, homework, lab reports.
4. Instructor took another faculty mentor's suggestion of circulating index cards in the class to get students' early feedback (both good and bad).
5. Equal l weight was given to fill in the blanks (for definitions), conceptual questions and materials design.
6. Students were given at least one week to turn in their homework on D2L. Deadline for one homework was extended by two days to help students turn in their work on time as a onetime exception.
7. All laboratory exercises were well planned in correlation with the topics covered in lectures; and the instructor spent adequate time to go over the lab reports so that students knew how they were expected to write in it for turning it in to earn credit. Students always got one week to turn in their lab report after completion of the lab. Several laboratory exercises included hands-on activities for sample preparation and testing methods which students appreciated. Particularly, they were very excited during the Scanning Electron Microscope (SEM) lab to observe a steel sample at high magnification.
8. Sample/practice tests were posted on D2L one week before the actual tests. Students were encouraged to practice them at home and solutions were presented in class before the actual test.
9. A senior faculty observed this instructor's teaching technique and submitted a detailed report to the department chair.
10. The Department chair observed the instructor's teaching and provided his feedback. This helped the instructor improve his teaching and student interaction.
11. An industry visit to a local company was arranged for students to observe an industry environment and to learn from engineers and technicians in the field of study. Ten out of forty nine students participated in the visit and it was a great learning experience for them.
12. A *materials poster* competition was arranged at the end of the semester and was scheduled on the study day so that students could score 5% bonus grade based upon poster's quality, content, presentation, and interaction with judges/reviewers.

Few students did respond to the instructor's request and scheduled a meeting to discuss their progress and started attending classes regularly. A few students, (2), who never attended lectures or laboratories, did not respond to setup a meeting and eventually dropped the course. The instructor also worked with a student athlete and rescheduled his exam in order to avoid the time conflict between his scheduled game and course exam. The instructor asked students to provide feedback regarding the GOOD and the BAD things about the course in the middle of the semester to gain perspective on his teaching techniques. Selected students' testimonials are summarized in Table 1 and selected students' feedbacks are shown in Figure 2.

Table 1: Summarized Student Testimonials – The Good and The Bad

THE GOOD	THE BAD
Lectures are good, detailed and understandable	Draw examples a little bigger for space
You care about us and try to help everyone which is very helpful and rare!	Some questions have how am I supposed to know this vibe
The class is good and I like how you teach us.	Lots of information but if you could relate them to real life, it would make more sense for us
I liked when you brought crystal structure models to class.	Class tends to run past the schedule
Very interesting class I have ever seen. You try to simplify as much as you could.	Sometimes, there is too much information and the lecture becomes hard to follow

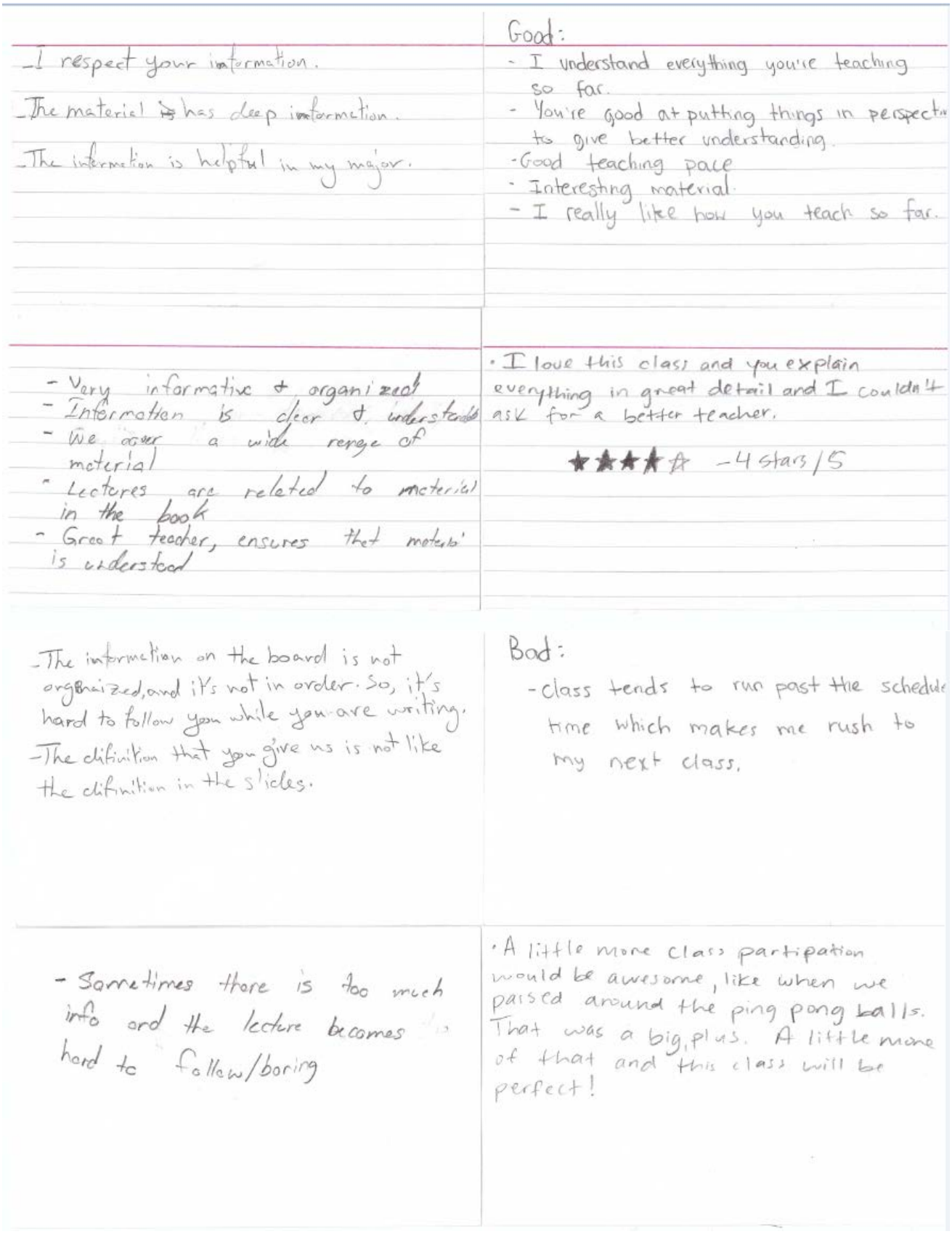

Figure 2: Students' midsemester feedback – The Good and The Bad

There were few suggestions from students such as increasing student participation, more quizzes, more visual aids, drawing bigger on board, scheduled time for class, too much information etc. Students greatly appreciated explanation of concepts well in lectures, repetition for slow learning students, step-by-step problem solving, real-world examples, and in-depth material. Students did emphasize that the instructor cared about students as well as his teaching. This valuable feedback helped the instructor improve his teaching techniques for the remainder of the semester.

Student evaluations for Spring 2014 are shown in Figure 3. The instructor performed well compared to the department as he was always engaged and connected to students. More specifically, on the "Intellectual and Scholarly Approach", the instructor scored almost perfect score which emphasizes his use of innovative teaching techniques. Assignments and grading were fair and timely feedback was provided to students.

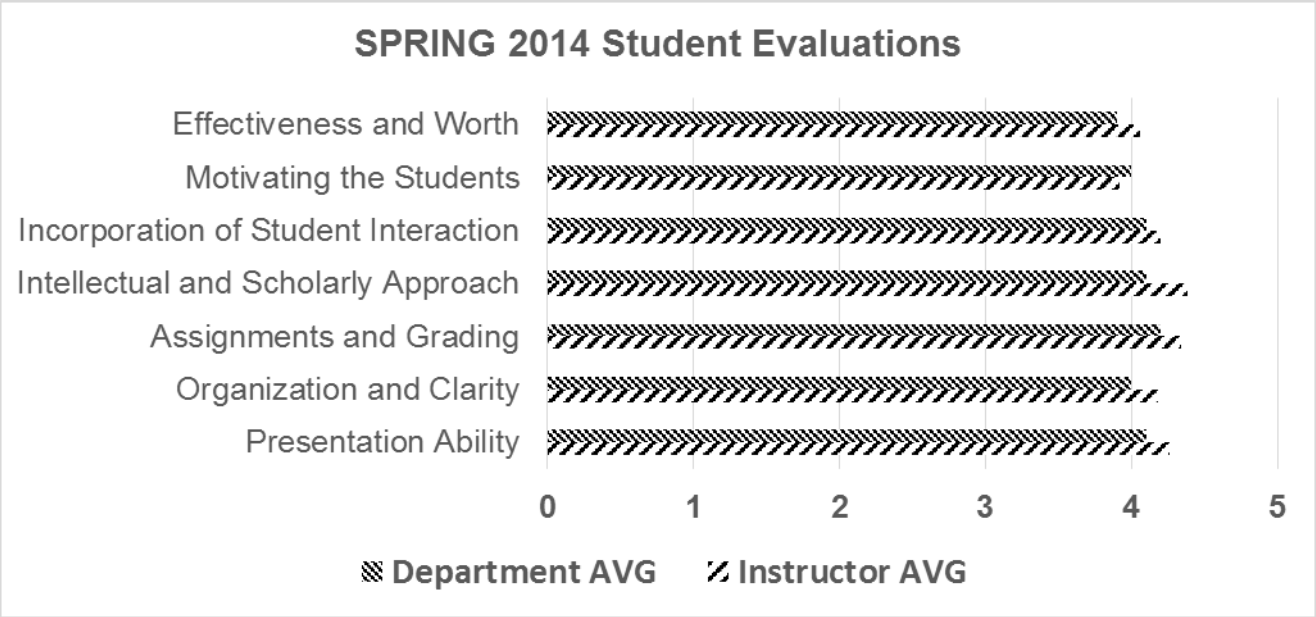

Figure 3: Student Evaluations Spring 2014

Ninety percent of the HW questions were based upon topics of the discussed during lectures, laboratories, online notes and textbook; the remaining ten percent questions were based upon materials design. In this HW model, students learned critical thinking about content covered in lecture and its correlation with real world examples/problems. All HW solutions sets and sample test solution set were posted on D2L three days before the actual test for students to study. The level of rigor and depth in HW and in tests were maintained throughout the semester. There was marginal change (<5%) in assignments that were offered in Fall 2013 and Spring 2014. The improved DFW rates can be attributed to students being better prepared for exams throughout the semester compared to the previous semester and the strong connect between the students and instructor.

Semester Three: Summer 2014

"Introduction to Metals and Metallurgy" was offered in summer 2014 for the first time in two sections. The class met four times a week for two hours followed by laboratory sessions. The duration of the course was five weeks. The instructor revised the syllabus specifically to meet the class times of a summer semester. He also revised the grade distribution in such a way that students were evaluated every week for the entire semester based upon the teachings of the previous week. This new format helped students revisit the material every weekend and prepare for a Monday test. Homeworks were regularly assigned and the solution sets were uploaded on D2L. Students used all available materials for tests such as textbook, class notes, slides, homework, and sample tests. This laser focused student oriented learning format resulted in **92%** ABC grade distribution. One student who dropped the course within first week of classes never attended any lectures or laboratories.

Student evaluations for summer 2014 are shown in Figure 4. This time around, the faculty instructor did exceedingly well in all six aspects of teaching and matched or even surpassed the department, college and the university's ratings. Hence, it was evident that he successfully connected with students from day one and enhanced their learning experience with improved teaching techniques. The instructor asked students to provide mid semester feedback after two weeks of classes, which helped him improve the quality of the lectures, laboratories and hence, enhance learning experiences of students. The instructor also videotaped all of his lectures taught during summer and evaluated himself every week based upon lecture content, delivery, student interaction and student engagement, laboratory exercises and recitations. Timely feedback was provided to students every week so that they could assess their performance in the course and improve upon it. The enrollment for academic year 2013 – 2014 is shown in Figure 1 along with the grade distribution. Figure 5 summarizes the class enrollment for the academic year 2013 – 2014. Also, it is evident from figure 5 that percentage of students dropping the course reduced throughout this study.

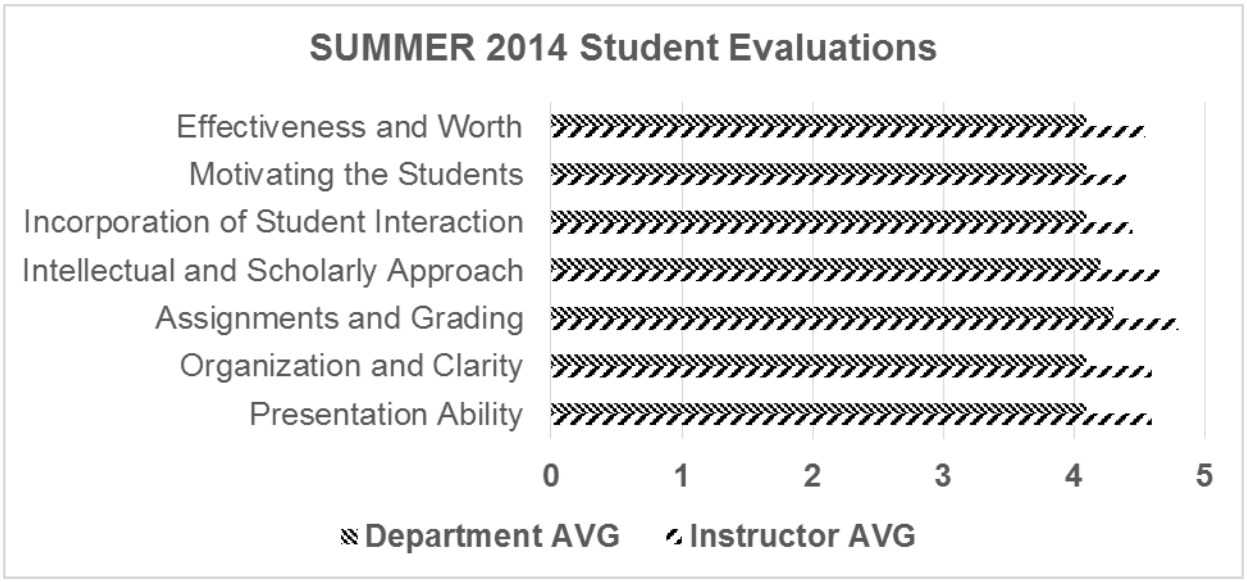

Figure 4: Student Evaluations Summer 2014

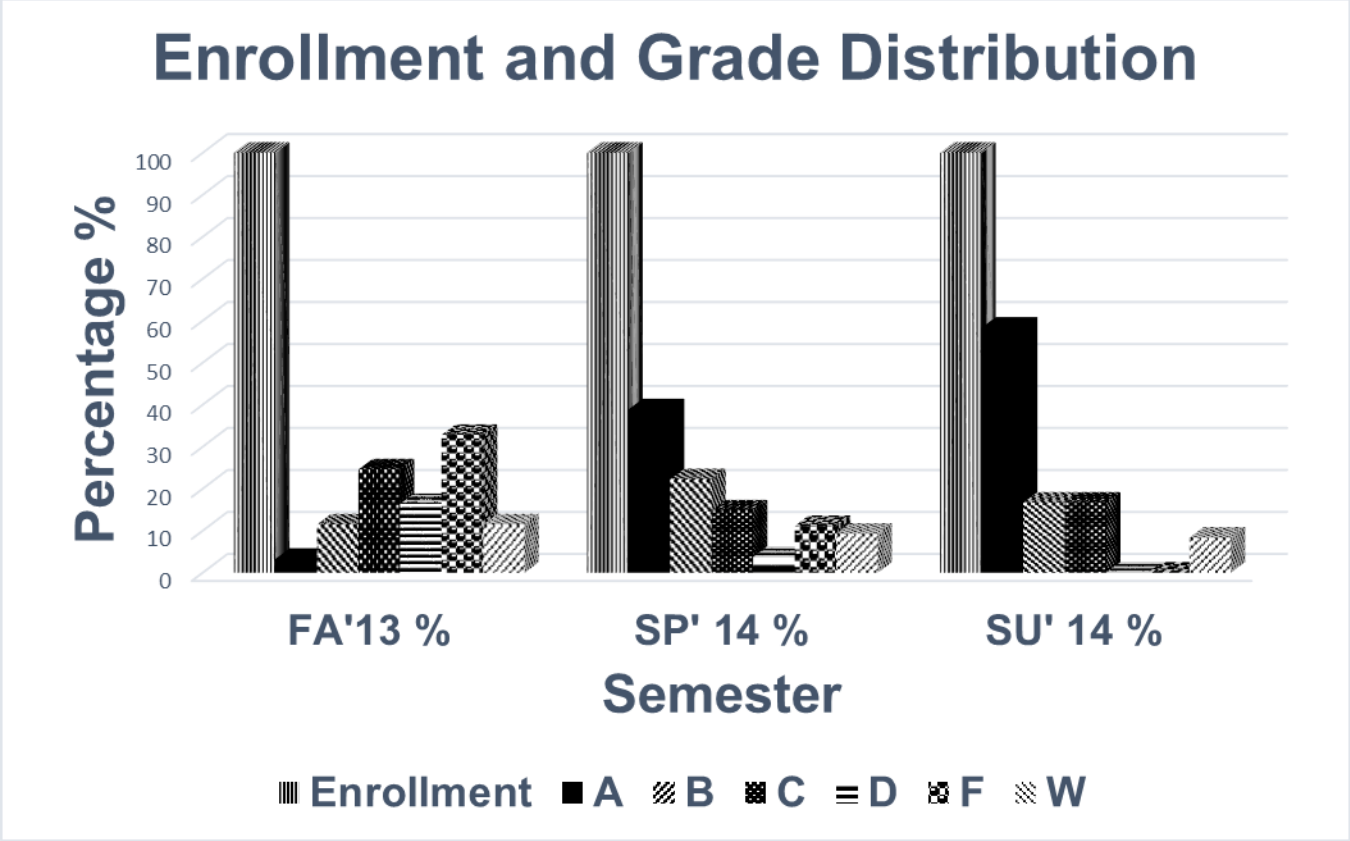

Figure 5: Enrollment and Grade Distribution for Academic Year 2013 – 2014

Revised Teaching Philosophy

Based on the teaching experiences of the academic year 2013 – 2014, the instructor revised his teaching philosophy. He oriented his teaching methods according to the audience so that they were always engaged in the process of active learning. In his Materials class, students were given every opportunity to participate in the class activities such as solving problems on the board, answering questions and giving constructive feedback. Based on the evaluations of Fall 2013, the instructor made significant changes in his teaching techniques, as explained in an earlier section, in order to adapt to the students' learning experiences. He took extra efforts to connect with students, understand their concerns, and provide help and feedback so that they not only improved their performance in the course but also learned how to efficiently learn and apply the knowledge in real world. The instructor also effectively used the technology to emphasize certain important topics, concepts, recitations, etc. For example, in a chapter titled "Crystal Structure"; online YouTube videos of 3D crystal structures helped students understand the 3D sense very quickly. Drawing a 3D structure on a 2D whiteboard often creates lot of confusion.

Proposed DO's and DON'Ts for New Engineering Educators

Below are some of the suggestions for new engineering educators based upon our experiences from teaching a freshman materials course:

1. Establish a connection with students on Day One. Do not be absent for the first Day/Week.

2. Have clear expectations from students with respect to submission of homework, tests, and laboratories. Do not assume that students know and understand everything that is delivered/taught in class.
3. Establish clear understanding of the syllabus and grade distribution and thoroughly explain it on first day of classes.
4. Be empathetic to freshman students. Be flexible when it comes to rescheduling tests for students with genuine conflicts.
5. Understand, care, and communicate with students.
6. Each student's pace of learning and grasping abilities are different. The instructor should take this into account while delivering a lecture.
7. Provide prompt feedback and timely help to students.
8. Always try and engage students in class using innovative teaching techniques.
9. Do not arrive late to classes and record attendance regularly.
10. Analyze students' performance in HW, tests and quizzes and correlate it to their attendance and class participation.
11. Provide incentives when students do well and put in extra efforts in the coursework.

Conclusion

In this article, teaching experiences of a new engineering educator over an academic year are presented. The instructor faced several issues in the first semester primarily due to the absence in the first two weeks of classes. This led to a disconnect between the instructor and the students and this was evident from the poor evaluations received for the Fall 2013. However, the instructor turned the tables when it came to the following Spring and Summer 2014 semesters, by consistently getting connected with students earlier in the semester, providing them prompt feedback, establishing clear expectations, and working with them on various academic or emergency situations. Hence, authors conclude that for making a connection with students, establishing clear expectations is extremely important for students' success and their enhanced learning experience. Authors also feel that the findings of this study will help New Engineering Educators prepare effectively for connecting with freshman students and providing outstanding and information rich learning environment to them.

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