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Increasing the Class Participation Experience for Engineers
Abstract

Class participation and instructor points are viewed by many as “give away” points, usually subjectively based. This study focused on techniques to encourage environmental engineering student participation in class discussion and exercises, while trying to quantify procedures to assess participation. Students were graded on presenting a relevant and timely environmental article to the class as a basis for generating discussion. Once an overview of the article was presented, the student was required to generate a general discussion with the class lasting a few minutes. These discussion sessions occurred the first five minutes of every class. Students were graded on their overview presentation as well as their level of participation during the discussion sessions of other articles. The study was conducted in four phases. First, the instructor explained the expectations verbally and in writing. An example article was present by the instructor and students were led through an example discussion. The second phase was a student feedback session conducted at 25% through the course. The third phase consisted of additional feedback in the form of a written assessment of the participation grade and tailored suggested methods of improvement to each student. During this phase, students were given the opportunity to discuss results individually with the instructor. The final phase was the overall assessment of student performance through the course of the semester with a final letter grade assigned and points awarded. After grades were assigned, a survey was conducted to determine the worthiness of the exercise from the perspective of the student. Results indicate initial student hesitancy to accept the exercise as a worthy endeavor. As the semester progressed, results indicate an attitude shift as students began to enjoy the articles and viewed them as an opportunity to learn about the subject matter in a real world context. The feedback shocked some students into participating more. Feedback was viewed positively as an opportunity to assist the student and let them know “where they stood”. Students complained the tracking mechanism led students to say anything regardless of the content so they could be counted toward a score. Students believed the grades assigned were fair and no student felt the process unfair. Results indicate an overall increase in class participation while developing a workable quantitative method for assessing participation grades.
Introduction

Discussion, as a learning tool, is difficult to accomplish correctly even by seasoned teachers and requires preparation and structure. Various experts have a number of suggestions on conducting this task but all agree that this is not an endeavor taken lightly. \[^{1, 2, 3, 4}\] Class discussion provides a number of benefits for the teacher and student. The teacher and student develop a closer relationship with each other as the teacher-student hierarchical relationship is relaxed. \[^{5}\] The teacher is viewed as more open and approachable. It places the teacher in a more egalitarian or democratic light during discussion exchanges. \[^{6, 7}\] Additionally, a teacher that permits classroom discussion implies recognition of students as active versus passive participants in their learning process and supports the notion that students learn more when they are actively engaged.

Classroom discussion is useful as a way of thinking and learning. \[^{8}\] Asking or seeking student input verbally encourages all students to think more fully about the content and the physical act of discussion helps students assimilate and integrate information acquired from readings and exercises. \[^{7}\] As students become impassioned about a particular topic, the experience of actually engaging in a discussion causes physical responses in the student’s body and mind (increased heart rate, perspiring, dry mouth, etc…) which will leave a more “ingrained” memory than a standard lecture. This approach is similar to the humanistic philosophy of learning where the whole person is engaged in the growth and development, which are viewed as real learning. \[^{9}\] The use of classroom discussion can also generate a broader way of looking at a subject and instill a desire to go beyond the basics of a particular subject. In an ideal world, college should be a place for the initial stages of development for a profession and should encourage learning that reflects the way professionals learn and work. \[^{10}\]

To make classroom discussion a successful experience the teacher must prepare and follow some fundamental considerations. First, the discussion should fit some objective or purpose. Failure to provide an overarching purpose tends to have students wondering “why”. \[^{7, 11}\] That is not to say that the discussion cannot be free to follow various meanders. When good discussion is occurring, student input can take the discussion into equally relevant subject areas that may or may not be applicable to the objective but valuable nonetheless. The teacher must artfully guide the discussion back, which can have negative effects on the class if not done properly. Second, students should be conditioned for discussion at the onset of the course of instruction. To launch into a discussion without giving explanation or expectations will generally lead to poor performance by the students because they do not understand the expectations. A good method is to outline expectations in writing and provide an example in the first class meeting. Finally, there should be variation in the class teaching routine. Variation in teaching techniques allows for the group discussion to be a refreshing change from a standard Socratic lecture format. \[^{7}\]

Using the group discussion learning technique, the author developed a method for integrating group discussion as a means for teaching engineering students about the applicability of the subject in a greater context. The author attempted to use what the students were learning in the classroom and demonstrate application of their learning to their everyday lives. This proved to be a far more difficult task than originally intended.
This study focused on techniques to encourage student learning of subject material and established a methodology for enhancing the learning experience through classroom discussion. Students were graded on their presentation and discussions of relevant and timely environmental articles in the class. Specifically, the target audience consisted of students taking an engineering elective and not students majoring in engineering. The study consisted of four phases: An introduction to the requirements by the instructor, a feedback session, individual performance counseling and finally grade assignment.

**Methodology**

The test population consisted of three separate sections of engineering students taking an entry level environmental engineering sequence course. The total population was 51 students broken into class sizes of 16, 17 and 18. Students were given the assignment of finding a timely, relevant article concerning the environment and to present a 2-3 minute summation of the article, tying it to the course learning objectives. After the summation, the student would lead a group discussion. Students in the class were required to contribute to the classroom discussion as part of their class participation grade. These discussion sessions occurred during the first five minutes of most classes. During these discussions, the author would not contribute and would allow the student to lead the class. The author would monitor input and summarize the discussion at the end of the five minute session.

The study was conducted in four phases. The first phase occurred during the first class meeting. The author detailed and explained to the class the expectations, verbal and written, for classroom discussion. After explaining the guidelines, the author demonstrated an acceptable article summary followed by a discussion. Once the discussion was completed, the author addressed several discussion techniques that would help the student lead the discussion. These discussion techniques included the use of three or four prepared questions to stimulate a response; the use of silence as an effective method for pressuring students to respond; and specifically identifying a student to answer a question with a follow up to another student. The author also explained that students would be graded on their contributions to the class discussion as well as leading the discussion.

The second phase was a student feedback session conducted during a lesson one quarter of the way through the course. The feedback was viewed as a significant attribute for improving student performance in this exercise. The feedback provided the student an opportunity to know if their current level of effort was reflective of a good grade. Additionally, it provides an opportunity for students to adjust their behavior and increase their grade. The feedback was in the form of a power point presentation showing individual cadet contribution to class discussion. The first slide of the presentation consisted of a list of student names followed by an assigned number. The second slide was a bar graph showing the number of times a student contributed to the discussion and the number assigned to each specific student (appendix A). A red bar was used to identify the acceptable discussion contribution level for at the one quarter of the way through the course. An early feedback session was selected to allow those who were below expectations enough time to improve their participation and increase their scores.
The third phase consisted of additional feedback in the form of a written assessment. The written assessment consisted of the participation grade and tailored suggested methods of improvement for each student. Those students who had a low participation grade were brought into the instructor’s office to discuss performance and review expectations. This allowed students the opportunity to discuss results individually and not in a public forum. Most of the counseling session focused on areas to improve the student’s performance. The author emphasized that if the student changed their current level of participation they could still receive an “A”.

The final phase was the overall assessment of student performance through the course of the semester with a final letter grade assigned and points awarded. Students were given their participation grade two lessons before the final meeting. Class participation grades were based on how well the student presented the article and if they participated in the other article discussions. The author maintained a running total of input by each student during the semester and a major portion of the student’s participation grade was based on how many times they provide relevant input to discussions. After all instructor/participation grades were assigned and known to the students, a survey was conducted to determine the worthiness of the exercise from the perspective of the student. The survey was completed before final course grades were assigned.

Results and Discussion

Initially students were regimented in their presentation approach and did not seem too receptive to the activity. The greatest difficulty for the student was generating discussion with the class. Students initially asked for input concerning what other students thought about the article. By its nature, effective discussion takes practice. The instructor provided guidance on effective discussion techniques and the class began to respond. Students started to generate three or four questions about the article prior to coming to class. This assisted the students in their ability to generate effective discussion. Additionally, students began to pose the question to specific students thus enabling them to personally engage someone, which resulted in more students involved in the discussion. This method was very effective when a class was not actively involved in a discussion. The students also used silence as an effective means for drawing out responses. As students contributed, the author noted their contribution via a check mark system. The quality of the contribution was not critiqued and any contribution by a student was noted. It was noted that some students began to make statements so they could get credit. In some cases their contributions were not well thought out and were out of sync with the flow of the discussion. This tended to embarrass some of those students as the group would respond in different ways. As the semester progressed, these “check the block” contributions disappeared and were replaced with thoughtful and insightful responses.

At a lesson one quarter of the way through the course, the classes were shown their current level of participation. A graph was used to show each student’s current grade and guidance provided so that each understood what was required to achieve a good grade. If students were below a certain level they were considered as “failing” or not meeting expectations. If they were above the level they were doing “A” work (appendix A). Appendix A shows before and after counseling performance. During the feedback session the students were shown only the before
information. The student assessment was based on the number of contributions to the article discussions. Several students were shocked or upset at the evaluation. The students who were below the level were required to attend a feedback counseling session to address their current performance. Class B1 actually had the whole class below the acceptable standard (appendix A). Of the 51 students, only 12 were at an acceptable participation level. The remaining 39 students were below the “A” level and were counseled. The counseling session consisted of the author talking with the student about the exercise and inquiring about any misunderstanding of the expectations. The author asked how the student might improve their grade. Most students suggested more effort on their part to add to the discussions. The author and the student then agreed upon a mutually acceptable course of action for achieving an “A”. The author made an effort to avoid dictating a solution and relied on the students to come up with an acceptable plan to improve their grade. Most students were receptive to the feedback and appreciated the author’s efforts to let them know where they stood and what they needed to do go get an “A”. At this point the author did not believe this project would have positive results. The author was concerned that, with such a large portion of the population below the acceptable level, the students would feel alienated and proceed to shut down and quit all together. The feedback was not intended to “scare” the students into discussion. It was obvious that the low threat level of the discussions lulled several students into sitting back and not participating. The feedback showed the students where they stood from the perspective of the instructor. Several students commented that this was the first time they had received such feedback and although they were surprised they appreciated the fact that they had the opportunity to improve their grade and receive an “A”.

After the feedback, there was a substantial increase in the class participation effort (table 1). The original 12 continued to perform at or above their previous effort level.

<table>
<thead>
<tr>
<th>Class Hour</th>
<th>Number of Students in Class</th>
<th>Number of Students Below Expectations Before Feedback</th>
<th>Number of Students Increasing Class Participation after Feedback</th>
<th>% Increase in Class Participation Discussion Responses</th>
<th>End of Semester Number of Students at the Acceptable Level</th>
<th>Number of Students Failing the Class Participation Grade</th>
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<td>3</td>
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<td>107%</td>
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One particular highlight occurred when Jacob, student number 1 of class A1, gave a surprise presentation to the class. Jacob had not participated in any discussion prior to the feedback session. After the feedback, Jacob became very engaged in the discussions. Near the end of the semester and after Jacob had completed his article presentation, he came to class and asked if he could do another discussion. Jacob had seen a TV commercial by General Electric (GE) discussing GE’s alternative energy program. Jacob accessed the website provided in the commercial and was amazed at the connection between class and the GE research. He spent 20 minutes describing everything he found and walking the class through the website. Not only was
it one of the better discussions of the semester, but it represented that the discussion and feedback techniques helped students to assimilate and integrate the information learned in class and apply this information to analyze real world scenarios.

Final grades were assigned near the end of the semester with 75% of the students achieving acceptable levels of class participation. A survey was given two lessons after instructor/class participation grades were assigned (appendix B). The results of the survey indicate the objective of enhancing the learning experience for students was achieved. Albeit not a perfect model, it seems the method presented has some value.

Conclusion

This study focused on techniques to encourage student learning and establish a methodology for enhancing the learning experience for students through classroom discussion. The methodology presented indicates that this effort has value for increasing the student experience. The first phase was essential for explaining and demonstrating to students what the expectations were for this exercise and students noted that the author’s example was instrumental in understanding the written guidance. The results of phase two’s feedback session was mixed. The author believes that the feedback was vital in pushing the students to engage in the article discussion. The intended outcome (greater discussion participation) was achieved, but several students considered this a “shock”, which left them with a negative feeling about the exercise. If not done correctly, this phase runs the risk of alienating the students which is contrary to the feedback’s intended purpose. The perception by students may leave them feeling negative about the whole exercise. A residual effect of this phase may be seen in question eight of the survey (appendix B). A good number of the students felt the techniques for monitoring class participation were not reflective of level of their participation. The individual counseling session during phase three was considered a good technique and gave students an opportunity to discuss performance with the author. It was however, very time consuming and required extensive coordination. The final student grade assignment was not arbitrary and rather easy to assign when the process was over. The author felt that an accurate picture of the student participation was obtained and proper grades assigned. One can argue that the methods employed here, especially in phase two, may be too draconian to be of educational value, but the author believes that this approach may be necessary in order to get the students to engage in a self directed learning approach. The study is not complete and is an initial attempt to develop a method for increasing class discussion participation.

Bibliography

Appendix A – Cadet Participation Feedback (Before and After Feedback)

Article Participation - A1

![Bar chart for Article Participation - A1]

Article Participation - B1

![Bar chart for Article Participation - B1]

Article Participation - G1

![Bar chart for Article Participation - G1]
Appendix B – Survey Results

1. The daily articles increased my curiosity about the environment.
2. The daily articles were useful and a worthwhile class exercise.
3. I found participating in the daily article discussions worthwhile and educational.
4. I felt my input into the daily article discussion was considered relevant.
5. I believe the daily articles should be sued again next year.
6. I was given ample opportunity to present an article and participate in class discussion.
7. I am more environmentally aware now and question information (environmental) presented in the media as a result of the daily articles and classroom discussion.
8. I felt the procedures used to monitor class participation reflected an accurate picture of my participation effort.
9. I considered the feedback given to me was a good tool to assess my participation effort and let me know what I needed to do for a good class participation grade.
10. I increased my level of participation based on the feedback given to me.
11. I see value in increasing class participation.
12. I learn more when I participate in class.

<table>
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<th>Question</th>
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<th>Neutral</th>
<th>Disagree</th>
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