Strategies for Improving the Classroom Environment*

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ABSTRACT

This paper describes some strategies for the educator seeking to better his/her classroom effectiveness. It was inspired by one of the technical sessions of the 29th Annual IEEE/ASEE Frontiers in Education Conference in which over a dozen experienced college instructors engaged in a roundtable discussion of ways to improve a classroom environment. In this paper, those ideas are discussed and then supplemented with general advice and specific suggestions from the experience of the authors. The paper concludes with a bibliography of related reference material from a wide variety of educational sources.

I. INTRODUCTION

An increasingly global and technical workplace requires United States colleges and universities to adapt the science and engineering classroom in order to attract and retain a diverse student body. At a national level, various reports—including the American Society for Engineering Education’s “Engineering Education for a Changing World” and the National Science Foundation’s “Restructuring Engineering Education: A Focus on Change”—have recognized this challenge and have made recommendations to reform science, mathematics, engineering, and technology (SMET) education. Besides describing faculty reward systems and comprehensive change across a college campus, these reports discuss a classroom environment where the process of education is student-centered, which features active learning, and that accommodates students’ varied learning styles.

In her monograph, They’re Not Dumb, They’re Different: Stalking the Second Tier, Sheila Tobias echoes these findings. Her work pinpoints some specific classroom characteristics that, if addressed, might help to retain some of the “second tier” students (i.e., those often high achievers who are serious about their learning and career goals but who, for some reason, chose not to pursue science and engineering). In particular, she notes the “classroom culture” of science and the traditional classroom environment and teaching style used. She asserts that many traditional science courses suffer from a lack of community (both between the instructor and the students and among the students themselves) and that many students desire this relationship and are more successful when it is incorporated into the classroom. Other factors that Dr. Tobias identifies as potentially inhibiting student success are the lack of identifiable goals in a course (i.e., the “big picture”), the competitive environment that is sometimes present in science and engineering courses, and the often exclusive problem solving nature of the classroom. She further states that many students would respond better to science if more cooperative and interactive modes of learning were part of the pedagogy, and if scientific knowledge were more closely and explicitly linked to important societal issues.

This paper discusses some practical suggestions for improving the classroom environment, many of which parallel the strategies discussed by Dr. Tobias. The ideas were inspired by a roundtable discussion of over a dozen science and engineering educators at one session of the 29th Annual IEEE/ASEE Frontiers in Education Conference in San Juan, Puerto Rico. That session led to a follow-up presentation at the 30th Annual IEEE/ASEE Frontiers in Education Conference where general advice and specific suggestions from the experience of the authors were used to supplement suggestions from the roundtable discussion. This paper is a further extension of that presentation. Here, strategies for success are categorized into activities that pertain to planning the course and those that concern conducting the course. A bibliography included at the end of this paper could be beneficial to instructors before entering the planning phase or throughout the course duration.

II. STRATEGIES FOR SUCCESS

A. Planning the Course

Success in a course comes, in part, from having planned structure. Three things that can lead to such structure are described here—preparing a clear set of instructional objectives, developing the course syllabus, and establishing grading policies conducive to student learning.

1) Instructional Objectives: Course instructors seek to convey knowledge, encourage learning and interest, and develop a group of
skilled individuals. One way to accomplish these things is to consider the exams before the semester begins and to list the skills that will be required to successfully complete them. Then, a set of instructional objectives for the course can be prepared to reflect the required skills.

In *Preparing Instructional Objectives*, Robert Mager describes some practical guidelines for writing effective instructional objectives. He asserts that the objectives must include three characteristics: (1) a statement about what the learner must be able to do, (2) a description of the conditions under which the performance is to occur, and (3) a description of the criteria for acceptable performance. James Stice states, “Instructional objectives are the most important tool in the teacher’s kit because they specify the outcome of the course.” Thus, preparing instructional objectives gives the instructor a clear idea of the purposes and goals of the course, allowing one to identify important material, delete extraneous content, and plan for the course activities. Further, when shared with the students, the objectives provide a logical and coherent framework for the course and appeal to those students who desire the big picture.

2) Course Syllabus: After the course instructional objectives have been prepared, the most appropriate methods and materials for delivering the content can be selected and a syllabus can be developed. The syllabus should describe how to achieve the course instructional objectives. It should clearly communicate the course goals and should include a description of the instructional objectives that will guide the course, provide information about the textbook, indicate a list of supplementary reference material, contain the grading policy, and address other course logistics. The syllabus should also list the instructor’s contact information and office hours, as well as a statement encouraging students to use the office hours (i.e., more than just the phrase “... and by appointment”). The instructor should also include some personal information and a description of his/her teaching philosophy. This will allow the students to feel a rapport with the instructor and may begin to establish a sense of community in the classroom.

3) Grading Policy: The goal of establishing a grading policy is to provide guidelines from which the instructor can measure different levels of accomplishment. This must be consistent with the course goals and with the course instructional objectives. As purported by Tobias, a grading policy that fosters student cooperation and diminishes the level of competition may be best for many courses in science and engineering. It is difficult to encourage teamwork and collaboration if students see classmates as competitors who could raise or lower the curve, and many experts recommend strongly against grading on a curve for just this reason.

The instructor should take into account student grading concerns when establishing the grading policy. Many students need clarity and specificity in this regard; it is an important component of every course in their eyes. The policy should address their key questions such as: How are the exams given? What will be their nature, frequency, and length? What fraction of the course grade will depend on exam scores? Further, the instructor should decide whether tests alone can accomplish the goals of the course or whether other devices (such as attendance, class participation, homework, and design projects) will be used to provide a measure of different achievement levels. From a student’s perspective, a verbal description of various achievement levels can further clarify the grading policy.

Finally, throughout the semester, the instructor should provide students with feedback about their performance with respect to the grading policy. This simple task can be a useful tool in motivating extra achievement for students with various learning styles.

B. Conducting the Course

Planning a productive first class session and adopting a classroom demeanor that may stimulate student interaction are two important issues in conducting a successful course. Other issues include incorporating practical applications into the classroom, motivating various student learning styles, encouraging class participation, and using active learning in the classroom.

1) The First Day: Getting off to a good start is vital, so the first class session is an ideal opportunity to be clear about expectations and to impress on the students that the course is well-planned and organized. This is a time for the instructor to share his/her expectations for the course, to describe the overall goals of the course, and to explain the relevancy of the course to the students’ curriculum and their education in general. This can begin to create a climate where students view the instructor as approachable.

In addition to reviewing the course syllabus, some suggested activities for the first day include reading and distributing a letter about one’s teaching philosophy and discussing the value of pedagogical activities (i.e., focus on learning styles, active learning, or teamwork). Also, having students read advice from others in previous courses or having them participate in a course-specific icebreaker activity on the first day, such as self-introduction, can go a long way towards fostering a sense of community.

2) Classroom Demeanor: The instructor should design each class period with the goals of improving students’ understanding of the concepts, having them learn to apply the basic principles of the course, and developing in them the ability to solve new problems with these skills. These goals are easier to achieve when the instructor’s classroom demeanor promotes confidence and community in the students, and it is important that the rapport one initiates on the first day be sustained throughout the semester. To facilitate this rapport, the instructor should be available to students by establishing ample office hours, both for students and for teaching assistants, and by being available during those times.

The instructor should also show that he/she respects the students and their time in the classroom. Adhering to the scheduled start and stop times of the class, not rushing through material at the end of the class session, eliminating meaningless activity and busywork, avoiding long, personal stories, and not reading verbatim from a textbook or other source are important means for achieving this focus.

Another way to establish a positive classroom demeanor is to vary the method for delivering course material. The instructor can distribute copies of key theoretical materials, leaving gaps for students to complete during class. The students will appreciate not having to take extensive notes during the class period, and they will have more time to concentrate on the material being presented. Also, many approaches to delivering course material—such as class email lists, websites, xeroxed handouts, and projects—can enliven and enrich teaching and learning experiences, so the instructor should strive to include a variety of these methods as well.

Setting realistic expectations and respecting students can also promote productive instructional activity. In this regard, instructors should avoid talking down to the students, should not discourage students because of their mistakes, should speak openly with the students, and should strive to practice positive, optimistic.
success-oriented teaching. Being responsive to and encouraging student questions also conveys respect. As such, the instructor should provide some answer to each student question, even if the answer is just, “I'll have to get back to you later about that.” Further, the instructor must follow through on what was promised by determining the answer and reporting back to the class.

To further promote a successful classroom environment, the instructor should practice some simple things such as facing the student audience and speaking slowly and clearly. Most students are either unfamiliar with the subject matter or are significantly less acquainted with it than the instructor, so what might be a normal exchange in a collegial context may be not understood at all by someone exposed to the material for the first time. Language difficulties (in terms of an instructor or student with English as a second language) can also be minimized with this approach. Rephrasing material throughout a lecture and keeping eye contact with students may also improve their understanding.

Throughout the semester, it is important to assess the progress of the course. The instructor should periodically review all assignments and tests, comparing them with the instructional objectives, and should determine whether the course is proceeding as expected. Collecting students’ written reactions and thoughts throughout the course can also be helpful in establishing a positive classroom demeanor, and their suggestions can help shape the course direction.

One final suggestion involves periodically updating the course content to reflect the evolving nature of engineering and technology. For example, changes in cost, size, and availability of electronic devices can be incorporated into electrical engineering courses, and selection of appropriate higher level programming languages, computer-aided design programs, and operating systems can be added into software engineering courses. Further it is important to introduce students to global issues and perspectives. For instance, local newspapers and popular periodicals frequently feature stories about technological innovations of other countries. Discussing a current story related to the course material can stimulate learning for many students. An attempt to verify that the goals of the course reflect the current needs of the profession is an ongoing necessity.

3) Practical Applications: Another key to completing a successful course involves relating the curriculum to real life problems and to current events. This is often made possible by including practical applications in the classroom, and the instructor can accomplish this by drawing on personal experience or by using student examples as sources of realistic problems. Students who participate in professional work programs, research activity, or community service while in college can be a valuable source of such information. Since there are many situations where universities, consortia, and academic-industrial partnerships bring students into contact with realistic problems, all that is necessary is to take advantage of those activities in teaching situations.

For example, Kettering University has a mandatory cooperative education program. Students are placed with an employer in their field of study (currently the school has partnerships with over 600 companies), and they alternate semesters at their worksite and on campus beginning with their first freshman semester. A similar situation is the Federal Work-Study Program at UCLA. Under this program, undergraduate students have some financial support from the federal government, and they get practical experience by working for the university, for governmental agencies, or for public or private non-profit organizations. At the University of Pittsburgh the connection with industry begins in the first year when students are teamed with alumni in the Pittsburgh area to assist the students with their semester writing projects. A similar program is the Manufacturing Engineering Education Partnership between Penn State, the University of Puerto Rico, and the University of Washington. Through all of these experiences, students are often able to provide practical insight to classroom activities.

4) Learning Styles and Class Participation: Striking a balance between lecturing and engaging in alternative teaching techniques to stimulate students with various learning styles can be a challenge. Learning style is a biologically and developmentally imposed set of personal characteristics that make some teaching (and learning) methods effective for certain students but ineffective for others, and various models of learning style preferences have been described. These include the Myers-Briggs Type Indicator, Kolb’s Learning Style Model, the Felder-Silverman Learning Style Model, and the Dunn and Dunn Learning Style Model. Several practitioners within the domains of science and engineering education have noted the importance of embedding a learning style approach within a variety of teaching strategies, and still others have studied applications of psychological types in various educational domains. Rita Dunn has offered the following statements based on current research on learning styles to assure that every person has the opportunity to learn:

- Each person is unique, can learn, and has an individual learning style.
- Individual learning styles should be acknowledged and respected.
- Learning style is a function of heredity and experience, including strengths and limitations, and it develops individually over the life span.
- Learning style is a combination of affective, cognitive, environmental, and physiological responses that characterize how a person learns.
- Individual information processing is fundamental to a learning style and can be strengthened over time with intervention.
- Learning style is a complex construct for which a comprehensive understanding is evolving.
- Learners are empowered by a knowledge of their own and others’ learning styles.
- Effective curriculum and instruction are learning-style based and personalized to address and honor diversity.
- Effective teachers continually monitor activities to ensure compatibility of instruction and evaluation with each individual’s learning style strengths.
- Teaching individuals through their learning style strengths improves their achievement, self-esteem, and attitude toward learning.
- Every individual is entitled to counseling and instruction that responds to his/her style of learning.
- A viable learning style model must be grounded in theoretical and applied research, periodically evaluated, and adapted to reflect the developing knowledge base.
- Implementation of learning style practices must adhere to accepted standards of ethics.

To promote effective learning, it is important to provide suitable activities that appeal to each learning style.

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An instructor who strives to understand his/her own learning style may also gain skill in the classroom. Consider the question, *How does the way you learn influence the way that you teach?* Most instructors tend to think that others see the world the way they do, but viewing things from a different learning perspective can be useful. It is good practice to specifically contemplate approaches to accommodate different learners, and this is often easiest after an instructor learns about his/her own learning style. An instructor with some understanding of differences in student learning styles has taken steps toward making teaching more productive.

It is also important for the instructor to encourage class participation, but one must keep in mind the differences in student learning style when doing so. Research has shown that there are dominant learning characteristics involved in the perception of information through concrete versus abstract experience.2,13,30 Some learners need to express their feelings, they seek personal meaning as they learn, and they desire personal interaction with the instructors as well as with other students. A characteristic question of this learning type is *why.* This student desires and requests active verbal participation in the classroom. Other individuals, though, best obtain information through abstract conceptualization and active experimentation. This learner tends to respond well both to active learning opportunities with well-defined tasks and to trial-and-error learning in an environment that allows them to fail safely. These individuals like to test information, try things, take things apart, see how things work, and learn by doing. A characteristic question of this learning type is *how.* Thus, this student also desires active participation; however, hands-on activity is preferred over verbal interaction.

The instructor must have a sincere interest in the students. However there is no best single way to encourage participation. Individual student differences in willingness to participate by asking questions often surface.37–39 Still, although the number of times an individual speaks up strongly depends on student personality qualities, a class where all are encouraged to enter into dialog is preferable, and opening the lecture to questions benefits all students.

5) Active Learning: An ancient proverb states, "Tell me, and I forget; Show me, and I remember; Involve me, and I understand." This is the basis for active learning in the classroom,41 and extensive research indicates that what people tend to remember is highly correlated with their level of involvement. Edgar Dale’s *cone of learning*41 shows that students tend to remember only 20% of what they hear and 30% of what they see. However, by participating in a discussion or other active experience, retention may be increased to up to 90%.

Cooperative learning is a formalized active learning structure which, as defined by Johnson, Johnson, and Smith,24–41 involves students working together in small groups to accomplish shared learning goals and to maximize their own and each other’s learning. Their work indicates that students exhibit a higher level of individual achievement, develop more positive interpersonal relationships, and achieve greater levels of academic self-esteem when participating in a successful cooperative learning environment.

However, cooperation is more than being physically near other students, discussing material with other students, helping others, or sharing materials amongst a group, and instructors must be careful when implementing cooperative learning in the classroom. For a cooperative learning experience to be successful, it is essential that the following five elements be integrated into the activity:24,41

1. **Positive Interdependence**—Students perceive that they need each other in order to complete the group task.

2. **Face-to Face Interaction**—Students promote each others’ learning by helping, sharing, and encouraging efforts to learn. Students explain, discuss, and teach what they know to classmates. Groups are physically structured (i.e., around a small table) so that students sit and talk through each aspect of the assignment.

3. **Individual Accountability**—Each student’s performance is frequently assessed, and the results are given to the group and the individual. Giving an individual test to each student or randomly selecting one group member to give the answer accomplishes individual accountability.

4. **Interpersonal and Small Group Skills**—Groups cannot function effectively if students do not have and use the required social skills. Collaborative skills include leadership, decision making, communication, trust building, and conflict management.

5. **Group Processing**—Groups need specific time to discuss how well they are achieving their goals and maintaining effective working relationships among members. Group processing can be accomplished by asking students to complete such tasks as: (a) List at least three member actions that helped the group be successful, or (b) List one action that could be added to make the group even more successful tomorrow. Instructors also monitor the groups and give feedback on how well the groups are working together to the groups and the class as a whole.

When including cooperative learning in the classroom, the instructor should do so after careful planning. Also, the students may be more receptive to the experience if the instructor shares some thoughts about cooperative learning and the benefits to be gained by the activity.

**IV. CONCLUDING THOUGHTS AND SUMMARY**

Many of the participants in the 29th *Annual IEEE/ASEE Frontiers in Education Conference* roundtable session that inspired this paper teach in universities throughout the United States in several departments of engineering and computer science. It is the experience of these participants and of the authors of this paper that students in those disciplines have strong competitive tendencies, frequently seek to avoid writing, and often obtain less training in verbal give-and-take than those in sociology, political science, and English. Some of the classroom practices recommended in this paper expose students to a mode of learning that supports writing and speaking skills, providing long-term career benefits for students.

There are many different approaches to improving a classroom environment, and Table 1 summarizes some suggestions identified in this paper. Including activities that appeal to all learning styles, creating a classroom with active participation of students, combining open-ended tasks and those with well-defined goals, including both demonstrations and lectures in the classroom, and using verbal and pictorial descriptions and examples are key to a good overall instructional model.
V. ADDITIONAL RESOURCES

The attached bibliography provides several ways to tap into the thoughts of others about class activities. One way to begin involves investigating learning or cognitive styles. Another is to focus on a subject area and seek out stimulating sources within it. A third approach involves reviewing material specifically geared towards improving class methods.

For the reader seeking reference material about effective ways to structure learning, the books presented in references 44–49 can be grouped under the heading Educational Quality. They discuss topics (such as society, culture, visual thinking, brain dominance, and quality issues) that pertain to the United States’ educational system. For those interested in the subject of mathematics, the citations listed under 50–61 could be classified as Quantitative Thinking. Several of these are written by non-mathematicians and cover a wide range of historic and cultural issues in the area of mathematics education.

Finally, besides the resources cited throughout this paper, references listed under 43–46 could be classified as Engineering Education, and they provide information that could be useful for any college instructor in science or engineering. Materials published by the American Society for Engineering Education (including Prism and the Journal of Engineering Education) and by the IEEE Education Society (including IEEE Transactions on Education) are also valuable resources. Many of these references have useful web sites as well (for example, see http://www.asee.org, http://fic.engrng.pitt.edu, http://www.ams.org/journals, or http://www.jstor.org/journals).

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