STUDENT MOTIVATION, ATTITUDE, AND APPROACH TO LEARNING

Notes From a Novice Teacher

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Professors are faced with outstanding-, average-, and poor-performance students every day in every class, but it seems that only a few try to understand what is wrong with the lower-end students and do something to help them. The natural tendency is to think of them as lazy or immature, or perhaps to view them as students who are in the wrong discipline. While some of them might indeed be immature or lazy, or misplaced, others could be failing courses in spite of their best efforts and are often in danger of dropping out of the course, or even dropping out of school.

When I think back to my days as an undergraduate and remember some of the smart and capable classmates who dropped out of school, I marvel that I managed to continue and to succeed when they did not. While the reasons are many and complex, some thoughts come to mind immediately—I was lucky enough to have several excellent teachers at different stages in my education, and they had a great influence on my academic and professional choices. I was exposed to different teaching styles throughout my college years and was able to take the best from each of them.

Some of my friends and relatives had the misfortune of having extremely poor teachers or badly organized courses at crucial stages of their education, with the result that they became discouraged or confused and eventually lost the will to continue their education. One friend from high school who had extremely good grades, dropped out of the university after one term in chemistry. She found that the impersonal teaching style of her college professors contrasted poorly with the cooperative teachers we had in high school, and it made a big difference in her own attitudes. While she was doing well (better than average), she was frustrated and none of the professors took the time to give her the reassurance she needed.

I am frequently impressed with the insight and intuitive understanding my own wife has of physical and chemical phenomena, in spite of her proclaimed dislike of "theoretical" explanations. She could have been an excellent chemical engineer, but she had "boring" chemistry teachers in high school and then in college she came face to face with the attitude (still prevalent) that women are not good at science—so she chose a different educational path. There are still professors who have different standards for men and women, claiming that "female chemical engineers will most likely end up staying home" while male chemical engineers would "most likely become field practitioners" and thus require a much more rigorous education. The sad truth is that many students with the potential to succeed are discouraged from doing so. In Felder's words,[1] "There is nothing wrong with the raw material" (when talking about the quality of American students)—it seems that the educational system itself has been adversely affecting many of them.

This situation does not have to continue. Professors can do many things to promote students' learning and to help them discover the best in themselves. Professors should focus on motivating students, adapting their teaching styles as necessary to nurture and promote the intellectual growth of their

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students. They should strive to help students rise to the top.

This is easily said, but how can it be accomplished? To answer that question, a short literature review on motivation, learning, and teaching styles follows, and a compilation of recommendations from distinguished chemical engineering educators is given. Finally, my personal perspective will be given in two ways: first, the description of my strategy for effective teaching, despite being new in the profession, and second, a retrospective analysis of the experiences gained during my first two years as an associate professor at the National Autonomous University of Mexico.

MOTIVATION FOR LEARNING

It is usually accepted that motivated students are easier to teach—that students who are interested in learning do, in fact, learn more. Professors should encourage and take advantage of students' motivation to learn. An optimal motivational level should be sought and established right from the course beginning. Since motivation and commitment are personal matters, what can be done to motivate the class as a whole? Cashin[2] proposes capitalizing on the students existing interests; relating the course to the students' interests whenever possible; explaining in detail the relevance of the course, using problems, case studies, examples, etc.; discussing the ways in which the teacher finds the course interesting; finding out which topics are of most interest or value to the students; including some optional or alternative units; encouraging alternative learning methods (*e.g.,* lectures, discussions, independent study, etc.) when possible.

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Ericksen[3] notes the negative effect on motivation when there is a conflict between the teacher and students over course objectives and content. In small classes it is not particularly difficult to negotiate this conflict, but in large lecture courses the objectives are operationally defined by the procedures used in evaluation and grading. In large classes, the teacher makes most of the decisions as to what is learned and when it is learned. The principle of a performance-oriented course is not compromised and the advantage of participation is gained when students mark out a subset of objectives with which they want to become involved. Initial responsibility for drafting objectives, however, rests with the teacher, who has the knowledge of both the discipline and the available resources.

The learning environment present in a university can shift students from an interest focus to a course focus. In other words, students who are used to a high level of commitment and have high expections for intellectual stimulation can be disappointed with the actual levels of each course offered in their university, to the point that getting "passing grades" becomes their main objective.[4]

Professors have to deal with a wide range of students; some are highly motivated and will succeed regardless of the subject matter, teaching effectiveness, or class size. But in nearly every class there are also those students who are "at risk," who suffer from poor motivation, low self-esteem, or a low sense of personal control. Menec and Perry[5] propose two ways to help these students: (1) professors should function as attributional retrainers; *i.e.,* they should modify students' (mis)perceptions of their successes and failures by using an attributional retraining technique, and (2) there should be a proper use of comments about students' performance and abilities.

PERSONAL PREFERENCE IN LEARNING (LEARNING STYLES)

Students learn in many different ways. Some prefer abstraction, others prefer facts. Some want details, others want the entire picture. Some think in terms of pictures and charts, others in terms of words, and still others in terms of symbols and equations.[6] Every human being has a preferred style. Woods[6] has recently published a detailed and interesting review on personal preferences in learning and provides a number of ideas on how to improve learning by accounting for the student's personal preference in learning. Felder[7] has also critically reviewed the literature on learning and teaching styles. Moreover, he stresses the importance of helping students build their skills in both their preferred and less-preferred modes of learning. To do so, it is important to teach using techniques or material adequate for all the categories of learning styles. This is called "teaching around the cycle."[7]

Different authors classify learning styles in slightly different ways. Woods[6] proposes three categories to classify learning styles. In the **first category** he includes those elements of learning style that are "robust," those that cannot be changed: (1) Jungian or Myers Briggs with their four dimensions for processing information; (2) visualizer/symbolizer/verbalizer, or drawing/equation/words (DEW), which refers to the preference for memorizing and thinking about information; and (3) Kirton's adaptor-innovator options for applying creativity. In a **second category**, he includes those styles that may or may not be possible to change: (4) serial versus holistic preference for processing information; and (5) inductive versus deductive preference for processing. In a **third category** he includes those styles that can be changed through training or experience: (6) Piaget's levels of development; (7) Perry's levels of attitude toward learning; (8) Kolb's learning cycle; and (9) Entwistle and Ramsden's

deep-versus-surface processing.

The explanation of these different learning styles and examples of how they manifest among students can be found elsewhere.[7-12] What is worth mentioning here is Woods' list of ideas on how to facilitate learning in a way that takes into account learning preferences.[7] To develop awareness, he proposes we

- *Identify our own learning preferences since teaching and testing will be highly influenced by our own style*
- *Help students identify their own learning preferences and discuss the implications of each style*
- *Help students become more understanding of learning-style differences.*

To cater to individual student's learning styles, Woods proposes

- *When presenting information, forcing oneself to present the key concepts of the course in different styles*
- *If possible, sectioning classes to match learning styles between teachers and students*
- *Writing course material in a way that it appeals to different styles*
- *Allowing different required texts*
- *Identifing the learning styles of colleagues and recruiting their help in the creation of exams, weekly assignments, and the review of course texts*
- *Having learning-style ombudspeople in the class to help the professor prepare and assess class material*
- *During assessment, providing flexibility in exam questions*
- *Whenever possible, working with smaller groups and using co-operative learning (with group membership influenced by knowledge of students' learning styles)*
- *Indivualizing teaching*
- *Individualizing testing*
- *Using the Keller "Proctorial System of Instruction" (PSI) plan.*[13]

To develop students' skill and flexibility in appreciating differences, Woods additionally recommends that we

- *Plan activities to explicitly help develop those elements of style that are less robust and create learning environments to promote a target style*
- *Use small-group "self-directed learning" (SDL) or "problem-based learning" (PBL) with smaller (5 or 6) groups of students.*

CONFLICTS BETWEEN LEARNING AND TEACHING STYLES

Junior professors might feel tempted to try some of the ideas suggested by Woods right away and to make changes in their teaching styles without full consideration. Although it is true that favoring one's own learning style by teaching in that style could be detrimental to students with different styles, it is also possible to create conflict with a higher proportion of students if they are not properly informed and involved in the change process.

There are several cases reported in the literature where conflict arose when changes were made to the instructor's teaching style. Saunders[14] noted the case of reluctant behavior of some participants in role-play simulations. Anderson and Adams[8] report conflict when students experience teaching styles that do not match their expectations. Miller, *et al.*,[15] mention some of the disadvantages of active learning, such as poor structure or lack of structure. The dynamics of interpersonal relationships in co-operative learning groups and lack of individual responsibility on the part of group members are potential sources of conflict, even in carefully structured groups. Woods[16] explains the problems (and solutions) encountered when incorporating PBL components (two courses) into the otherwise traditional chemical engineering program at McMaster University. In the paper he mentions nine issues of concern; one of them is gaining student acceptance.

A common remedy to eliminate or attenuate the conflict is to clearly inform the students of the objectives and benefits of the new approaches and to explain how they can manage conflict—prior to making the changes. In some cases it is important to previously train the students on necessary skills, such as problem-solving, interpersonal and group behavior, and learning approaches.[16] Some students may be so reluctant to change that the use of different teaching styles and even different (yet known) assessment procedures may be needed.

EXPERTS' RECOMMENDATIONS FOR STUDENT LEARNING IMPROVEMENT

There are many things that can be done to accommodate differences in learning styles, levels of motivation, levels of intellectual development, and judgment modes among students. One approach is to try to follow the "seven principles" for good practice in undergraduate education:[17]

- *Encourage contact between students and faculty*
- *Develop reciprocity and cooperation among students*
- *Use active learning techniques*
- *Give prompt feedback*
- *Emphasize time on task*
- *Communicate high expectations*
- *Respect diverse talents and ways of learning*

Wankat[18] proposed "ten learning principles." The first six of them coincide with the previous principles, and the remaining four are:

- *Develop a structured hierarchy of content and guide the learner*
- *Develop images and use visual modes of learning*
- *Challenge the students*
- *If possible, separate teaching and evaluations*

Similarly, Bird[19] also proposed "seven rules" for teaching:

- *Do not show off*

- *Do not bluff*
- *Do not intimidate*
- *Do know what you are going to teach*
- *Do know why you are going to teach it*
- *Do know how you are going to teach it*
- *Remember that the teacher's job is to serve the student (keeping in mind that serving does not mean being "crowd-pleaser" or rewarding poor performance).*

Felder and Silverman[9] proposed several teaching techniques to address all learning styles. They include

- *Motivating learning*
- *Providing a balance of concrete information and abstract concepts*
- *Balancing the material that emphasizes practical problem-solving methods with material that emphasizes fundamental understanding*
- *Providing explicit illustrations of intuitive and sensing patterns*
- *Following the scientific method in presenting theoretical material*
- *Using graphical material (pictures, plots, figures) before, during, and after the presentation of verbal material*
- *Using computer-assisted instruction*
- *Providing (short) active intervals during lectures*
- *Giving the students the option of cooperating on homework assignments to the greatest possible extent*
- *Applauding consistent effort*
- *Talking to students about learning styles*

The comfort level of feelers (in the Jungian typology) in technical courses can be raised by (a) bringing out the social relevance of the course material, (b) addressing some non-technical topics, and (c) using student-centered instructional approaches such as cooperative learning.[11]

To promote a deep approach to learning, the following conditions should be present:[11] student-perceived relevance of the subject matter; clearly stated instructional objectives, practice, and feedback; appropriate tests; reasonable workload; and choice over learning tasks.

To help the students move up the intellectual-development ladder, it is necessary to provide an appropriate balance of challenge and support, occasionally posing problems one or two levels above the student's current position. Instructors should assign open-ended, real-world problems throughout the curriculum, but should not make course grades heavily dependent on them. Providing feedback on performance with these types of problems is very important.[12]

Felder, *et al.*,[20,21] and Stice, *et al.*,[22] have prepared a comprehensive study of teaching methods that promote learning and how to train teachers to apply those methods. The emphasis is on engineering courses, but most of the ideas are also applicable to other disciplines.

THOUGHTS ON WHAT TO DO TO IMPROVE STUDENT LEARNING

A junior professor might be overwhelmed by the amount of information cited in this paper for improving student learning by accounting for personal preference and implementing changes in their style of teaching. Even some experts on education recommend that junior professors in research-intensive institutions give priority to getting started with their research projects and obtaining funding; that they start modestly in their first teaching efforts, trying to get as much help as possible from senior professors when it comes to course design and material.[23]

But what about those students in our classes during our first few years in academia? Is it okay to "lose" some of them during this early period of learning to teach? The answers to these questions should be answered by the new professors themselves. My first-year-as-a-professor answers are provided in the following paragraphs.

I envision teaching as a continuous attempt to promote students' growth, both intellectual and personal, by using optimal mixtures of the three components in play: the students themselves, the teacher (myself), and the subject discipline or course topic.

As to the first ingredient of the learning mixture—the students— there are several aspects that I try to keep in mind. The first is that students are human beings, and as such they deserve respect and consideration. The second important aspect is to recognize that students have different learning styles, attitudes, and motivations for learning. To get the best out of them (to be used in the "learning mixture"), it is necessary to motivate them (to an appropriate level), and to be able to adapt my teaching style to their learning styles, or to convince them of the convenience of being exposed to learning styles not initially compatible with theirs. Whenever possible, I try to allow my students to negotiate learning objectives and the assessment procedure.

The second ingredient in the mixture is the teacher—myself. Although most of my professional life has been focused on industrial engineering practice and applied research in polymer reaction engineering, I have always considered teaching as a noble and important activity. Much of what I am today was inspired by former teachers of mine and my parents. My love of mathematics, chemistry, and physics (key components in chemical engineering) was triggered with the help (and promoted by the example and teaching styles) of several excellent professors. Many of my teaching strategies were stolen from those teachers.

Some of the positive early aspects of my teaching style have been my respect for students (as a student, I was turned off by those who made students feel less intelligent, mature, or trained) and responsibility in my activities. As a teaching assistant at McMaster University, I always tried to fully

understand the material before a tutorial took place or when talking to students (most of the time I tried the solutions to assignments and exams myself, even when the solutions were available from the instructor). When I did not know the answer to a student's question, I tried to find the answer and get back to the student as soon as I could. Whenever possible, I tried to design assignments that were connected to actual problems and situations that the students would face in their professional lives.

Teaching is sufficiently important that we need to continuously refine it through a systematic and scholarly approach. That is the very least our students and our society deserve.

Despite the fact that I followed the example of inspiring teachers in my early teaching experiences, I discovered that I was not as effective as I had wished to be. Being somewhat introverted and a "feeler" (in the Jungian typology), I realized that my teaching style was biased toward students with learning styles similar to mine. I did not use many group activities, my lecture material was abstract (mostly text, equations, and diagrams), and I used to speak softly. I knew something was not working the way I wanted it to. In this area, I received some valuable help from a credit course I decided to take while I was a graduate student (titled "Principles and Practice of University Teaching").

The last ingredient in my teaching mixture is the course subject. If I want to teach something, I should understand it deeply and I should like it. I should be able to make it appealing and interesting to the students. I should be able to make the students understand why it is worth studying the discipline. To that end, I spent three years as a practitioner in order to garner first-hand experience in an actual work environment. To help my understanding of the area, I enrolled in graduate school where I obtained my MEng and PhD degrees. Throughout this time, I detected areas of opportunity for research and technological improvement and learned many things that I would like to share with students. I may even be able to help some individuals to find and exploit (or reinforce) their potential as professionals in this area.

In short, a young professor can improve student learning by liking to teach, establishing interesting and novel research lines, providing multiple real-life applications of topics taught in the course, taking advantage of the instructional development courses and facilities where and when available, and never ceasing to learn.

CLOSING REFLECTIONS

After two years of research and teaching experience as Associate Professor of Chemical Engineering, I can add some additional thoughts on the subject. It is not easy to be a "quick starter," even if one tries to follow Brent and Felder's[24] advice on how to become one, or even if one reads what Felder[25] wished he had been told.

I still made mistakes or inadequate choices during my first two years as a professor. In my first semester I offered a graduate course with "cutting edge" content and found I had to spend an average of six hours of preparation time per lecture hour (in the second semester I reduced that to a two-hour preparation per lecture hour, but was responsible for three courses). I put too much emphasis on the course content at the cost of little active student participation. As a thesis supervisor I gave too much freedom to my undergraduate and graduate students (I myself was the independent type who did not like my supervisors over me all the time) until I realized that most of them liked and needed closer supervision. I did not start manuscript writing early, so I had to spend several weeks of twelve to fifteen working hours in order to reach my own research goals during my first year as a professor.

Not everything could be classified as a "failure," however. I also implemented some good ideas from the experts.[22-24] I tried to incorporate much of my own research into my course materials; I started several collaboration projects with experienced researchers from industry; I asked colleagues to read and provide the toughest critique to my research proposals (so far, funding has been granted in all cases); I applied for course load reduction (standard optional procedure for the first two years of new faculty) in order to concentrate on research funding activities, etc.

In order to motivate students, the teacher does not necessarily have to be easy-going and charismatic (although it helps). Even introverted or absent-minded teachers can motivate students. In my courses I try to motivate the students in a number of different ways. For instance, as mentioned before, I use my research projects to provide examples of material covered in the course. This helps make matters more interesting and, at the same time, it helps attract students to my research projects. Sometimes there may be topics in the course that I do not feel at ease explaining (in advanced or graduate courses, for example)—in those situations, in addition to spending time reading and updating my knowledge, I try to invite other professors or respected industry researchers to give short lectures within the course. Students usually respond positively to these special lectures.

For one month during this school year I had a distinguished professor from Canada who participated in some of my courses and co-supervised some of my graduate students. They already know some of his work since I use it in my courses, and knowing he would be here had a positive

effect on my undergraduate and graduate students. They waited anxiously for his visit and felt they would learn something new and useful while he was here, which they indeed did. I am also arranging the visit of another well-known and well-respected Canadian professor next year who will co-chair with me the organization of a microsymposium within a major conference in my field.

My students, both undergraduate and graduate, are aware of my efforts to establish a research group. In a department where the average age of the professors is over 45, I find that some of the undergraduate students are eager to get involved in projects significantly different from the more traditional ones. Graduate students are more reluctant to change, though, and they usually prefer to work for senior professors. Nonetheless, they also acquire a high degree of motivation from courses where content is related to research as much as possible. Innovation and change gets students' attention and encourages them to go beyond the contents of textbooks.

In other words, young professors can concentrate on setting up their research programs (what counts for promotions and stimuli in our academic world) and still be able to promote learning in their students by sharing with them the enthusiasm for this activity. Students who get involved with actual research projects in their courses develop a higher degree of motivation than students who just follow the book.

Students are individuals, and as such they have different learning styles, motivations, and expectations for learning. It is very important that when implementing "non-traditional" teaching methods in their courses, professors let their students know the objectives and the value of the new teaching approaches. It helps to stress the usefulness of these approaches. There may be students who remain reluctant to accept them, even after the purposes and benefits of non-traditional techniques have been explained. The instructor should be prepared to use alternate teaching styles or have alternate assessment procedures (known to the student).

Students are a precious resource that should not be squandered through ineffective teaching. Teaching is sufficiently important that we need to continuously refine it through a systematic and scholarly approach. That is the very least our students and our society deserve.

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