ChE classroom

TEACHING AS AN EXERCISE IN PROJECT MANAGEMENT

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Stepping from the industrial world into the academic world can be a daunting, but challenging, experience. After almost twenty years in industry, including some ten years in project management, I returned to academia and found myself facing the question of how I could best apply my industrial experience to at least partially compensate for my lack of teaching experience. I felt that several aspects needed to be addressed: first, I needed an overview of the position, including all of its duties and responsibilities; second, I needed to understand the role that lectures and exams play, and their interrelationship, in addition to an understanding of the grading system; and third, consideration had to be accorded the students and their abilities and aspirations. I concluded that some of the fundamental philosophies of project management that I had practiced in industry could be applied to teaching, and that a number of analogues existed between the two professions.

THE PROFESSOR'S ROLE

In constructional project management, the role of the project manager is to build something—anything from a house, say, to a nuclear power plant. Overseeing the construction involves meeting deadlines and specifications. In most cases, however, both time and specifications are subject to change, and this in turn affects costs—so the project manager often has to strike the best balance he can between time, specifications, and costs. In addition, he stands between the contractor and the client, and, whether or not he is employed by either of them, he must satisfy both of them. Contractual obligations must be met and personal differences must be overcome if they exist.

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The professor is similarly positioned between the requirements of the university and the needs of the students. The university requires a certain academic standard (the specification) in upholding the reputation of the institution, while the students seek an education, within a certain time frame, that will qualify them for a professional position in society.

Cost is also a factor, just as it is in project management. Additional fees are incurred when a student, who does not meet the academic specification, fails and graduation (and earning power) is delayed. It is idealistic to hope that all students will pass, but students who fail should serve as an incentive for reviewing and improving teaching standards.

Another aspect of cost is the value of the service provided. While a project manager is well aware of the costs involved when a contractor stands idle for an hour, is the professor fully aware of the costs involved when he cancels a class? A significant number of dollars can be involved if you consider his salary, his time commitment to a particular course, the students' fees for the course, and the number of students enrolled in the class (not to mention government subsidies). Professors should feel an obligation to make the best use of the allocated time and to provide a service that is commensurate with the overall cost.

LECTURES AND EXAMS

Lectures have been defined as the transfer of knowledge from the professor's notebook to the students' notebooks without that knowledge having passed through the mind of either of them. If this is true, why not just hand out copies of the notes at the beginning of the term? If we presume that students absorb only a small amount of knowledge through the writing process, then we must assume that the bulk of their knowledge is obtained outside the classroom. Consider the opposite extreme—a highly gifted lecturer who can hold the class spellbound for an hour at a time. Can we assume that those students will automatically achieve top grades? Of course not. There is obviously still a need for acquisition of knowledge outside even the best lectures. An integral part of

the learning process is usually some form of self-study—most people maintain that what they know best is what they learned on their own, through their own efforts. It seems, therefore, that the most efficient method of teaching would be to create a self-learning environment, with the direction and inspiration coming from the lectures.

From the point-of-view of a project manager, the end result is what really counts—and for students the end result (the final examination) is also what counts. The normal progression of giving lectures and then giving a test on the lecture material can be reversed with good results. The technical content and the required standard for the final examination can be set in advance, just as specifications for engineering construction are pre-set. Setting such instructional objectives allows the professor to adopt a management-by-objectives approach to teaching and gives the students direction. Further guidance can be provided through regular assignments that have a similar content as the final examination, with the lectures providing guidance on how to execute the assignments.

Students need other skills in addition to technical skills, and some of them (particularly written communication and mathematical computation) are demonstrated in the examinations. Assignments throughout the course help to develop these skills, and the final examination is to some extent a measure of the development of these skills during the course. There is an analogue with athletes or musicians who practice avidly for the big event—students need to practice their skills before attempting the final examination; such practice comes through regular execution of assignments.

STUDENT'S ASPIRATIONS

The obvious end result of a student's aspirations is a degree. That is the goal of all students, and each course can be viewed as one step along the way. In general, the more demanding the steps, the more valuable the degree. The aspirations of the students are no different from those of the university—to achieve a high academic standard. Human nature, however, provides some inertia to the process and fosters a tendency to take the line of least resistance, creating short-term goals of merely surviving from one examination to the next. It is therefore important that the students have an overall vision of the program.

In construction, it is obviously foolish and expensive to build something that cannot be used, or to have to rebuild something that was built wrongly. It is also important for the sequence of construction to be correct and logical. The same principle applies to a student's educational program and even to the individual courses within that program. Expertise should be developed in a logical and constructive manner. Students accept hard work when they can see a tangible return for the effort they put forth. They find a measure of satisfaction if their examination grade reflects that effort, and, if they can find some satisfaction in each of the approximately fifty courses they take in the engineering curriculum, they will graduate with a sense of achievement.

There is a before-and-after perception of a degree, just as there is in any project, where the completed project never seems quite as good as its initial visualization. Figure 1 shows a mind's-eye conception of a new house before its construction and the actual view of that same house after completion. It is obvious from the illustration that some time must be allocated to reap the full benefit of good landscaping. The same principle applies to a degree: often, a number of years can pass before a satisfactory job related to an individual's expertise is secured. It should also be accepted that the degree may have a few poor grades in its construction, just as a house may have some bad workmanship. This is part of the student's overall experience, and ultimately, a good engineer is an engineer who has the foundation of a solid basic education around which to frame a career.

PLAN OF ACTION

To structure a course from a project-management perspective, definite goals and certain specified levels of acceptance are required. The course should be monitored with respect to time and performance so that the required standard is achieved on the due date, precise specifications for the structure of the final examination should be set in advance, and the steps toward the final examination and final grade should be clearly indicated. As an example, when the final examination em-

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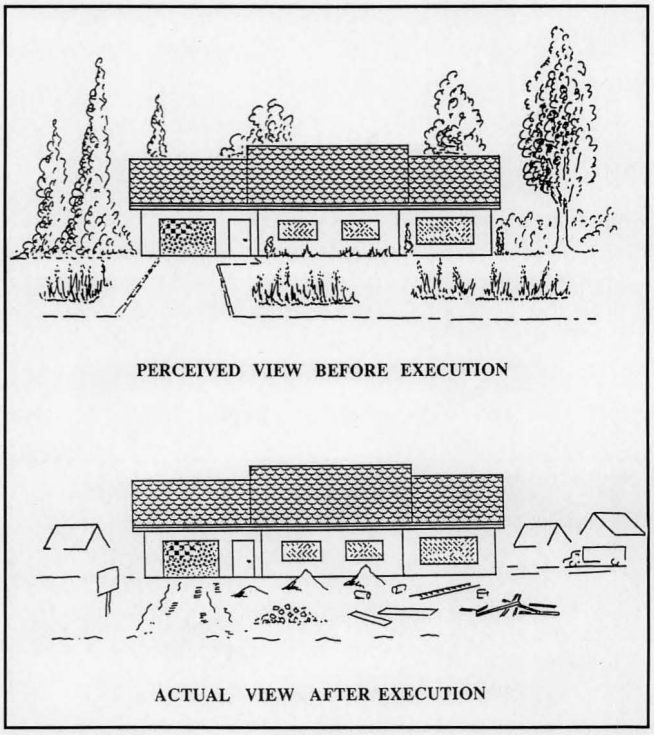

Figure 1

PRACTICALITIES

It is easy to set up a session of presentations. All that is needed is a room, some chairs, an overhead projector, and a screen. The audience can consist of the group of presenting students, and in that case the session can also become an effective teaching situation since students tend to listen to their peers, especially when the work presented is similar to their own. The assessor should sit as far from the presenter as possible in order to check the speaker's audibility and the visibility of the visual aids. Keeping in mind that it is difficult for an audience to concentrate for more than an hour at a time, breaks should be scheduled during the series of presentations. We have found that eight ten-minute presentations during a 2 - 2.5-hour period is a workable session.

It is helpful to spend some time preparing students before they make their presentations. Hanzevack and McKean[1] recommend a brief lecture in addition to written guidelines, and they also provide a useful summary for distribution to the students. The most important point to be stressed is that *the audience wants the presenter to do well.* Most students are very nervous about giving a presentation, but their fears can be somewhat allayed by convincing them that the audience is on their side.

Students should also be shown the assessment form before they give their presentation so they will be aware of the aspects that are being observed and graded.

The best presentations are always given without notes, so students should be encouraged from the very beginning to present without using them. Suggest that they use their overheads as prompts. It is also important to stress how much time they have for the presentation and that they will be penalized for running beyond that limit. Since presenters often try to include too much material, they should be made aware of the importance of tailoring their presentation to the available time. A good guideline to give them is, "If in doubt, leave it out."

The audience should be encouraged to ask questions since one of the best ways to determine if the speaker understands the material is from the way he or she handles questions. When the audience is made up of peer presenters, a scheme can be devised to provide a material reward for questioning—that is, marks can also be given for questions. For example, each student can be allowed a certain number of questions, with a mark given for each of them (provided the question is relevant and hasn't already been asked!).

Most presentations discuss work done by the student, but the mark given for the presentation should be only for its effectiveness. Marks for the technical content should be assessed separately, although the impression formed from the presentation may also have some impact on the other mark. For example, we run second-year laboratories where the total mark of 100 is split 30 for the experimental work, 40 for the written report, and 30 for the presentation. The quality of the experimental work is marked in the first two of these categories, but if the presentation indicates a lack of understanding by the student, the mark achieved in the first two categories can be affected.

The completed assessment form, with both the good and bad points highlighted, should be shown to the presenter. At the end of the session the assessor should comment on some general points, remembering to find something positive to say about each presentation, no matter how dire it was. Constructive criticism goes a long way in helping to correct a presenter's deficiencies. Good presentations are given by confident presenters, so it is beneficial to build up the student's confidence.

REFERENCES

1. Hanzevack, E.L., and R.A. McKean, "Teaching Effective Oral Presentations as Part of the Senior Design Course," *Chem. Eng. Ed.*, **24**(1) (1990) ❐

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braces problems that have a time limit for solution, the student should have had experience (practice) with similar problems on prior assignments and tests throughout the course. Feedback from those problems can be quite valuable in monitoring the student's progress through the steps leading to the final examination.

Lectures are a means of presenting basic material and guiding students to problem solutions, and they should be structured in that fashion. They should be well-directed toward an end condition, with the professor delivering the necessary information as efficiently as possible. The problems should be sufficiently varied to test all of the student's problem-solving skills.

Students who are motivated to learn through good self-study habits should be recognized for their efforts and be awarded grades that reflect their initiative as well as their skills. Grades should not be scaled to some inflexible scale dictated by policy or statistics. Those students who get an "A" should have earned it.

CONCLUSION

It is possible to meet both the requirements of a university system and the aspirations of its students by applying conventional project-management philisophies to teaching. This method of teaching also provides appropriate direction for the student, making his education meaningful and productive, and leaving him well-prepared for a career in industry where project-management philosophies are applied daily. ❐