

## **AC 2007-101: THE ROLE OF ADJUNCTS IN TEACHING ASCE'S BODY OF KNOWLEDGE**

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# **The Role of Adjuncts In Teaching ASCE's Body of Knowledge**

## **Abstract**

The National Research Council (NRC) published a report citing “serious concerns” with engineering graduates. This view is shared by the American Society of Civil Engineers’ (ASCE) Body of Knowledge (BOK) which has outlined several desired learning outcomes. To address these concerns, a two-semester senior design course was developed and taught by an adjunct faculty member at Rowan University. Student evaluations over the past several years consistently result in high scores when this course is taught by the adjunct. Therefore, it is believed that adjunct instructors’ practical experience and knowledge of day-to-day operations of engineering projects effectively supplements the traditional engineering curricula. It is further believed that the aforementioned “serious concerns” with engineering graduates are being addressed, while effectively integrating ASCE’s BOK.

## **Background**

The National Research Council (NRC) published a report<sup>1</sup> citing “serious concerns” with engineering graduates. It was suggested that graduates who do not understand “The Big Picture” may not be able to “provide safe, practical designs in a complex future.” This view is shared by the American Society of Civil Engineers’ (ASCE) Body of Knowledge (BOK)<sup>2</sup> which has outlined several desired learning outcomes. The BOK indicates that “98 percent of students switching from engineering to another major cited poor teaching as a reason for their departure.”

Structural Engineer Magazine<sup>3</sup> noted that current engineering education programs in the United States are broken and need to be fixed. Providing engineering students in the United States with an expanded education to meet the increasing body of knowledge requirements is a must, especially considering our highly competitive and expanding global marketplace.

The author has noted instances where graduate engineers appear to lack the ability to apply engineering judgment to their designs. While technically competent, some graduates rely too

heavily on computer programs to provide design results without understanding how the results were obtained. Such instances effectively reduce the graduates to technicians, and undermine their confidence. Graduate engineers need to develop leadership and management skills to effectively communicate with clients and colleagues, and technical skills to produce construction cost estimates, design plans, and project specifications. Often, graduate engineers do not possess these skills.

The author believes that adjunct instructors can supplement faculty members by providing practical experience and an industry perspective to address these apparent shortcomings.

### **Need for Adjuncts**

There are many reasons for employing adjunct faculty. As pointed out by Gosink and Streveler<sup>4</sup> variability of student enrollment, start-up of new programs, the need for specific expertise, and the replacement of sabbatical or on-leave faculty are factors which necessitate temporary arrangements to ensure coverage of instruction. There are estimates that as many as 40% of faculty members nationwide are adjuncts.

In addition, Spoto<sup>5</sup> points out that in light of shrinking budgets, it is a fact of life that many colleges and universities must rely on adjunct faculty to carry a portion of the teaching responsibilities. Often, the use of adjunct faculty is seen as a stopgap measure, until a more suitable tenure-track faculty can be hired.

However, adjuncts can serve a very useful function by diversifying the faculty and providing a different perspective on the profession. Gappa and Leslie<sup>6</sup> suggest that adjuncts may be described by four categories: career enders, aspiring academics, freelancers, and specialists. Adjunct engineering faculty most often fall into the categories of aspiring academic and specialist.

An aspiring academic is typically someone who has completed a doctoral degree and is unable to find a tenure track or continuing appointment. The specialist usually has an active, full-time job.

Both of these categories can be a tremendous source of stimulation to both full-time faculty and students.

### **Benefits of Using Adjuncts**

Laxpati and Saad<sup>7</sup> note that enrollments at engineering schools typically experience a short term cyclical change caused by fluctuations in employment opportunities for engineers. The conditions for full-time faculty on the other hand usually remains stable, as changes in the size and professional expertise tend to be very slow. The adjunct faculty provide a means of quick response to the changing demands for teaching faculty while ensuring quality of education to the students.

Adjunct faculty can play a significant role in developing practical courses and in guiding students to solving real world problems. The adjunct faculty is in a position to be both an academic and a nonacademic role model. An adjunct faculty that is actively engaged in design brings a unique perspective of engineering to the class room. The engineering topics are interspersed with personal anecdotal comments which keeps the students' interest and attention high. More importantly, the students are exposed to the value and practical significance of the subject. Puzifferro-Schnitzer<sup>8</sup> indicates that it is important for adjuncts to relate their daily and past experiences to the current coursework – a trait that is often unique with adjuncts.

Gosink and Streveler<sup>4</sup> believe that the industrial perspective of adjunct faculty often manifests itself through an emphasis on communication and presentation skills, and concern for customer needs. Students observing these attributes come away with a better appreciation for the demands of the engineering workplace. In fact, adjuncts that present examples solely from textbooks, or from theoretical considerations are at a distinct disadvantage.

Akili<sup>9</sup> believes that adjunct's familiarity with "nuts & bolts" of the practice, including: appropriate design and construction methods, customer needs, alternative solutions, environmental aspects of the design, as well as their decision-making, are ample reasons why their expertise enrich students' learning. Adjunct's use of case histories to explain course

material provides relevant, concise examples for students. Adjuncts are able to draw on their experience to provide first-hand information, and encourage questions designed to promote confidence and community amongst the students. The monotony often experienced in traditional lectures are often avoided by creating a class room environment that resembles an engineering office.

The utilization of adjunct faculty must consider the skills of the individual, and the needs of the department. Spoto<sup>5</sup> suggests that adjuncts:

1. Teach courses in applied areas of engineering design. That is, areas with low potential for research funding, thus little faculty interest.
2. Teach courses in specialized areas where no full time faculty have expertise, but where the adjunct has developed expertise over years of practice in that area.
3. Teach broad based design courses, particularly Capstone Design courses, where the adjunct's breadth of knowledge and expertise is exactly what is needed.
4. Teach business oriented courses, such as ethics, engineering construction, and professional practice courses, where the adjunct's daily exposure to the issues involved brings a dimension to the course that full time faculty cannot match.

For the typical practicing engineer, limiting oneself to a few tightly defined areas of expertise is usually a career detriment. Usually, practicing engineers are more generalists and know enough about a wide variety of topics to get by. As such, a practicing engineer can often provide more of a big picture of a design assignment.

As a practicing engineer, and an adjunct instructor, the author has attempted to address the aforementioned "serious concerns" with engineering graduates by developing and teaching a two-semester senior design course at Rowan University. The course was designed to emphasize areas that appear to be lacking. The goal of the course is to take the student through an entire design project, from the proposal stage through final design. The course revolves around an actual design assignments that was previously completed by the author.

Students develop leadership and management skills by forming “companies” and business plans. Each team is required to assign one person to act as the team’s project manager. The selection of the project manager is in itself a lesson in communication and compromise, as often all students want to be the project manager.

The student teams then compete with one another to “win” the job by preparing written proposals and oral presentations. Actual marketing techniques and strategies are reviewed and methods to write successful proposals are discussed. A popular class exercise is used to peek student interest and get their competitive juices flowing. The author brings in actual project proposals for review and evaluation by the students. The students select which proposals were believed to have been “winners” or “losers” and why. At the conclusion of the exercise, the author reveals which actual proposals were successful. When the student proposals are complete, both full time faculty and guest consultants are brought in to serve on the proposal panel and rate each team’s oral presentation. This provides public speaking experience and an opportunity to discuss the project’s “big picture” prior to focusing on design details (which are addressed later in the class).

Once the teams “win the job,” (provide adequate proposals to advance to the next step in the design), detailed research is performed to identify applicable design codes, design methods, client standards, and required environmental permits. The author’s experience as a design engineer proves valuable at this stage, as most of this information is not readily available in textbooks, and was obtained through past experience. The most important lesson at this stage is that solving an engineering problem is relatively easy. However, identifying the appropriate inputs or “givens” of an engineering problem is very challenging. For example, students are used to designing a beam when given loading and design criteria. However, for this class, the author requires that the students research and identify the appropriate beam loading and design criteria prior to completing the design. Admittedly, most students thoroughly dislike this stage of the assignment, but that is the point of the exercise. In order to develop self-confidence and independence, the students are taught to only rely on material that was thoroughly researched and referenced.

The final design portion of the assignment requires students to prepare a design schedule. The author allows students to schedule tasks however they'd like, but holds them to their schedule for the remainder of the class. Each week, the teams meet with the author to review their schedule and resource assignments. Short and long term goals are discussed and weekly grades are provided based on whether they have maintained their design schedule. At the completion of the assignment, team project managers are asked to compare their actual and anticipated design schedules and prepare a short paper summarizing their differences. This provides an excellent exercise in critical path scheduling and lessons learned. This also teaches students how important project schedules are, and how difficult it can be to prepare schedules that accurately represent the design effort. As such a valuable lesson in project management is learned.

Prior to completing the engineering design of their project, students are asked to develop a list of anticipated design outcomes. For instance, in a beam design, which limit state will govern the design (strength, serviceability, or fatigue) and why? Also, which design option will be the most cost effective and why? After their designs are completed, students are asked to revisit their list of anticipated design outcomes. If their final designs do not agree with their anticipated outcomes, students must either recognize that their design is incorrect, or that their overall project understanding is flawed. That is, common sense and engineering judgment must always accompany numeric analysis.

The final design includes a project report, engineering computations, construction cost estimates, project specifications, and design plans. The design considers issues such as: utility accommodation, right-of-way, access, maintenance and protection of traffic, construction staging, and regulatory requirements. Therefore, the big picture of the assignment is adequately addressed. It is believed that the author's use of an actual project is most beneficial for this purpose, and that the adjunct's ability to draw from practical experience and an industry perspective is most suited for this class.

Other than occasional lectures to discuss specific subject matter, the author acts as a "client's representative," answering questions and continually inquiring about budget, schedule, and

quality. The students work with actual design documents such as boring logs, and survey plans, to introduce them to conditions that they will experience in professional practice.

Real-world problems are inserted into the assignment such as the presence of unknown utilities, political pressure from stakeholders, and strict schedule compliance. For example, for one assignment, after a bridge was designed and detailed, the client (ie. the author) requested that the bridge be re-designed to include sidewalks and wider bridge shoulders. Students had to revise their design schedule, bridge design, right-of-way accommodations, etc. Though not a popular exercise with students, it does provide insight as to what really happens on many design assignments. It should be noted that students did take some comfort in learning that such a change would entitle them to more money had this been an actual project.

At the conclusion of the course, the results of the actual project are unveiled, and comparisons are made with the students' projects. Often, enthusiastic discussions result, including debates as to what was the best solution.

This class allows students to gain experience proposing, planning, designing, and managing an actual transportation project. It is believed that practicing professionals (adjuncts) are best suited to teach this class, as they have recent experience with local design and permitting requirements, and are familiar with advances in CAD, project management, budget oversight, contract negotiation and design drawing preparation. In fact, this course is used to measure the entire engineering program against the desired teaching goals. This places the adjunct as one of the final arbiters of how well the engineering program has prepared students.

### **Adjunct Assessment Results**

Puzziferro-Schnitzer<sup>8</sup> indicates that evaluation data are useless, unless they are shared and used for program improvement. Thus it is important to select a tracking tool to summarize, securely store, and analyze data. Being organized is the key to success.

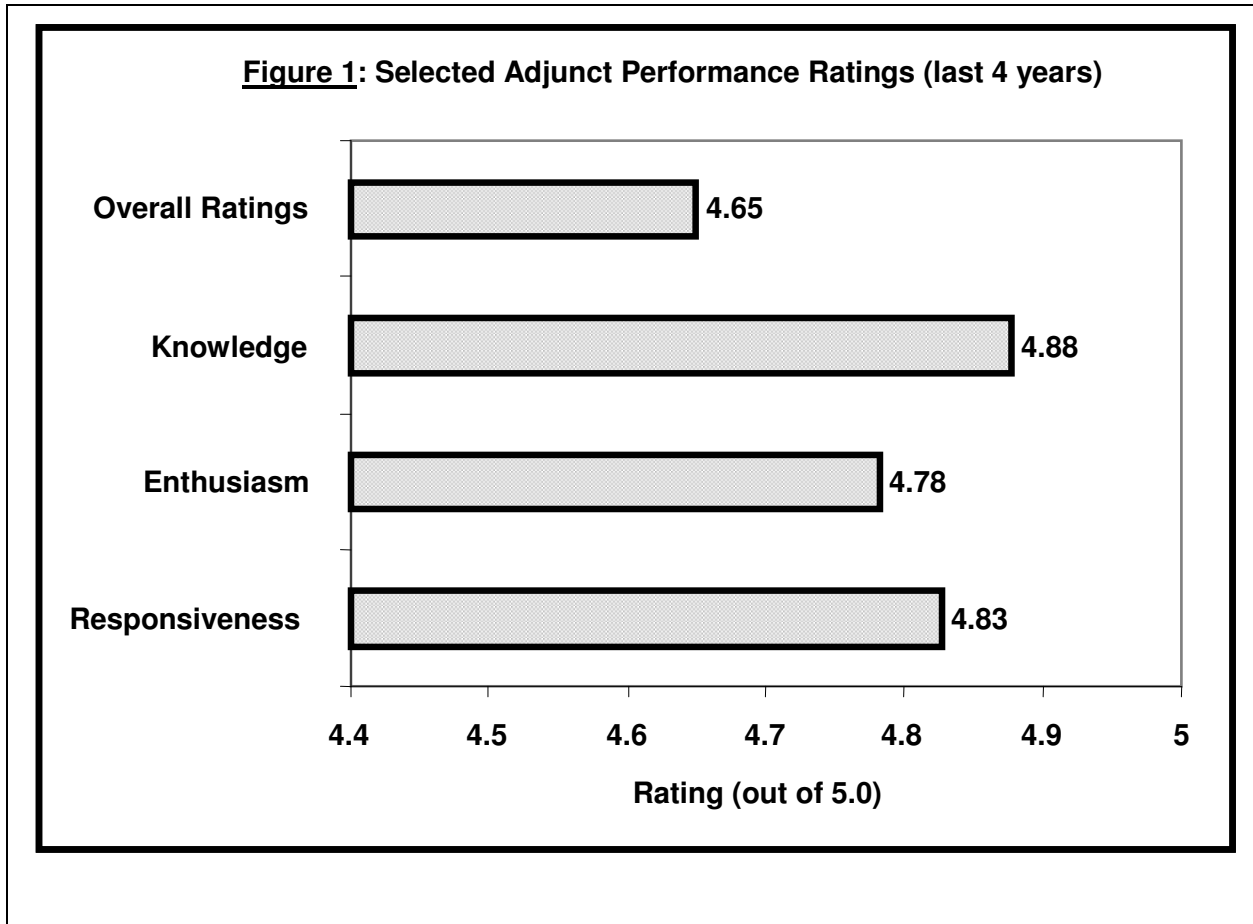
Student evaluations at Rowan University over the past several years consistently result in higher scores when this course is taught by adjuncts. Therefore, it is believed that adjunct instructors' practical experience and knowledge of day-to-day operations of engineering projects effectively supplements the traditional engineering curricula. It is further believed that the aforementioned "serious concerns" with engineering graduates are being addressed, while effectively integrating ASCE's BOK.

To illustrate this, recent assessment results for the aforementioned senior design course are shown below:

1. Adjunct Average Assessment (author's results): 4.74 out of 5.0 (8 design classes)
2. Full-time Faculty Average Assessment (one faculty member): 4.0 out of 5.0 (4 design classes)

While both of the above assessments show favorable student ratings, it is noted that the adjunct has been able to maintain a favorable rating over a larger sampling period (more design classes taught).

When one extrapolates key performance ratings from the above assessment, additional data can be found to support the adjunct. Specifically, four key criteria have been isolated: Overall Ratings, Knowledge, Enthusiasm, and Responsiveness, see Figure 1 as follows:



When asked to comment on the adjunct instructor and the course that he developed, students indicated the following:

1. "I enjoyed the real-life project, rather than theory."
2. "I got a taste of what it's like working in the real world."
3. "[the professor] explains the differences between what is taught and what is practiced."
4. "The information taught is not found in textbooks."
5. "The real-life stories were helpful."
6. "I learned about the business end of engineering."
7. "I enjoyed the material and the motivation."
8. "We gained guidance on how engineering has evolved and the direction it is going."
9. "The project was interesting and challenging."

10. "I feel like we're working for a real company."
11. "Working on your own forces time management."
12. "We were given a better understanding about processes involved in a design project.  
Also, the amount of work and design decisions have come as a surprise and has been very helpful."
13. "I liked the idea of having a real-life design project and to have the opportunity to go through the entire design process."
14. "Taught effectively using examples from personal experience"
15. "Learned a lot about specifications, budgets, cost estimates, and project management."

### **Managing Adjuncts**

It is the author's opinion that practicing professionals can supplement faculty members to provide practical experience and an industry perspective in teaching ASCE's BOK. But what do colleges and universities need to know regarding how to manage them?

Puzziferro-Schnitzer<sup>8</sup> believes that adjuncts are professionals, and as professionals, they value timely and accessible support. Having familiar, collegial, and multiple points of contact helps them develop and maintain the confidence they need to be successful teachers. Allowing some degree of flexibility with the content of the course shell gives adjuncts some professional autonomy, and allows them to go beyond the course shell and share their talents and experiences with students.

Rowan University addresses these issues by: assigning a full-time faculty member to each adjunct, to serve as a point of contact; and scheduling adjunct-taught courses to accommodate the professional's schedule.

## **Identification of Adjuncts**

Identification of competent adjuncts can be a difficult task. Gosink and Streveler<sup>4</sup> suggest focusing on organization skills, self confidence, enthusiasm, familiarity, and depth of insight with the material.

Another hiring approach is to ask yourself why engineering adjuncts do it? Sputo<sup>5</sup> states that for most adjunct faculty members, it sure isn't the money! So why do adjuncts take time out of their busy days to travel to the university to teach and counsel students? The reasons are varied, but include:

1. A love of teaching and working with students.
2. A desire to enhance the engineering profession through training and aspiring young engineers.
3. A general desire to further the engineering profession.
4. Intellectual stimulation of the university environment.
5. The prestige of being associated with an institute of higher learning.

The author has found that being an adjunct instructor is revitalizing. As engineers gain experience, they often find themselves taking on responsibilities that are un-related to engineering; they become managers in lieu of engineers. For example, it is possible to find yourself consumed with preparing and monitoring project budgets, reviewing invoices, attending networking functions, preparing yearly staffing projections, preparing monthly department reports, etc. While these tasks are necessary, they can become mundane. Teaching can remind us why we like the engineering profession. It fosters stimulation, reinforces engineering concepts, and is a welcome change to daily our responsibilities.

## **Conclusion**

Adjuncts can serve a useful purpose in an engineering department by bringing their practical experience, and introducing relevant field applications and problems to the class room. They can provide the project “big picture” and assist students in developing designs that employ common sense and engineering judgment. They can motivate students to develop leadership and management skills and stress the importance of effectively communicating with clients and colleagues. Therefore, the author contends that adjuncts can supplement faculty members to effectively address the desired learning outcomes outlined in ASCE’s BOK.

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<sup>1</sup> National Research Council Panel on Undergraduate Education, Committee on the Education and Utilization of the Engineer, Commission on Engineering. 1986. *Engineering Education and Practice in the United States: Engineering Undergraduate Education*, National Academy Press, Washington, D.C.

<sup>2</sup> American Society of Civil Engineers, Body of Knowledge Committee on the Academic Prerequisites for Professional Practice. 2004. *Civil Engineering Body of Knowledge for the 21<sup>st</sup> Century, Preparing the Civil Engineer for the Future*, American Society of Civil Engineers, Reston, VA.

<sup>3</sup> Weingardt, R.G. "Educating Tomorrow's Structural Engineers: Who Cares?" *Structural Engineer Magazine*, December, 2006.

<sup>4</sup> Gosink, J.P. and Streveler, "Bringing Adjunct Engineering Faculty into the Learning Community," *Journal of Engineering Education*, Volume 89, No. 1, January 2000.

<sup>5</sup> Sputo, T. "Care and Feeding Instructions for Your Adjunct Faculty" *Journal of Professional Issues in Engineering Education*, Volume 132, Issue 1, pp. 14-17, January 2006.

<sup>6</sup> Gappa, J.M. and Leslie, "The Invisible Faculty," Jossey-Bass, San Francisco 1993.

<sup>7</sup> Laxpati, S.R. and Saad, "Adjunct Faculty As Agents for Re-Engineering Engineering Education" *Frontiers in Education Conference*, Volume 3, pp. 1223-1226, November 1996.

<sup>8</sup> Puzziferro-Schnitzer, M. "Managing Virtual Adjunct Faculty: Applying the Seven Principles of Good Practice," *Online Journal of Distance Learning Administration*, 2005. Available online: <http://distance.westga.edu/~distance/ojdl/summer82/schnitzer82.pdf>

<sup>9</sup> Akili, W. "Work in Progress: The Contribution of an Adjunct Faculty in Addressing the Practice in a Geotechnical Engineering Class," 36<sup>th</sup> ASEE/IEEE Frontiers in Education Conference, San Diego, CA, October 2006.