# Teaching Pedagogy 101

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Abstract

What are the basics to consider in becoming an effective teacher? So you are a new faculty member just assigned a course and a textbook. Your only teaching experience is as a TA filling in for your traveling professor while teaching directly from your personal course notes taken when you took the course. Sound familiar? Where do you go? Who do you call? How do you quickly prepare yourself to be an effective teacher? Or maybe you have a few years of teaching experience and want to improve your performance as a teacher. Where do you start in preparing the course and the individual lessons such that the students are engaged in learning, and maybe entertained as well?

This paper will try to answer these questions by offering helpful hints from a team of participants who recently completed the ExCEEd Teaching workshop and applied its lessons at their home institutions. The ExcEEd (Excellence in Engineering Education) Teaching Workshop sponsored by the American Society of Civil Engineers (ASCE) provides the content and structure for presenting the pedagogical basics that every teacher should know. The workshop consists of 12 seminars covering how people learn, what constitutes good teaching, and how to prepare a good class. We will focus on the key points necessary to kick-start a teaching career or to begin to immediately improve a career. Over 300 workshop participants from over 170 CE programs have been touched by the ExCEEd (Excellence in Civil Engineering Education) Teaching Workshops 1999-2003, the ExcEEd 2004 (Excellence in Engineering Education) Teaching Workshop, and the NSF funded predecessor "Teaching Teachers To Teach Engineering" ($T^4E$) Teaching Workshops 1996-1998. This does not include the Mechanical, Electrical, and Chemical faculty members who have participated in $T^4E$ and ExcEEd. Five years of long term assessment data will be summarized to demonstrate the effectiveness and benefit of these pedagogical basics to the participants.

## I. Introduction

The ExCEEd Teaching Workshop (ETW) is the direct descendent of the $T^4E$ workshop, Teaching Teachers To Teach Engineering[1]. $T^4E$ was funded through the National Science Foundation (NSF) for three years and was provided at the United States Military Academy (USMA) for engineering professors, such as civil, mechanical, aerospace, electrical, chemical, etc., with less than four years of teaching experience. $T^4E$ was such a huge success that ASCE decided to continue the program under the ExCEEd Teaching Workshop moniker with one caveat: the program was offered only to civil engineering professors with less than four years of teaching experience. To date, there have been thirteen offerings of ETW: 1999- 2004 at USMA, 2000-2004 at the University of Arkansas and 2002 and 2003 at Northern Arizona University with each session having 24 participants. There were nine observers from the ASCE Program Design

Workshop[2] at USMA in 1999 and six observers (two each from ASME, IEEE, and AIChE) at USMA in 2000. In 2004, the workshop included mechanical, electrical, and chemical engineers under the ExcEEd moniker.

Modifications to the original one-week T$^4$E program have been relatively minor. Most changes have dealt with the addition or deletion of a few supplemental topics. ETW, and previously T$^4$E, uses the six-week instructor-training model from the Department of Civil and Mechanical Engineering (C&ME) at USMA as its foundation[3].

First, the ETW organization is provided to establish a baseline for the workshop experience that led to the bulk of the paper – the teaching hints. It is followed by participant assessment of their experience not only during the workshop, but after their first semester using the skills learned at the workshop that then sets the stage for discussion of the benefits of attending a teaching workshop like the ETW.

## II. ETW Organization

How is ETW organized? ETW is a one-week short course (Figure 1) providing seminars on the basics of excellent teaching (using Lowman[4] and Wankat and Oreovicz[5] as textbooks), demonstrations of effective teaching, laboratory exercises requiring the participants to teach lessons followed by group assessment, and discussions on how to apply the presented techniques

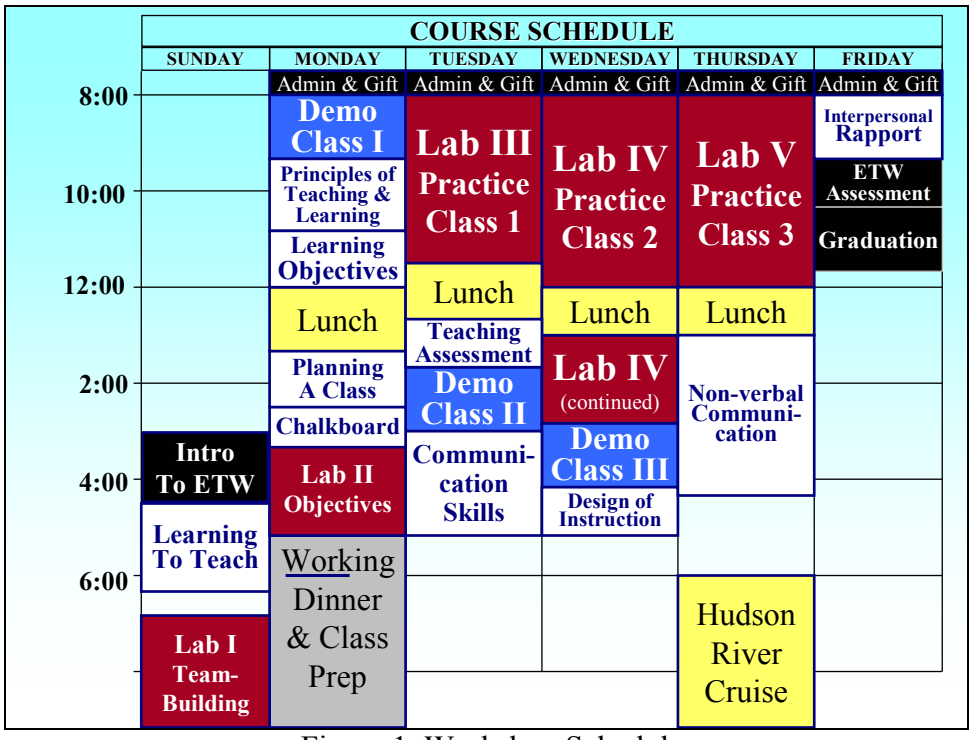

Figure 1. Workshop Schedule

in different university settings (laboratory, large classrooms, auditoriums, or seminar groups, etc.). The ETW seminars continually build on each other as they progress from teaching

principles, to the course and lesson objectives, to lesson preparation, to rehearsals, to presentation of the lesson, to finally assessment of the lesson content and presentation.

The most critical and transformational part of the ETW is the opportunity to learn new techniques, and then try them in the three practice classes presented by each participant. Team members assume the role of students during the class and assessors at its conclusion. The senior mentor is the primary assessor for the first class, while follow-on classes are critiqued by all with the actual participant instructor leading the last critique with a self-assessment – essential for any improvement and/or maintenance of excellent teaching techniques.

The 24 workshop participants are divided into four-person teams along with a senior and assistant mentor. The participants are faculty members from across the nation with generally one to four years of teaching experience. The senior mentors are current or retired C&ME Faculty or graduates of $T^4E$ or ETW. The assistant mentors at USMA are new C&ME faculty that just completed the full six-week version of C&ME instructor training. At the University of Arkansas and Northern Arizona University, the assistant mentors are recent graduates of $T^4E$ or ETW.

One team of participants that came from both research and teaching institutions chronicled their experience in individual journals. The ETW experience made such a dramatic impact on this team's teaching performance that they felt motivated to pass along these hints for successful teaching.[6] The teaching hints, which can be categorized into four areas - organization, preparation, practice, and rapport - were developed after review of the journals[7] and the discussions of common experiences at their respective universities during the year following ETW. The journals not only recorded each member's thoughts (material, methodology, perceptions, attitudes, etc.) as the week progressed, but also provided insight into possible hints for successful teaching. ETW is about learning and practicing new skills, internalizing methods for successful teaching, and developing as teachers during the week. The journals served as a vehicle for reflecting about this developmental process. The hints listed in the journals and discussed via e-mail between team members from five different universities during the year after ETW were consistent with most texts and articles on exceptional teaching techniques.

## III. Hints

The following teaching hints grouped into four subsets – organization, preparation, practice, and rapport - are augmented by an assessment (when available) provided in a tabular format by students and peers, as well as, self-assessments. Student assessments come directly from the course-end critiques. At many universities, there are standard questions asked of each student concerning the instructor's performance.

Not every university has a formal peer assessment program. The United States Military Academy is fortunate enough to have such a program in many of its departments (e.g., each instructor must assess 3 peer classes of other instructors each semester). Some of the authors at other universities have been successful in establishing peer groups willing to assess each other's classes. There is no substitute for assessment. Whenever possible, peer comments are provided.

Self-assessments are the most subjective, but also extremely important, of the three types of assessment provided.[8] Most of the comments are the result of personal assessment of daily lessons, a block of lessons in a course, or an entire course. Numerous references to the key texts used during the ETW are provided to efficiently guide the reader through additional self-study.

III. A. Hints – Organization

Success in any endeavor requires proper organization. This is especially true in higher education. Without organization and structure, teaching can easily lose priority relative to research. The preparation and presentation without organization will miss the desired goal of properly educating and then motivating the students to continue in the discipline as a student, an educator, or a practitioner. According to Lowman, "Most excellent instructors plan very seriously, fully aware that alternative ways of organizing class sessions are available, which go beyond the mere presentation of material to the promotion of active higher-order learning and motivation."[9]

Establish lesson-learning objectives. The key to efficient lesson organization is to establish written learning objectives for each lesson prior to the start of the semester. The learning objectives not only guide lesson development, but also serve as a contract with the students as to what will be covered during the semester.[10] There must be at least one objective for each lesson. Generally, three to five lesson objectives are ideal with the action verbs defining the level of desired performance based on Bloom's Taxonomy of Educational Objectives.[11] Lesson objectives for a class on truss analysis are:

- Define and Identify zero-force members in a truss.
- Solve for the internal forces in truss members using:
    - Method of Joints.
    - Method of Sections.

Formal lesson objectives provide the proper focus for lesson preparation. Ideally lesson objectives should be provided to the students at the beginning of the semester. The first time through a course, individual lesson objectives may need to be developed as you prepare a block of lessons. If this is the case, provide them as a handout at the beginning of the block. As a minimum, place the lesson objectives on the board at the beginning of class or have the students physically refer to them in the syllabus (or recently distributed handout). The lesson objectives then serve as a road map to help the students understand the importance and content of what is being presented and discussed during the class. Of course, full student understanding of a lesson objective is accomplished through both in-class and out-of-class work (i.e., notes, discussions, reading assignments and homework). The listing of lesson objectives at the start of a semester does not preclude a change in the course based on some type of assessment or determined need. Simply providing the rationale for the change and a listing of the new objectives for the changed lessons will quell most student anxiety. Regardless of when the lesson objectives are provided to the students, the lesson objectives must be assessed at the conclusion of each lesson.

The table below presents feedback or assessment from peers and students, as well as self-assessment at the conclusion of a lesson or a block of lessons. Review of the assessments for the team members over the past year provided valuable insight for each hint.

Table 1. Establish Lesson-Learning Objectives

| Peer | Self | Student |
|---|---|---|
| • Always write lesson objectives on the board. Physically check them off or mention them as you accomplish them. | • Important to give the students the big picture for each lesson.<br>• Guides development of relevant topics/events to introduce each lesson.<br>• Helpful in writing examinations that test the most important concepts. | • The lesson objectives help me focus on what to study – study aid.<br>• I can see how certain topics fit into the class as they are presented.<br>• Sense of purpose.<br>• Instructor used lesson objectives. |

Establish course objectives. In general, many professors establish course objectives before the start of the semester. Some may even provide a more detailed list of course objectives beyond what is mentioned in the course description. The course objectives establish the structure of the course that allows for connectivity between courses and provides insight into what the course is supposed to accomplish.[12] An example of one course objective in a Statics Course covering the analysis of trusses is:

Apply equilibrium equations to calculate internal member forces in trusses.

Any type of program assessment will assess each course's objectives to determine if the offered courses meet the stated program goals.

Table 2. Establish Course Objectives

| Peer | Self | Student |
|---|---|---|
| • Use course objectives to relate this course to other courses in the curriculum. | • I will limit change until I see student assessment.<br>• Great - students know exactly what will be covered in the course. | |

Schedule course in proper classroom. How a professor plans to conduct the class and engage the students dictates the proper type of classroom setting. Lowman states that, "College classrooms are dramatic arenas first and intellectual arenas second."[13] Maybe this is why many classrooms have raised platforms near the board and overhead lighting to improve student observation of the professor during active learning. If a professor desires to conduct in-class small group exercises, an auditorium probably is not the best choice. Either individual student desks or large tables with multiple chairs may be more suitable. The equipment in the room to include the amount of chalkboard space, projection systems, etc. may limit how course material is presented. Is the classroom close to a laboratory or is there classroom space in the laboratory if experiments are

part of the lesson objectives? Is there space in the classroom for large models or demonstrations? Is the course covering design or is it a seminar?[14] All of these (and many more) issues affect the learning environment for the course. Do not forget things like climate control, external noise or built-in distractions like a window view of a sports field.

Even though there is an appearance at some universities that funding is only sought for research facilities rather than maintaining or upgrading existing classrooms, the professor must still seek out and demand classrooms that are conducive to learning if they are going to establish the proper learning environment. Where is the future researcher nurtured initially? - In the classroom. The professor constantly must consider the intellectual and emotional objectives that can be accomplished in class.[15]

Table 3. Schedule Course In Proper Classroom

| Peer | Self | Student |
|---|---|---|
| • Big room (+) allows for demonstrations and lab exercises to be set up right in the back of the room.<br>• This room has a lot of boards. Now you do not need to erase often during class. | • I like at least 10 black board sections (no erasing) to cover most material in a lesson.<br>• I want a place in the room to place CE interest items in the room.<br>• Room needs overhead screen (and phased lighting) not blocking a black board, if possible.<br>• I like individual student desks so that I can modify the classroom setting from lesson to lesson. | • I like when we work in small groups in class (by circling up desks). |

Schedule realistic course preparation time. Each professor must organize her time to meet the requirements for both research and teaching. As with research, effective teaching requires time to prepare, practice, grade, and be available to students (i.e., office hours) for out-of-classroom assistance. Each professor has a threshold of required time to effectively teach a given lesson. A large amount of time is usually essential in preparing the lesson for the first time. Learning how to teach effectively before teaching that first class can significantly reduce the amount of time required to feel comfortable and prepared to teach any lesson.[16] Even less time may be required if minor modification (based on assessment of lesson objectives, content, models, demonstrations, etc.) is required the second time a lesson is taught.

Table 4. Schedule Realistic Course Preparation Time

| Peer | Self | Student |
|---|---|---|
| • Always prepared for class. Seldom carried around lesson (board) notes. | • I need a minimum of half a day to prep for class. It used to be one full day of prep for one day of lessons.<br>• I need 5 – 6 hours for a new lesson, 2 – 3 hours for a previously prepared lesson. | • Instructor was a master of the material.<br>• Professor knew his stuff.<br>• Instructor had a plan for every lesson.<br>• Instructor demonstrated depth of knowledge. |

Schedule feedback. Students are a great source for determining quality of presentation.[17] Some type of student feedback should be planned as a minimum at the end of each quarter of the course. The assessment can occur during class, on a course web page, or as a single page homework requirement. The key is to keep their input anonymous and to make changes or at least comment on their input.

Table 5. Schedule Feedback

| Peer | Self | Student |
|---|---|---|
| • Good timing for muddiest point paper at the end of class (first lesson in 5 lesson block). I know it was hard to adjust the next lesson, but I can see that the students benefited from it. | • Student feedback provides me insight to whether I have covered the material properly.<br>• The students are very perceptive and catch idiosyncrasies that I do not know exist. | • Great teacher, you actually used what we provided during the one-minute paper and changed the next lesson. |

III. B. Hints – Preparation

There are only a set number of lessons during each semester for professors to properly cultivate learning within their students. When a professor walks into class, opens up the course folder to the sticky note marking the spot the previous lesson stopped, and begins at that point to try and determine what to discuss in class, precious student contact time is wasted.[18] The lesson can quickly disintegrate into a stream of consciousness with an occasional concept being placed in any empty space available on the chalkboard. What is needed is a "grabber" – something at the beginning of class to stimulate the student's curiosity for the current lesson.[19] Maybe the "grabber" is a physical demonstration or use of a great model not sabotaged by inadequate preparation.

Board notes. A lesson is generally considered fully prepared once the professor has developed lesson objectives, studied the material, planned exactly what he or she intends to place where on the chalkboard, acquired the lesson materials (handouts, structural plans, models, etc.), constructed physical models, rehearsed the class, planned in-class group or individual exercises,

planned possible in-class assessments, and prepared the associated homework. The key activity is planning what to actually present in class including the material to be placed on the board. According to Lowman, "Teachers who carefully consider what content should be presented and how learning should be organized are more likely to orchestrate virtuoso performances than those who leave much to improvisation."[20]

During the ETW, the development of board notes established what material was to be placed where on the chalkboard (Figure 2).[21] Each rectangle represents a section of the chalkboard or reasonable board space. Some board notes pages have 6 sections of material, while others may only have 4 sections. Board notes can be used to plan the entire lesson to include when to do a demonstration or use a model (Figure 3). The third board has a note (i.e., start w/ demo) as a reminder when the physical model (i.e., zero-force demonstrator) needs to be used during an actual class. Some teachers use the left-hand rectangles for the actual chalkboard material and the right-hand rectangles for notes or questions to ask in class associated with the material in the left-hand rectangle. Wankat relates this to the playwrights putting stage directions in their plays to indicate announcements, reminders, breaks for student activities, alternate solution paths, etc. Normally the posing of good, clear questions, rather than relying on spontaneity, requires thorough preparation.[22] Notice that only the minimum amount of material required to guide the student's learning should be placed on any one board (Figure 3).

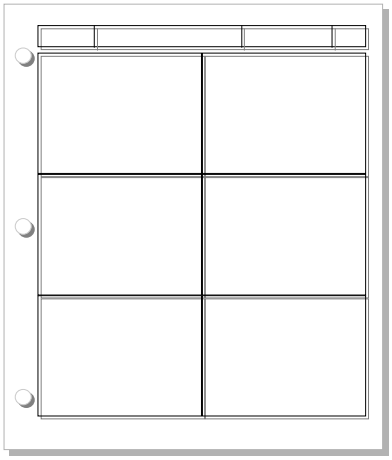

Figure 2. Blank Board Notes

Fully thought-out board notes usually accomplish all but the lesson rehearsal and the development of homework. Most homework usually causes in-depth use of the concepts presented in class (i.e., what is in the board notes). The process of reproducing/thinking through the board notes (i.e., tying together why we present the material in a certain order) will prepare the professor to focus on engaging the students rather than thinking about what or how it should be placed on the board. If during board note development a group exercise is incorporated into the class, then the professor must decide if the student desks need to be arranged for the exercise at the beginning or during class. If there is a desire to modify group dynamics for each group exercise, then the professor may want to place name cards (names on folded 5x8 cards) on desks prior to class. Board notes also provide a written record as to what was actually taught during that lesson which is essential during course assessment.

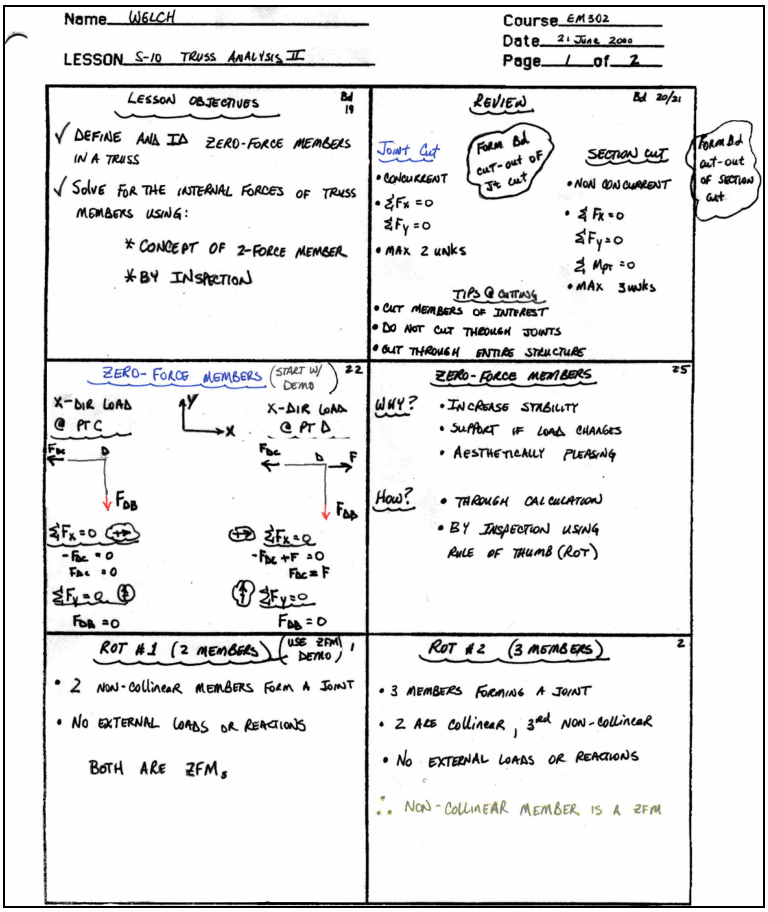


Figure 3. Board Notes For Workshop Demonstration Class

Table 6. Board Notes

| Peer | Self | Student |
|---|---|---|
| • Great presentation and organization of board material!<br>• Students can easily see points of emphasis based on chalk color.<br>• No wasted effort in the class. | • Well thought out board notes free up personal memory during class, lessens my anxiety, and improves flow of the class.<br>• Minimizes the amount of material placed on the board (efficient notes increase student learning).<br>• I can view notes from a student's perspective.<br>• Use to gage the timing of my class. I know how long it takes to put up one board worth of | • I liked how organized my notes appeared after your class.<br>• My notes are now easier to use in studying the course material.<br>• Instructor communicated effectively.<br>• Instructor demonstrated depth of knowledge. |

| | | |
|---|---|---|
| | material. | |

Physical models. Whenever possible, have a demonstration or physical model as part of a lesson. Just as with a play, except here the professor is the sole performer, the props greatly assist in the effectiveness of the performance.[23] Simply put - a picture is worth a thousand words. During board note development, the suitability of models or demonstrations should become obvious. Some prep time is usually required to have a proper model prepared or a demonstration set-up in time for a given lesson.[24]

Table 7. Physical Models

| Peer | Self | Student |
|---|---|---|
| • Visual learning is so important in your course. I could not fully understand concept until you pulled out the model.<br>• Excellent training aids. | • I need to try and have one for every lesson.<br>• Need more demos even though I was not taught that way - I would have benefited greatly (especially us visual learners). | • I liked all the toys (models) in class – I could see (understand) many of the concepts much better.<br>• Instructor used visual imagines. |

Use the textbook in class. During class, use the pictures and charts (tremendous aid and saves a great deal of time[25]) in the textbook when explaining equations or concepts. The chart or figure should be displayed on an over-head (or power point slide with scanned picture/chart), but the student should be using their text to look more closely at the figure. The professor should ensure that as much of the board note material as possible is referenced back to the text through written page or equation numbers on the chalkboard. This technique will encourage students to consult the textbook if a point is not clear or if they want more information.[26] Instructors should use notation and symbology on the chalk board that is consistent with that found in the text. If the students have to use the textbook in class, then they will more likely use the text during homework and begin the process of understanding how to self-learn through other available references.

Table 8. Use The Textbook In Class

| Peer | Self | Student |
|---|---|---|
| • Good use of textbook in class. | • I use material in the textbook every lesson. I cite and write on the chalkboard equation numbers and figures. | • I actually used the textbook more in your course than in others. |

Assign design teams. In the real world engineers do not get to pick and choose who they want to work with. The professor should assign the teams based on some parameter(s) (background of courses, surveyed skills, in-class observations, etc.).[27] The assignment of students to teams should be done early in the semester to allow teams to sit together and work together on in-class and out-of-class group exercises. Learning then truly becomes a team effort throughout the semester.

Table 9. Assign Design Teams

| Peer | Self | Student |
|---|---|---|
| | • This is critical. I must set all teams up for success. Get to know them before assigning teams. | • I liked that teams appeared to be evenly stacked.<br>• I would rather work with my friend on a design team. |

Develop homework after review of a block of lessons. This statement is as true for faculty teaching the same course every semester as it is for someone teaching a course for the first time. Since homework helps the student learn the material, all levels of Bloom's taxonomy should be covered.[28] Without a proper review of the course and lesson objectives, board notes, and reading assignments for a specific block of instruction (i.e., steel tension member design), a homework assignment could ask for something that will not be covered in the course or the textbook or beyond the skill level of the students. It is also important to work the assignment prior to handing it out to ensure that all required material is given or noted for the students to develop a proper solution. There is nothing more frustrating for students than to have key information beyond their capability to infer missing in a homework assignment. A professor should not waste the time that a student is able to provide to a course by spinning his/her wheels while trying to solve a problem when some key information is missing in the problem statement. On the other hand, it is permissible to provide more information than they need to solve the problem forcing the students to assemble the pertinent facts only.

Table 10. Develop Homework After Review Of A Block Of Lessons

| Peer | Self | Student |
|---|---|---|
| | • I need to improve on development of homework that goes beyond repeating basic concepts covered in class.<br>• Need homework that drives the in-class discussion. | • Out of class requirements met the 2 hr guideline. (meaning homework associated with a one hour class could be completed in 2 hours). |

III. C. Hints – Practice

A professor who has been teaching the same course for a large number of years may be able to walk into a lesson with little to no practice and present it in an effective, flawless manner, while accomplishing the desired student reaction to the material. For the majority, some type of practice or in-depth review of the material is required. Who has the time? All of us must make time! Few of us are brave enough to walk into a conference without developing the slides, reviewing the order of the slides and thinking through what we plan to say. The same process

must be used before presenting a lesson. Enough time must be set aside to ensure that the professor is confident about what, when, where, why and how material is to be presented and the desired effect.

Rehearsal. Actors and actresses start with a script (board notes) and rehearse.[29] In the same way, a professor must rehearse in order to use the time available during a class as efficiently as possible. Good teachers will physically or at least mentally walk-through a prepared lesson one or two times prior to class. The last rehearsal may be on the way to class if it is not in the same building as your office. The lesson should have a certain flow to it with the questioning of the students (active teaching) used to not only lead the development of chalkboard material, but to provide the transition (i.e., stage directions[30]) between lesson topics. The class should be organized, well thought out, energetic, and fun. Just think about some of the great lectures or classes you have been to, and then think about some of the worst. Even if the material was interesting, poor delivery has a huge negative impact.

The authors used the physical reproduction of the prepared board notes in the desired colors of chalk (using pens) as part of their mental rehearsal of the class. Difficult charts and figures to be presented on the chalkboard should be physically practiced at least once before the class (i.e., full dress rehearsal). It is amazing how difficult it is to recreate a complex chart or 3D picture on a chalkboard. Some would argue, why not just use an over-head of the picture or chart? If the completed chart from the textbook is the end result, then why not, but if the development of the chart is part of the learning process, then the chart must be developed on the board. It is usually important to have an accurate figure on the chalkboard when done, and that requires practice.

Table 11. Rehearsal

| Peer | Self | Student |
|---|---|---|
| • Black board drawings were very neat and easy to understand. | • Need to force myself to practice at the black board all tough figures.<br>• Desktop rehearsal is more than adequate for me. I am satisfied.<br>• More relaxed. Can concentrate on the students. | • Scored above Department average in all questions related to preparation, knowledge, and organization in end of course survey. |

Memorize the board notes? The paradox is that the professor "needs to be thoroughly prepared yet appear spontaneous."[31] Overly prepared instructors may appear too rigid, while an under prepared instructor may appear confused. When a professor has thoroughly thought through the topic at hand, just knowing the order to present certain topics is all that is needed. Proper questioning and interaction with students will lead to development of the required board material. If the lesson is structured in a logical manner and the transitions cause a natural flow among topics, there is no need to memorize board notes. An occasional glance will suffice. The professor who has already planned what to present next, how to present it, and what type of questions to ask, can focus on engaging the students in the class by asking good questions, assessing the levels of student understanding, connecting seemingly off the mark student

responses to the over all concept, and even diverting the discussion for very short periods to related student questions. Thoroughly knowing the objective of the lesson and the path for getting there actually increases the freedom of the professor when presenting the lesson material.

Table 12. Memorize The Board Notes?

| Peer | Self | Student |
|---|---|---|
| • Seldom looked at notes. Great flow to the class. | • To not have the board notes in my hands, I initially needed to memorize my notes. Now I visualize the flow and by rehearsing (rewriting the board notes, developing the student questions, and practicing the use of models or demos) the class a couple of times I can develop the board notes while engaging the students. | • Your classroom environment made learning fun. |

III. D. Hints – Rapport

There are many who feel that developing rapport with the students in each course they teach is unnecessary, but those students who enjoy the time they spend with their professor will enjoy the classroom environment. They are actively engaged in class and feel they learn more.[32] Lowman considered interpersonal rapport so important that it became one dimension of his two-dimensional model for effective teaching.[33]

Learn student names. Professors should learn their student's names by the second class. Learning student's first names greatly assists in developing personal rapport in the classroom. Questioning is more effective when the professor can call on a specific student for specific questions.[34] It allows the faculty to greet students in a more personable way around campus or town. The simple requirement to have their first name on a folded 5x8 card, that the professor provides, on the desk for one or two weeks is generally all that is required to learn everyone's name. A few great teachers are known to stop the first lesson early to videotape or photograph each student as they depart. This visual aid with the student saying the name they want to be called provides for a more rapid face to name recognition.

Table 13. Learn Student Names

| Peer | Self | Student |
|---|---|---|
| • Wow! You knew most names by the end of the first lesson. | • Knowing student first names makes teaching more personal.<br>• More students actually wave or say hello around campus or at the mall. It used to be just a nod before.<br>• More conducive atmosphere for learning. | • Was very surprised and happy that you took the time to learn my name.<br>• The instructor served as a role model.<br>• Instructor demonstrated enthusiasm.<br>• Instructor cares about my learning. |

Ask each student a question daily. Active education implies engaged students throughout the lesson. The best technique is to train the students to expect questioning during the lesson.[35] Ask the question, pause, and call on a student using their first name.[36] Once trained, the simple act of posing a question will heighten everyone's senses, keeps all students "at risk"[37], and causes them to think about an answer for the question. Once the students know that you will call on everyone, call on each student more than once each lesson to ensure that they do not disengage once they arrive for class or answer their first question.[38] Keep the students on the edge of their seat. Challenge them. Asking questions also slows down the presentation to allow students to ponder or catch up on note taking. Once the professor asks questions, the students will eventually be encouraged to ask the professor questions based on intriguing course material – and then true learning begins. Asking each student a question each lesson shows that you care about his/her learning and want to include him/her in the learning process.

Table 14. Ask Each Student A Question Daily

| Peer | Self | Student |
|---|---|---|
| • Good questioning techniques.<br>• You spread the questions around the classroom.<br>• A number of students raised their hand to tackle what I thought were tough questions. | • Not easy to do. Must work at it.<br>• I must ensure that a handful of students are not the only ones participating.<br>• I must not always call on the brightest to answer my questions.<br>• Questioning is an art form. | • I felt like I could not hide in your class.<br>• You kept me focused in class because I never knew when you would call on me. You never let me off the hook with "I do not know".<br>• I like to participate in class, but I do not want to raise my hand. You made it easy to participate. |

Be early to class. Go to class early and stay after class for awhile, even if it is outside of the classroom waiting for the last class to end or the next to begin.[39] Engage the students in

conversation to learn more about their interests and what is happening around campus.[40] Maybe answer a few questions concerning a past lesson or the current homework they are working on. Be personable and let the students learn more about the life of an engineering professor.

Table 15. Be Early To Class

| Peer | Self | Student |
|---|---|---|
| | • I always get to class 15 minutes early.<br>• I try to engage the students in some conversation. Over time more and more students arrived early to class and joined in on the conversations. | • I enjoyed talking to you about engineering practice.<br>• I am thinking of going past a master's degree after talking to you about your research projects. |

Smile. If a professor does not enjoy teaching, he/she should change professions. It is extremely important that students see the faculty enjoying teaching.[41] A smile is a great invitation to join the learning process, to try to answer the question posed, and to ask a question that is probably on other's minds. Students are more likely to participate if they view the professor as friendly. When you walk into the classroom or a meeting for after class assistance, there is NO other place in the world you want to be. Make the student feel that they are important to you.

Table 16. Smile

| Peer | Self | Student |
|---|---|---|
| • Students appeared to enjoy being in your class. There was a lot of laughing and smiling by all.<br>• Very enthusiastic. | • Allowing enthusiasm for subject material to come through.<br>• Proper completion of all hints makes this easy to accomplish – being prepared makes it fun. | • Instructor demonstrated enthusiasm.<br>• I enjoyed being in your class even though the tests and homework were hard! |

Know your students. Get to know more about who your students are by using a student survey on the first day of class. Ask what is his/her favorite movie, song, performing group, sport, university activity, etc. Who knows, you just might have something in common with them. Let the students know the results of the survey to show that you actually reviewed the information they provided. Usually there are a few unique responses that will provide instant humor in any setting. If activities that interest you are added to your schedule, then something that is fun for you can also be used to connect with your students.[42] A thumbs-up at the event for a great performance or personal comment before class starts or a class wide comment enlisting the future support of more students for an event, can help the students to connect with the faculty.

Table 17. Know Your Students

| Peer | Self | Student |
|---|---|---|
| | • You can turn a student on to your course by just talking to them. This is very important.<br>• I played the music at the beginning of class they mentioned in my first lesson student survey.<br>• I enjoyed talking to those with an interest in soccer, volleyball, and wrestling. I usually was able to get the inside scoop. | • Instructor wanted to know what are my skill levels. Appeared to adjust lessons to meet my needs.<br>• Instructor cares about my learning. |

## IV. Assessments

The experience of this particular ExCEEd workshop team was not unique. Five years of long-term assessment data reveals that the ETW is consistently positive and professionally valuable for its participants. Figure 4 presents the survey data collected from participants during their second semester after attending ExCEEd at West Point (1- none, 2- small, 3- moderate, 4- high, 5- very high). For each topic they note the contribution of each major area of the ExCEEd Teaching Workshop to their overall success. Generally it could be noted that the group in 2003 possibly experienced less contribution for their success from ETW. However, the real measure must take into consideration the start point of the participants before ETW as shown in Figure 5. Upon comparison of the long-term results for each group of participants, the delta between before and after for each category has been relatively consistent since the workshop started in 1999.

Lesson organization (board notes), presentation of material (board notes), student interaction (through questioning), use of demonstrations and visual aids, and energy and enthusiasm (for teaching) constantly lead to improvement in teacher confidence and student evaluations. The obvious result is that demonstration of excellent teaching and the practicing of new concepts by participants under the watchful gaze of a mentor is key to improving teaching in a short period of time.

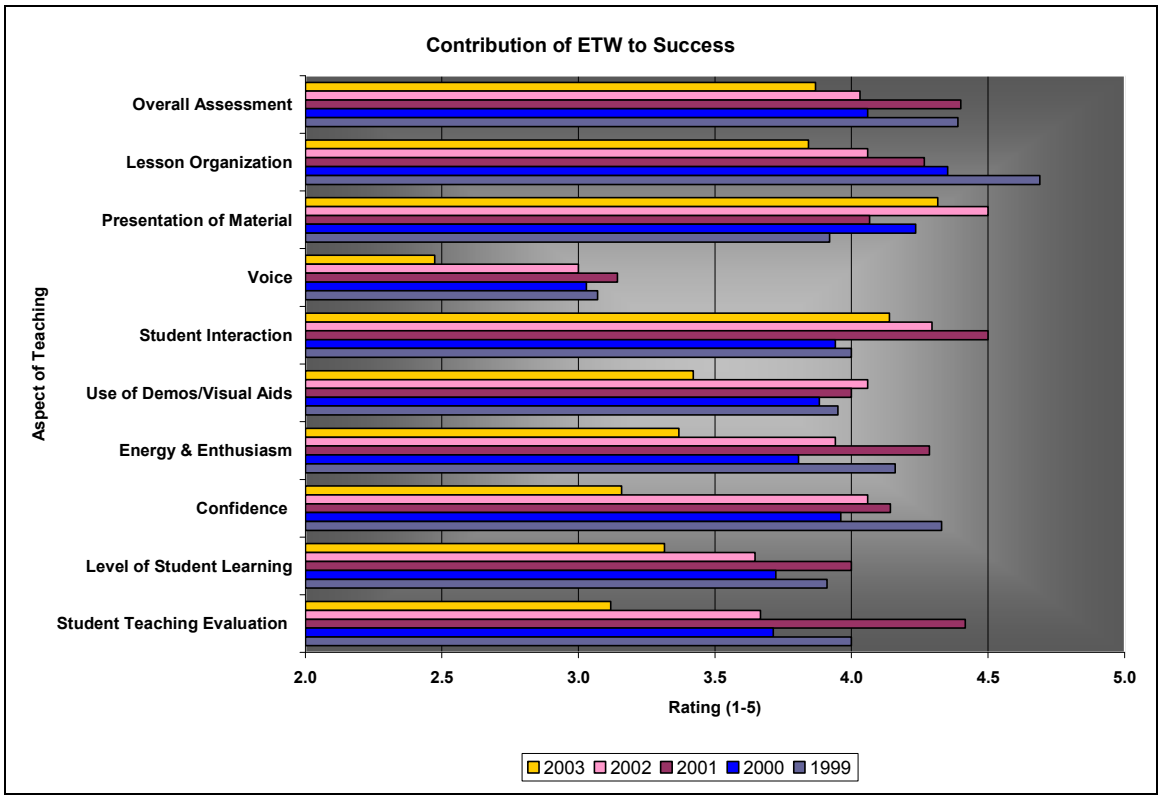


Figure 4. Contribution of ETW to Success

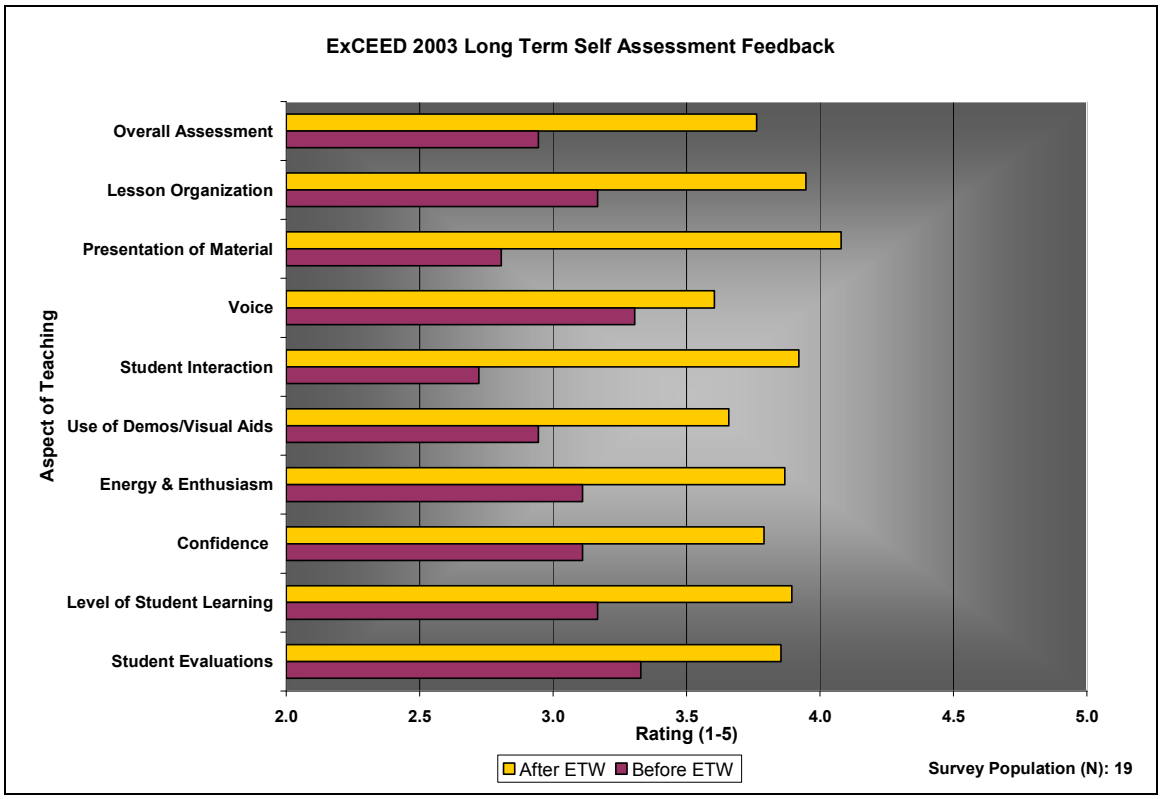


Figure 5. ExCEEd 2003 Long Term Self Assessment Feedback

## V. Benefits

The ETW participants truly enjoy teaching. They are more relaxed and enthusiastic in the classroom, partly due to experience, but mostly due to the lessons (hints) learned at ETW. While some are born with innate qualities that make them good teachers, ETW identifies several objective approaches to improve any faculty member's teaching ability. The training gives a sense of confidence through completion of a successful program taught by successful teachers. Ultimately, it is the students who benefit most by a program such as ETW. The one-week program is undoubtedly rigorous, but its benefits should last a lifetime.

Although revising teaching methods to incorporate the teaching principles advocated by ETW is a significant investment in time, the ETW participants find that they were more effective in teaching preparation activities. A great deal of time can be saved when preparing in an efficient and effective manner. This allowed them to move beyond their preparation and look more closely at the student. How are they doing? Is the pace right for them? Do they understand? Who is having trouble? They look for continued improvement in teaching efficiency as they gain experience. The methods discussed in the workshop are adaptable to any engineering professor's individual teaching situation. Improved efficiency in lesson preparation eventually equates to increased research time.

Teaching takes place only when the students are learning. Many equate teaching with the act of presenting material in a lecture. ETW shows how to organize a class, effectively present the material, and establish good rapport with the students. The improved rapport with students makes being a faculty member more enjoyable and increases student learning. Generally, the classroom is filled with laughter as the students have fun and get caught up in the professor’s excitement for the subject material.

Many of the participants have been nominated for teaching awards with some winning department teaching awards. The accolades have increased from both peers and students alike. Assessed areas have shown dramatic improvement to the point of generally exceeding departmental and university averages. Some peers are now adopting displayed techniques (i.e., board notes, models, demonstrations, etc.) for their own use.

## VI. Conclusions

Based on their experience with the ExCEEd Teaching Workshop and feedback from participants back at their home universities, formal instructor training could be valuable for every professor AND every teaching assistant. The granting of a degree (Ph.D. or M.S.) does not automatically bestow teaching skills, especially effective teaching skills. Most professors simply try to emulate observed styles without any justification as to the effectiveness of different teaching styles. The lack of formal training programs at most universities, and nearly nonexistent programs to provide constructive criticism from peers relegates most faculty to the very slow process of developing effective (if they are lucky and persistent) teaching styles through a long career of trial and error. Add the demands of research and the priority at many universities of the greater importance of research over teaching, and it is easy to understand the reason for the large number of ineffective teachers at the college level. However, it only takes a relatively small

amount of focused effort in an exceptional program like ETW to lay the necessary foundation to become an effective teacher, as presented in Figures 4 and 5. Even though the workshop does not have to necessarily look exactly like ETW, the workshop must present the principles of effective teaching (i.e., presentation skills and class organization), demonstrate effective teaching styles and techniques, and require the participants to practice their skills under a mentor's gaze and assessment.

These hints for successful teaching were presented as a synopsis of the key ingredients of the ETW workshop. These hints are not provided as a replacement for this exceptional program, but as a reminder of some of the key points to being successful as a teacher and to serve as a starting point for those waiting to get into a teaching workshop. There is no replacement for actually teaching a class under a mentor's gaze and learning through a personal assessment of the class. For more information concerning the ExCEEd Teaching Workshop, see www.asce.org/exceed.

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Any opinions expressed here are those of the authors and not necessarily those of any supporting agencies.

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