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SEVEN PRINCIPLES FOR GOOD PRACTICE IN UNDERGRADUATE EDUCATION

*by Arthur W. Chickering and Zelda F. Gamson**

Apathetic students, illiterate graduates, incompetent teaching, impersonal campuses—so rolls the drumfire of criticism of higher education. More than two years of reports have spelled out the problems. States have been quick to respond by holding out carrots and beating with sticks.

There are neither enough carrots nor enough sticks to improve undergraduate education without the commitment and action of students and faculty members. They are the precious resources on whom the improvement of undergraduate education depends.

But how can students and faculty members improve undergraduate education? Many campuses around the country are asking this question. To provide a focus for their work, we offer seven principles based on research on good teaching and learning in colleges and universities.

Good practice in undergraduate education:

1. Encourages contacts between students and faculty.
2. Develops reciprocity and cooperation among students.
3. Uses active learning techniques.
4. Gives prompt feedback.
5. Emphasizes time on task.
6. Communicates high expectations.
7. Respects diverse talents and ways of learning.

We can do it ourselves—with a little bit of help ....

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A FOCUS FOR IMPROVEMENT

These seven principles are not ten commandments shrunk to a twentieth century attention span. They are intended as guidelines for faculty members, students, and administrators—with support from state agencies and trustees—to improve teaching and learning. These principles seem like good common sense, and they *are*—because many teachers and students have experienced them and because research supports them. They rest on 50 years of research on the way teachers teach and students learn, how students work and play with one another, and how students and faculty talk to each other.

While each practice can stand on its own, when all are present their effects multiply. Together, they employ six powerful forces in education:

- Activity
- Cooperation
- Diversity
- Expectations
- Interaction
- Responsibility

Good practices hold as much meaning for professional programs as for the liberal arts. They work for many different kinds of students—white, black, Hispanic, Asian, rich, poor, older, younger, male, female, well-prepared, underprepared.

But the ways different institutions implement good practice depends very much on their students and their circumstances. In what follows, we describe several different approaches to good practice that have been used in different kinds of settings in the last few years. In addition, the powerful implications of these principles for the way states fund and govern higher education and for the way institutions are run are discussed briefly at the end.

As faculty members, academic administrators, and student personnel staff, we have spent most of our working lives trying to understand our students, our colleagues, our institutions, and ourselves. We have conducted research on higher education with dedicated colleagues in a wide range of schools in this country. We draw the implications of this research for practice, hoping to help us all do better.

We address the teacher's *how*, not the subject-matter *what*, of good practice in undergraduate education. We recognize that content and pedagogy interact in complex ways. We are also aware that there is much healthy ferment within and among the disciplines. What is taught, after all, is at least as important as how it is taught. In contrast to the long history of research in teaching and learning, there is little research on the college curriculum. We cannot, therefore, make responsible recommendations about the content of a good undergraduate education. That work is yet to be done.

This much we can say: An undergraduate education should prepare students to understand and deal intelligently with modern life. What better place to start but in the classroom and on our campuses? What better time than now?

SEVEN PRINCIPLES OF GOOD PRACTICE

1. Encourages Contacts Between Students and Faculty

Frequent student-faculty contact in and out of classes is the most important factor in student motivation and involvement. Faculty concern helps students get through rough times and keep on working. Knowing a few faculty members well enhances students' intellectual commitment and encourages them to think about their own values and future plans.

Some examples: Freshman seminars on important topics, taught by senior faculty members, establish an early connection between students and faculty in many colleges and universities.

In the Saint Joseph's College core curriculum, faculty members who lead discussion groups in courses outside their fields of specialization model for students what it means to be a learner. In the Undergraduate Research Opportunities Program at the Massachusetts Institute of Technology, three out of four undergraduates have joined three-quarters of the faculty in recent years as junior research colleagues. At Sinclair Community College, students in the College Without Walls program have pursued studies through learning contracts. Each student has created a "resource group," which includes a faculty member, a student peer, and two "community resource" faculty members. This group then provides support and assures quality.

2. Develops Reciprocity and Cooperation Among Students

Learning is enhanced when it is more like a team effort than a solo race. Good learning, like good work, is collaborative and social, not competitive and isolated. Working with others often increases involvement in learning. Sharing one's own ideas and responding to others' reactions sharpens thinking and deepens understanding.

Some examples: Even in large lecture classes, students can learn from one another. Learning groups are a common practice. Students are assigned to a group of five to seven other students, who meet regularly during class throughout the term to solve problems set by the instructor. Many colleges use peer tutors for students who need special help.

Learning communities are another popular way of getting students to work together. Students involved in SUNY at Stony Brook's Federated Learning Communities can take several courses together. The courses, on topics related to a common theme like science, technology, and human values, are from different disciplines.

Faculty teaching the courses coordinate their activities while another faculty member, called a "master learner," takes the courses with the students. Under the direction of the master learner, students run a seminar which helps them integrate ideas from the separate courses.

3. Uses Active Learning Techniques

Learning is not a spectator sport. Students do not learn much just by sitting in classes listening to teachers, memorizing pre-packaged assignments, and spitting out answers. They must talk about what they are learning, write about it, relate it to past experiences, apply it to their daily lives. They must make what they learn part of themselves.

Some examples: Active learning is encouraged in classes that use structured exercises, challenging discussions, team projects, and peer critiques. Active learning can also occur outside the classroom. There are thousands of internships, independent study, and cooperative job programs across the country in all kinds of colleges and universities, in all kinds of fields, for all kinds of students. Students also can help design and teach courses or parts of courses. At Brown University, faculty members and students have designed new courses on contemporary issues and universal themes; the students then help the professors as teaching assistants. At the State University of New York at Cortland, beginning students in a general chemistry lab have worked in small groups to design lab procedures rather than repeat prestructured exercises. At the University of Michigan's Residential College, teams of students periodically work with faculty members on a long-term original research project in the social sciences.

4. Gives Prompt Feedback

Knowing what you know and don't know focuses learning. Students need appropriate feedback on performance to benefit from courses. When getting started, students need help in assessing existing knowledge and competence. In classes, students need frequent opportunities to perform and receive suggestions for improvement. At various points during college, and at the end, students need chances to reflect on what they have learned, what they still need to know, and how to assess themselves.

Some examples: No feedback can occur without assessment. But assessment without timely feedback contributes little to learning.

Colleges assess students as they enter in order to guide them in planning their studies. In addition to the feedback they receive from course instructors, students in many colleges and universities receive counseling periodically on their progress and future plans. At Bronx Community College, students with poor academic preparation have been carefully tested and given special tutorials to prepare them to take introductory courses. They are then advised about the introductory courses to take, given the level of their academic skills.

Adults can receive assessment of their work and other life experiences at many colleges and universities through portfolios of their work or through standardized tests; these provide the basis for sessions with advisors.

Alverno College requires that students develop high levels of performance in eight general abilities such as analytic and communication skills. Performance is assessed and then discussed with students at each level for each ability in a variety of ways and by a variety of assessors.

In writing courses across the country, students are learning, through detailed feedback from instructors and fellow students, to revise and rewrite drafts. They learn, in the process, that feedback is central to learning and improving performance.

5. Emphasizes Time on Task

Time plus energy equals learning. There is no substitute for time on task. Learning to use one's time well is critical for students and professionals alike. Students need help in learning effective time management. Allocating realistic amounts of time means effective learning for students and effective teaching for faculty. How an institution defines time expectations for students, faculty, administrators, and other professional staff can establish the basis for high performance for all.

Some examples: Mastery learning, contract learning, and computer assisted instruction require that students spend adequate amounts of time on learning. Extended periods of preparation for college also give students more time on task. Matteo Ricci College is known for its efforts to guide high school students from the ninth grade to a B.A. in six years through a curriculum taught jointly by faculty at Seattle Preparatory School and Seattle University. Providing students with opportunities to integrate their studies into the rest of their lives helps them use time well.

Workshops, intensive residential programs, combinations of televised instruction, correspondence study, and learning centers are all being used in a variety of institutions, especially those with many part-time students. Weekend colleges and summer residential programs, courses offered at work sites and community centers, clusters of courses on related topics taught in the same time block, and double-credit courses make more time for learning. At Empire State College, for example, students design degree programs organized in manageable time blocks; students may take courses at nearby institutions, pursue independent study, or work with faculty and other students at Empire State learning centers.

6. Communicates High Expectations

Expect more and you will get more. High expectations are important for everyone—for the poorly prepared, for those unwilling to exert themselves, and for the bright and well motivated. Expecting students to per-

form well becomes a self-fulfilling prophecy when teachers and institutions hold high expectations of themselves and make extra efforts.

Some examples: In many colleges and universities, students with poor past records or test scores do extraordinary work. Sometimes they outperform students with good preparation. The University of Wisconsin-Parkside has communicated high expectations for underprepared high school students by bringing them to the university for workshops in academic subjects, study skills, test taking, and time management. In order to reinforce high expectations, the program involves parents and high school counselors.

The University of California, Berkeley introduced an honors program in the sciences for underprepared minority students; a growing number of community colleges are establishing general honors programs for minorities. Special programs like these help. But most important are the day-to-day, week-in and week-out expectations students and faculty hold for themselves and for each other in all their classes.

7. Respects Diverse Talents and Ways of Learning

There are many roads to learning. People bring different talents and styles of learning to college. Brilliant students in the seminar room may be all thumbs in the lab or art studio. Students rich in hands-on experience may not do so well with theory. Students need the opportunity to show their talents and learn in ways that work for them. Then they can be pushed to learning in new ways that do not come so easily.

Some examples: Individualized degree programs recognize different interests. Personalized systems of instruction and mastery learning let students work at their own pace. Contract learning helps students define their own objectives, determine their learning activities, and define the criteria and methods of evaluation. At the College of Public and Community Service, a college for older working adults at the University of Massachusetts-Boston, incoming students have taken an orientation course that encourages them to reflect on their learning styles. Rockland Community College has offered a life-career-educational planned course. At the University of California, Irvine, introductory physics students may choose between a lecture-and-textbook course, a computer-based version of the lecture-and-textbook course, or a computer-based course based on notes developed by the faculty that allow students to program the computer. In both computer-based courses, students work on their own and must pass mastery exams.

WHOSE RESPONSIBILITY IS IT?

Teachers and students hold the main responsibility for improving undergraduate education. But they need a lot of help. College and university leaders, state and federal officials, and accrediting associations have the power to shape an environment that is favorable to good practice in higher education.

What qualities must this environment have?

- ▶ A strong sense of shared purposes.
- ▶ Concrete support from administrators and faculty leaders for those purposes.
- ▶ Adequate funding appropriate for the purposes.
- ▶ Policies and procedures consistent with the purposes.
- ▶ Continuing examination of how well the purposes are being achieved.

There is good evidence that such an environment can be created. When this happens, faculty members and administrators think of themselves as educators. Adequate resources are put into creating opportunities for faculty members, administrators, and students to celebrate and reflect on their shared purposes. Faculty members receive support and release time for appropriate professional development activities. Criteria for hiring and promoting faculty members, administrators, and staff support the institution's purposes. Advising is considered important. Departments, programs, and classes are small enough to allow faculty members and students to have a sense of community, to experience the value of their contributions, and to confront the consequences of their failures.

States, the federal government, and accrediting associations affect the kind of environment that can develop on campuses in a variety of ways. The most important is through the allocation of financial support. States also influence good practice by encouraging sound planning, setting priorities, mandating standards, and reviewing and approving programs. Regional and professional accrediting associations require self-study and peer review in making their judgments about programs and institutions.

These sources of support and influence can encourage environments for good practice in undergraduate education by:

- ▶ Setting policies that are consistent with good practice in undergraduate education.
- ▶ Holding high expectations for institutional performance.
- ▶ Keeping bureaucratic regulations to a minimum that is compatible with public accountability.
- ▶ Allocating adequate funds for new undergraduate programs and the professional development of faculty members, administrators, and staff.
- ▶ Encouraging employment of under-represented groups among administrators, faculty members, and student services professionals.
- ▶ Providing the support for programs, facilities, and financial aid necessary for good practice in undergraduate education. ■

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ABSTRACT

Seven principles that can help to improve undergraduate education are identified. Based on research on college teaching and learning, good practice in undergraduate education: (1) encourages contacts between students and faculty; (2) develops reciprocity and cooperation among students; (3) uses active learning techniques; (4) gives prompt feedback; (5) emphasizes time on task; (6) communicates high expectations; and (7) respects diverse talents and ways of learning. Examples of approaches that have been used in different kinds of college in the last few years are described. In addition, the implications of these principles for the way states fund and govern higher education and for the way institutions are run are briefly discussed. Examples of good approaches include: freshman seminars on important topics taught by senior faculty; learning groups of five to seven students who meet regularly during class to solve problems set by the instructor; active learning using structured exercises, discussions, team projects, and peer critiques, as well as internships and independent study; and mastery learning, contract learning, and computer-assisted instruction approaches, which required adequate time on learning. (SW)

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BACKGROUND & DEFINITIONS

The past decade has seen an explosion of interest among college faculty in the teaching methods variously grouped under the terms 'active learning' and 'cooperative learning'. However, even with this interest, there remains much misunderstanding of and mistrust of the pedagogical "movement" behind the words. The majority of all college faculty still teach their classes in the traditional lecture mode. Some of the criticism and hesitation seems to originate in the idea that techniques of active and cooperative learning are genuine alternatives to, rather than enhancements of, professors' lectures. We provide below a survey of a wide variety of active learning techniques which can be used to supplement rather than replace lectures. We are not advocating complete abandonment of lecturing, as both of us still lecture about half of the class period. The lecture is a very efficient way to present information but use of the lecture as the only mode of instruction presents problems for both the instructor and the students. There is a large amount of research attesting to the benefits of active learning.

"Active Learning" is, in short, anything that students do in a classroom other than merely passively listening to an instructor's lecture. This includes everything from listening practices which help the students to absorb what they hear, to short writing exercises in which students react to lecture material, to complex group exercises in which students apply course material to "real life" situations and/or to new problems. The term "cooperative learning" covers the subset of active learning activities which students do as groups of three or more, rather than alone or in pairs; generally, cooperative learning techniques employ more formally structured groups of students assigned complex tasks, such as multiple-step exercises, research projects, or presentations. Cooperative learning is to be distinguished from another now well-defined term of art, "collaborative learning", which refers to those classroom strategies which have the instructor and the students placed on an equal footing working together in, for example, designing assignments, choosing texts, and presenting material to the class. Clearly, collaborative learning is a more radical departure from tradition than merely utilizing techniques aimed at enhancing student retention of material presented by the instructor; we will limit our examples to the "less radical" active and cooperative learning techniques. "Techniques of active learning", then, are those activities which an instructor incorporates into the classroom to foster active learning.

(top)

TECHNIQUES OF ACTIVE LEARNING

Exercises for Individual Students

Because these techniques are aimed at individual students, they can very easily be used without interrupting the flow of the class. These exercises are particularly useful in providing the instructor with feedback concerning student understanding and retention of material. Some (numbers 3 and 4, in particular) are especially designed to encourage students' exploration of their own attitudes and values. Many (especially numbers 4 - 6) are designed to increase retention of material presented in lectures and texts.

1. **The "One Minute Paper"** - This is a highly effective technique for checking student progress, both in understanding the material and in reacting to course material. Ask students to take out a blank sheet of paper, pose a question (either specific or open-ended), and give them one (or perhaps two - but not many more) minute(s) to respond. Some sample questions include: "How does John Hospers define "free will"?", "What is "scientific realism"?", "What is the activation energy for a chemical reaction?", "What is the difference between replication and transcription?", and so on. Another good use of the minute paper is to ask questions like "What was the main point of today's class material?" This tells you whether or not the students are viewing the material in the way you envisioned.

2. **Muddiest (or Clearest) Point** - This is a variation on the one-minute paper, though you may wish to give students a slightly longer time period to answer the question. Here you ask (at the end of a class period, or at a natural break in the presentation), "What was the "muddiest point" in today's lecture?" or, perhaps, you might be more specific, asking, for example: "What (if anything) do you find unclear about the concept of 'personal identity' ('inertia', 'natural selection', etc.)?".

3. **Affective Response** - Again, this is similar to the above exercises, but here you are asking students to report their reactions to some facet of the course material - i.e., to provide an emotional or valuative response to the material. Obviously, this approach is limited to those subject areas in which such questions are appropriate (one should not, for instance, inquire into students' affective responses to vertebrate taxonomy). However, it can be quite a useful starting point for courses such as applied ethics, particularly as a precursor to theoretical analysis. For example, you might ask students what they think of Dr. Jack Kevorkian's activities, before presenting what various moral theorists would make of them. By having several views "on the table" before theory is presented, you can help students to see the material in context and to explore their own beliefs. It is also a good way to begin a discussion of evolutionary theory or any other scientific area where the general public often has views contrary to current scientific thinking, such as paper vs. plastic packaging or nuclear power generation.

4. **Daily Journal** - This combines the advantages of the above three techniques, and allows for more in-depth discussion of or reaction to course material. You may set aside class time for students to complete their journal entries, or assign this as homework. The only disadvantage to this approach is that the feedback will not be as "instant" as with the one-minute paper (and other assignments which you collect the day of the relevant lecture). But with this approach (particularly if entries are assigned for homework), you may ask more complex questions, such as, "Do you think that determinism is correct, or that humans have free will? Explain your answer.", or "Do you think that Dr. Kevorkian's actions are morally right? What would John Stuart Mill say?" and so on. Or you might have students find and discuss reports of scientific studies in popular media on topics relevant to course material, such as global warming, the ozone layer, and so forth.

5. **Reading Quiz** - Clearly, this is one way to coerce students to read assigned material! Active

learning depends upon students coming to class prepared. The reading quiz can also be used as an effective measure of student comprehension of the readings (so that you may gauge their level of sophistication as readers). Further, by asking the same sorts of questions on several reading quizzes, you will give students guidance as to what to look for when reading assigned text. If you ask questions like "What color were Esmerelda's eyes?" (as my high school literature teacher liked to do), you are telling the student that it is the details that count, whereas questions like "What reason did Esmerelda give, for murdering Sebastian?" highlight issues of justification. If your goal is to instruct (and not merely to coerce), carefully choose questions which will both identify who has read the material (for your sake) and identify what is important in the reading (for their sake).

6. **Clarification Pauses** - This is a simple technique aimed at fostering "active listening". Throughout a lecture, particularly after stating an important point or defining a key concept, stop, let it sink in, and then (after waiting a bit!) ask if anyone needs to have it clarified. You can also circulate around the room during these pauses to look at student notes, answer questions, etc. Students who would never ask a question in front of the whole class will ask questions during a clarification pause as you move about the room.

7. **Response to a demonstration or other teacher centered activity** - The students are asked to write a paragraph that begins with: I was surprised that ... I learned that ... I wonder about ... This allows the students to reflect on what they actually got out of the teachers' presentation. It also helps students realize that the activity was designed for more than just entertainment.

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Questions and Answers

While most of us use questions as a way of prodding students and instantly testing comprehension, there are simple ways of tweaking our questioning techniques which increase student involvement and comprehension. Though some of the techniques listed here are "obvious", we will proceed on the principle that the obvious sometimes bears repeating (a useful pedagogical principle, to be sure!).

The "Socratic Method"

Taking its namesake from the most famous gadfly in history, this technique in its original format involved instructors "testing" student knowledge (of reading assignments, lectures, or perhaps applications of course material to a wider context) by asking questions during the course of a lecture. Typically, the instructor chooses a particular student, presents her with a question, and expects an answer forthwith; if the "chosen" student cannot answer the question presented, the instructor chooses another (and another) until the desired answer is received. This method has come under criticism, based on claims that it singles out students (potentially embarrassing them), and/or that it favors only a small segment of the class (i.e., that small percentage of the class who can answer any question thrown at them). In addition, once a student has answered a question they may not pay much attention as it will be a long time before the teacher returns to them for a second question. In spite of these criticisms, we feel that the Socratic method is an important and useful one; the following techniques suggest variations which enhance this method, avoiding some of these pitfalls.

8. **Wait Time** - Rather than choosing the student who will answer the question presented, this variation has the instructor WAITING before calling on someone to answer it. The wait time will generally be short (15 seconds or so) - but it may seem interminable in the classroom. It is important to insist that no one raise his hand (or shout out the answer) before you give the OK, in order to discourage the typical scenario in which the five students in the front row all immediately volunteer to answer the question, and everyone else sighs in relief. Waiting forces every student to think about the question, rather than passively relying on those students who are fastest out of the gate to answer every question. When the wait time is up, the instructor asks for volunteers or randomly picks a student to answer the question. Once students are in the habit of waiting after questions are asked, more will get involved in the process.

9. **Student Summary of Another Student's Answer** - In order to promote active listening, after one student has volunteered an answer to your question, ask another student to summarize the first student's response. Many students hear little of what their classmates have to say, waiting instead for the instructor to either correct or repeat the answer. Having students summarize or repeat each others' contributions to the course both fosters active participation by all students and promotes the idea that learning is a shared enterprise. Given the possibility of being asked to repeat a classmates' comments, most students will listen more attentively to each other.

10. **The Fish Bowl** - Students are given index cards, and asked to write down one question concerning the course material. They should be directed to ask a question of clarification regarding some aspect of the material which they do not fully understand; or, perhaps you may allow questions concerning the application of course material to practical contexts. At the end of the class period (or, at the beginning of the next class meeting if the question is assigned for homework), students deposit their questions in a fish bowl. The instructor then draws several questions out of the bowl and answers them for the class or asks the class to answer them. This technique can be combined with others (e.g., #8-9 above, and #2).

11. **Quiz/Test Questions** - Here students are asked to become actively involved in creating quizzes and tests by constructing some (or all) of the questions for the exams. This exercise may be assigned for homework and itself evaluated (perhaps for extra credit points). In asking students to think up exam questions, we encourage them to think more deeply about the course material and to explore major themes, comparison of views presented, applications, and other higher-order thinking skills. Once suggested questions are collected, the instructor may use them as the basis of review sessions, and/or to model the most effective questions. Further, you may ask students to discuss the merits of a sample of questions submitted; in discussing questions, they will significantly increase their engagement of the material to supply answers. Students might be asked to discuss several aspects of two different questions on the same material including degree of difficulty, effectiveness in assessing their learning, proper scope of questions, and so forth.

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Immediate Feedback

These techniques are designed to give the instructor some indication of student understanding of the material presented during the lecture itself. These activities provide formative assessment rather than summative assessment of student understanding,

Formative assessment is evaluation of the class as a whole in order to provide information for the benefit of the students and the instructor, but the information is not used as part of the course grade; summative assessment is any evaluation of student performance which becomes part of the course grade. For each feedback method, the instructor stops at appropriate points to give quick tests of the material; in this way, she can adjust the lecture mid-course, slowing down to spend more time on the concepts students are having difficulty with or moving more quickly to applications of concepts of which students have a good understanding.

12. **Finger Signals** - This method provides instructors with a means of testing student comprehension without the waiting period or the grading time required for written quizzes. Students are asked questions and instructed to signal their answers by holding up the appropriate number of fingers immediately in front of their torsos (this makes it impossible for students to "copy", thus committing them to answer each question on their own). For example, the instructor might say "one finger for 'yes', two for 'no'", and then ask questions such as "Do all organic compounds contain carbon [hydrogen, etc.]?". Or, the instructor might have multiple choice questions prepared for the overhead projector and have the answers numbered (1) through (5), asking students to answer with finger signals. In very large classes the students can use a set of large cardboard signs with numbers written on them. This method allows instructors to assess student knowledge literally at a glance.

13. **Flash Cards** - A variation of the Finger Signals approach, this method tests students' comprehension through their response to flash cards held by the instructor. This is particularly useful in disciplines which utilize models or other visual stimuli, such as chemistry, physics or biology. For example, the instructor might flash the diagram of a chemical compound and ask "Does this compound react with H_2O?". This can be combined with finger signals.

14. **Quotations** - This is a particularly useful method of testing student understanding when they are learning to read texts and identify an author's viewpoint and arguments. After students have read a representative advocate of each of several opposing theories or schools of thought, and the relevant concepts have been defined and discussed in class, put on the overhead projector a quotation by an author whom they have not read in the assigned materials, and ask them to figure out what position that person advocates. In addition to testing comprehension of the material presented in lecture, this exercise develops critical thinking and analysis skills. This would be very useful, for example, in discussing the various aspects of evolutionary theory.

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Critical Thinking Motivators

Sometimes it is helpful to get students involved in discussion of or thinking about course material either before any theory is presented in lecture or after several conflicting theories have been presented. The idea in the first case is to generate data or questions prior to mapping out the theoretical landscape; in the second case, the students learn to assess the relative merits of several approaches.

15. **The Pre-Theoretic Intuitions Quiz** - Students often dutifully record everything the instructor says during a lecture and then ask at the end of the day or the course "what use is any of this?", or "what good will philosophy [organic chemistry, etc.] do for us?". To avoid such questions, and to get students interested in a topic before lectures begin, an instructor can give a quiz aimed at getting students to both identify and to assess their own views. An example of this is a long "True or False" questionnaire designed to start students thinking about moral theory (to be administered on the first or second day of an introductory ethics course), which includes statements such as "There are really no correct answers to moral questions" and "Whatever a society holds to be morally right is in fact morally right". After students have responded to the questions individually, have them compare answers in pairs or small groups and discuss the ones on which they disagree. This technique may also be used to assess student knowledge of the subject matter in a pre-/post-lecture comparison. The well-known "Force Concept Inventory" developed by Hestenes to measure understanding of force and motion is another good example of this.

16. **Puzzles/Paradoxes** - One of the most useful means of ferreting out students' intuitions on a given topic is to present them with a paradox or a puzzle involving the concept(s) at issue, and to have them struggle towards a solution. By forcing the students to "work it out" without some authority's solution, you increase the likelihood that they will be able to critically assess theories when they are presented later. For example, students in a course on theories of truth might be asked to assess the infamous "Liar Paradox" (with instances such as 'This sentence is false'), and to suggest ways in which such paradoxes can be avoided. Introductory logic students might be presented with complex logic puzzles as a way of motivating truth tables, and so forth. In scientific fields you can present experimental data which seems to contradict parts of the theory just presented or use examples which seem to have features which support two opposing theories.

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Share/Pair

Grouping students in pairs allows many of the advantages of group work students have the opportunity to state their own views, to hear from others, to hone their argumentative skills, and so forth without the administrative "costs" of group work (time spent assigning people to groups, class time used just for "getting in groups", and so on). Further, pairs make it virtually impossible for students to avoid participating thus making each person accountable.

17. **Discussion** - Students are asked to pair off and to respond to a question either in turn or as a pair. This can easily be combined with other techniques such as those under "Questions and Answers" or "Critical Thinking Motivators" above. For example, after students have responded to statements, such as "Whatever a society holds to be morally right is in fact morally right" with 'true' or 'false', they can be asked to compare answers to a limited number of questions and to discuss the statements on which they differed. In science classes students can be asked to explain some experimental data that supports a theory just discussed by the lecturer. Generally, this works best when students are given explicit directions, such as "Tell each other why you chose the answer you did".

18. **Note Comparison/Sharing** - One reason that some students perform poorly in classes is

that they often do not have good note-taking skills. That is, while they might listen attentively, students do not always know what to write down, or they may have gaps in their notes which will leave them bewildered when they go back to the notes to study or to write a paper. One way to avoid some of these pitfalls and to have students model good note-taking is to have them occasionally compare notes. The instructor might stop lecturing immediately after covering a crucial concept and have students read each others' notes, filling in the gaps in their own note-taking. This is especially useful in introductory courses or in courses designed for non-majors or special admissions students. Once students see the value of supplementing their own note-taking with others', they are likely to continue the practice outside of class time.

19. **Evaluation of Another Student's Work** - Students are asked to complete an individual homework assignment or short paper. On the day the assignment is due, students submit one copy to the instructor to be graded and one copy to their partner. These may be assigned that day, or students may be assigned partners to work with throughout the term. Each student then takes their partner's work and depending on the nature of the assignment gives critical feedback, standardizes or assesses the arguments, corrects mistakes in problem-solving or grammar, and so forth. This is a particularly effective way to improve student writing.

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Cooperative Learning Exercises

For more complex projects, where many heads are better than one or two, you may want to have students work in groups of three or more. As the term "cooperative learning" suggests, students working in groups will help each other to learn. Generally, it is better to form heterogeneous groups (with regard to gender, ethnicity, and academic performance), particularly when the groups will be working together over time or on complex projects; however, some of these techniques work well with spontaneously formed groups. Cooperative groups encourage discussion of problem solving techniques ("Should we try this?", etc.), and avoid the embarrassment of students who have not yet mastered all of the skills required.

20. **Cooperative Groups in Class** - Pose a question to be worked on in each cooperative group and then circulate around the room answering questions, asking further questions, keeping the groups on task, and so forth.. After an appropriate time for group discussion, students are asked to share their discussion points with the rest of the class. (The ensuing discussion can be guided according to the "Questions and Answers" techniques outlined above.)

21. **Active Review Sessions** - In the traditional class review session the students ask questions and the instructor answers them. Students spend their time copying down answers rather than thinking about the material. In an active review session the instructor posses questions and the students work on them in groups. Then students are asked to show their solutions to the whole group and discuss any differences among solutions proposed.

22. **Work at the Blackboard** - In many problem solving courses (e.g., logic or critical thinking), instructors tend to review homework or teach problem solving techniques by solving the problems themselves. Because students learn more by doing, rather than watching, this is probably not the optimal scenario. Rather than illustrating problem solving,

have students work out the problems themselves, by asking them to go to the blackboard in small groups to solve problems. If there is insufficient blackboard space, students can still work out problems as a group, using paper and pencil or computers if appropriate software is available.

23. **Concept Mapping** - A concept map is a way of illustrating the connections that exist between terms or concepts covered in course material; students construct concept maps by connecting individual terms by lines which indicate the relationship between each set of connected terms. Most of the terms in a concept map have multiple connections. Developing a concept map requires the students to identify and organize information and to establish meaningful relationships between the pieces of information.

24. **Visual Lists** - Here students are asked to make a list--on paper or on the blackboard; by working in groups, students typically can generate more comprehensive lists than they might if working alone. This method is particularly effective when students are asked to compare views or to list pros and cons of a position. One technique which works well with such comparisons is to have students draw a "T" and to label the left- and right-hand sides of the cross bar with the opposing positions (or 'Pro' and 'Con'). They then list everything they can think of which supports these positions on the relevant side of the vertical line. Once they have generated as thorough a list as they can, ask them to analyze the lists with questions appropriate to the exercise. For example, when discussing Utilitarianism (a theory which claims that an action is morally right whenever it results in more benefits than harms) students can use the "T" method to list all of the (potential) benefits and harms of an action, and then discuss which side is more heavily "weighted". Often having the list before them helps to determine the ultimate utility of the action, and the requirement to fill in the "T" generally results in a more thorough accounting of the consequences of the action in question. In science classes this would work well with such topics as massive vaccination programs, nuclear power, eliminating chlorofluorocarbons, reducing carbon dioxide emissions, and so forth.

25. **Jigsaw Group Projects** - In jigsaw projects, each member of a group is asked to complete some discrete part of an assignment; when every member has completed his assigned task, the pieces can be joined together to form a finished project. For example, students in a course in African geography might be grouped and each assigned a country; individual students in the group could then be assigned to research the economy, political structure, ethnic makeup, terrain and climate, or folklore of the assigned country. When each student has completed his research, the group then reforms to complete a comprehensive report. In a chemistry course each student group could research a different form of power generation (nuclear, fossil fuel, hydroelectric, etc.). Then the groups are reformed so that each group has an expert in one form of power generation. They then tackle the difficult problem of how much emphasis should be placed on each method.

26. **Role Playing** - Here students are asked to "act out" a part. In doing so, they get a better idea of the concepts and theories being discussed. Role-playing exercises can range from the simple (e.g., "What would you do if a Nazi came to your door, and you were hiding a Jewish family in the attic?") to the complex. Complex role playing might take the form of a play (depending on time and resources); for example, students studying ancient philosophy might be asked to recreate the trial of Socrates. Using various sources (e.g., Plato's dialogues, Stone's The Trial of Socrates, and Aristophanes' The Clouds), student teams can prepare the prosecution and defense of Socrates on the charges of corruption of youth and treason; each team may present witnesses (limited to characters which appear in the

Dialogues, for instance) to construct their case, and prepare questions for cross-examination.

27. **Panel Discussions** - Panel discussions are especially useful when students are asked to give class presentations or reports as a way of including the entire class in the presentation. Student groups are assigned a topic to research and asked to prepare presentations (note that this may readily be combined with the jigsaw method outlined above). Each panelist is then expected to make a very short presentation, before the floor is opened to questions from "the audience". The key to success is to choose topics carefully and to give students sufficient direction to ensure that they are well-prepared for their presentations. You might also want to prepare the "audience", by assigning them various roles. For example, if students are presenting the results of their research into several forms of energy, you might have some of the other students role play as concerned environmentalists, transportation officials, commuters, and so forth.

28. **Debates** - Actually a variation of #27, formal debates provide an efficient structure for class presentations when the subject matter easily divides into opposing views or 'Pro'/'Con' considerations. Students are assigned to debate teams, given a position to defend, and then asked to present arguments in support of their position on the presentation day. The opposing team should be given an opportunity to rebut the argument(s) and, time permitting, the original presenters asked to respond to the rebuttal. This format is particularly useful in developing argumentation skills (in addition to teaching content).

29. **Games** - Many will scoff at the idea that one would literally play games in a university setting, but occasionally there is no better instructional tool. In particular, there are some concepts or theories which are more easily illustrated than discussed and in these cases, a well-conceived game may convey the idea more readily. For example, when students are introduced to the concepts of "laws of nature" and "the scientific method", it is hard to convey through lectures the nature of scientific work and the fallibility of inductive hypotheses. Instead, students play a couple rounds of the Induction Game, in which playing cards are turned up and either added to a running series or discarded according to the dealer's pre-conceived "law of nature". Students are asked to "discover" the natural law, by formulating and testing hypotheses as the game proceeds.

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