

Environmental sciences: active learning in large classes

Ciencias medioambientales: aprendizaje activo en grandes clases

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Abstract

The lecture is still the dominant mode of instruction in institutions of higher education. Yet, due to the diversity in student learning styles there is a need for instructors to lecture less, to make learning environments more interactive and to use active learning strategies when appropriate. This paper suggests specific and practical ways the environmental educator can use in incorporating active learning within the large lecture class format. The active learning techniques discussed include listening practices which help students absorb what they hear, short writing exercises in which students react to lecture material or complex group exercises in which students apply course material to "real life" situations. Each strategy suggested is illustrated by concrete examples from a variety of environmental sciences. In implementing active learning techniques teachers become facilitators and not merely disseminators of information and students are given opportunities to recognize and accept their responsibility for lifelong learning and continued personal and professional development.

Key words: lectures, active learning, strategies, large classes.

Resumen

La conferencia magistral es aun el método dominante de instrucción en la educación superior. Todavía, a causa de los diversos estilos estudiantiles de aprendizaje, hay una demanda de instructores que en estas clases pueden crear un ambiente de aprendizaje más interactivo y que usen estrategias activas de aprendizaje apropiado. Estas maneras específicas y prácticas del educador en los cursos de medio ambiente puede incorporar métodos activos en las grandes clases. Estas técnicas activas de aprendizaje incluyen prácticas auditivas que ayuden a los estudiantes a absorber lo que escuchen, breves ejercicios escritos donde los estudiantes reaccionan con el material de la conferencia o, grupos de ejercicios complejos cuando los estudiantes aplican el material de la clase en situaciones reales. Cada estrategia propuesta es ilustrada con ejemplos concretos de la variedad de las ciencias medioambientales. Para aplicar las técnicas activas de aprendizaje los profesores deben convertirse en facilitadores y no simplemente divulgar información, que los estudiantes tengan la oportunidad de reconocer y aceptar su responsabilidad por un aprendizaje de toda la vida y continuar un desarrollo personal y profesional.

Palabras clave: conferencias, aprendizaje activo, grandes clases,

INTRODUCTION

The majority of teachers in higher education still teach their classes in the traditional lecture mode. The lecture is an efficient way to communicate a large amount of information to large audiences, maximizes instructor control and is non-threatening to students. Yet, given that student populations are characterized by a diversity of learning styles there are pressures for instructors to lecture less, to make learning environments more interactive and to use active learning strategies when appropriate (LEAL FILHO, 1996; MATHEWS, 1998; BIGGS, 1999; FREDERICK, 2000; SPRAU, 2001; "Teaching Strategies", 2001).

Active learning means that students do not merely listen passively to an instructor's lecture. Less emphasis is placed on transmitting information and more emphasis is placed on developing the skills of the students. There is preference for students to be involved in higher order thinking such as applying, analyzing, synthesizing and evaluating. Greater emphasis

is placed on the exploration of student values and attitudes (BONWELL & EISON, 1991; McKEACHIE, 2001).

For reasons already outlined, this paper will not advocate complete abandonment of lecturing. Rather, it will suggest several specific, practical ways of promoting active, participatory learning within the large class lecture format. Each of these approaches assumes a class size of at least one hundred students, sitting in conventionally tiered lecture halls, with chairs in rows bolted to the floor facing an instructor up (or down) a lectern.

The active learning suggestions of this paper are grouped into three sections: exercises for individual students; pair activities; and exercises involving more than two students or the whole class, and, in particular, visual lists, surveys or polls, experience discussions and role-playing. Each of these practices is followed by concrete examples from a variety of environmental sciences.

EXERCISES FOR INDIVIDUAL STUDENTS

The "One Minute Paper" is a highly effective technique for checking student progress, both in understanding the material and in reacting to course material. The teacher asks students to take out a blank sheet of paper, poses a question (either specific or open-ended), and gives them one or two minute(s) to respond. Some sample questions: "What is environment and ecosystem?" "Can you provide examples of these terms from your region?" "What is an estuary?" "How does soil particle size affect texture and drainage?" "How does irrigation increase salinity?", and so on. Another good use of the minute paper is to ask questions like "What was the most important point (or two or three most important points) of today's class material?" Examination of the responses will let the instructor know if students are able to distinguish between central information and details. Also, when the students know beforehand that this question is coming they will tend to watch for the main points as the class unfolds, with obvious pedagogical benefits.

The Muddiest (or most Confusing) Point(s) is a variation on the one-minute paper, though the teacher may wish to give students a slightly longer time period to answer the question. Here, the instructor asks (at the end of the class period, or at a natural break in the presentation), "What was the muddiest point (or the two or three muddiest points) in today's class?" or, perhaps, he / she might be more specific, asking, for example: "What do you find unclear about the concept of "eutrophication", "natural selection", "primary succession", etc.?" The responses to such questions may be a surprise. What the teacher may have considered to be the most difficult points or concepts may not appear on many papers; what may show up may be things the instructor took for granted, which were skimmed over in his / her lecture or were not explained or emphasized enough but which were unfamiliar and baffling to students (PAULSON and FAUST, 2002; "Creating an Active Learning Environment", 2002).

The *Daily Journal* allows for more in-depth discussion of or reaction to course material. The teacher sets aside class time, for students to complete their journal entries, or assigns this as homework. The only disadvantage to this approach is that the feedback will not be as "instant" as with work assigned and collected the same day. But with this approach, particularly if entries are assigned for homework, the instructor may ask more complex questions (PAULSON & FAUST, 2002), such as, "Do you think that anthropocentrism is correct? Justify your answer." Another idea is to have students find and discuss reports of scientific studies in popular media on topics such as the greenhouse effect, ozone depletion, and so forth.

PAIR ACTIVITIES

In a technique called *Pair Discussion* students pair off and, either in turn or as pair, engage in activities such as: (a) respond to a question or a limited number of questions, (b) respond to a limited number of true or false statements, (c) respond to a limited number of multiple choice statements, (d) fill in a limited number of incomplete sentences or phrases, (e) find their own examples of a concept. After completion of any of the above tasks students compare their answers and discuss where they differed. The teacher may decide to mix students who are confident with those who feel less confident.

In *Notes Checking Pairs* the idea is to engage students with their notes to insure that they develop good note-taking skills. There are many ways to avoid the above pitfalls. For example, at the end of a lecture segment (15 to 20 minutes is a good length) students pair up to compare notes and fill in gaps they might have, summarize the two or three major arguments of the lecture, choose the most important idea that will appear on the exam, or use the notes to solve an example problem ("Creating an Active Learning Environment", 2002). Students should also be encouraged to continue working with their notes outside of class time ideally meeting at the same time and place every week. As out of class activities students could continue the practices already mentioned or engage in other practices such as using the notes to write essays or prepare themselves for examinations (NEAL, 2001).

In *Evaluating Another Student's Work* students are asked to complete an individual homework assignment or paper. On the day the assignment is due, students submit one copy to the teacher to be graded and one copy to their partner (PAULSON and FAUST, 2002). Each student then takes their partners work and depending on the nature of the assignment comments on the work taking into account criteria such as: Does the content relate to the title and / or purpose of the assignment? Is the breadth of the content sufficient? Is the depth of the content sufficient? Is sufficient evidence given to support arguments? Is there evidence of appropriate critical thinking? Are conclusions drawn appropriately? ("Peer and Self Assessment in Student Work", 2007). Some examples: "Would you support clearing of forests and plowing of grasslands that have significant ecological importance in order to support agriculture in countries that have significant hunger? Where do you draw the line between preserving ecosystems and human interest?", "Why do you suppose consumers were so quick to adapt the 'use it once, then throw it away' lifestyle after World War II? What values, beliefs and perceptions does this reveal?"

VISUAL LISTS, POLLS, EXPERIENCE DISCUSSIONS, ROLE-PLAYING

In *visual lists* 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, they are asked to analyze the lists with questions appropriate to the exercise. For example, when discussing such topics as eliminating chlorofluorocarbons or reducing carbon dioxide emissions 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 (PAULSON & FAUST, 2002).

Another technique, which can generate a high level of interest, is called *survey or poll*. Students are asked to vote about items they have an opinion about. During the vote there is little discussion but if the results are tabulated striking differences between groups may appear. This can lead to fertile discussion. Alternatively, students may be asked to predict the outcomes of polls or surveys in advance and then compare their predictions with the actual results. The students could vote either through a questionnaire sent to them in advance or during class. This can also lead to fertile discussion ("Teaching and Learning Strategies", 2002). An example: To protect the environment... 1) The government should pay more money. 2) I would pay higher prices. 3) I would pay higher taxes. 4) I would accept a lower standard of living (Dunlap, Gallup and Gallup, 1992; NORC, 1994).

In *Experience Discussion* the instructor may create a class discussion based on some selected type of life experience, a book, article or movie. Among the above sources films are, perhaps, the most powerful teaching media. By asking students to report their *reactions* to particular movies (or parts of movies), and eventually having several such views "on the table", the teacher can build a solid basis not only for discussing class material but also for helping students to further explore their own beliefs (D'Andrea and Ewens, 1990). For example, movies such as *Medicine Man* and *Erin Brockovich* can be very useful in discussing theories of change regarding man and the natural environment such as functionalism and Marxism.

Role-playing is a powerful learning strategy, which can motivate and animate most students as well as confuse and make nervous many. In a role-play exercise students "act out" a part. Role-playing is the reconstruction of a situation of real life conflict(s). As the role players search for a solution to a problem views and emotions become explicit and opposed interests come out in the open. The problem may be solved if the basic needs of the parties become known and explained (GEORGOPOULOS & TSALIKI, 2002).

An example: As the rainforests in Malagasy Republic, an island off the east coast of Africa, will disappear by the year 2010, along with the majority of animal species that live in them, there will be a meeting in the capital of the island in which various groups, i.e. representatives of the government, farmers, loggers, ecologists, and economists, will address the problem of the future of rainforests in the island.

After giving the students the scenario, which briefly describes the problem to be solved, the class is divided into a number of small groups (of varying sizes), and each group is assigned a role. Then, each group presents its views and through active interaction with the other groups an effort is made to reach commonly acceptable solutions. And, finally, and most importantly, the end of the exercise is followed by an evaluation of the whole process. This is when the substantive lessons of the experience are discovered, explored and confirmed. This is when those students who may have served as observers will offer their insights and analysis of what happened. Above all, this is when the actors will need an opportunity to talk about how they felt in their roles and what they learned, both about themselves and about the substantive issues involved (FREDERICK, 2000; FREDERICK, 2002).

CONCLUSIONS

Given the diversity in learning styles which characterizes today's student populations in institutions of higher education this paper suggested specific and practical ways the environmental educator can use in incorporating active learning within the large lecture class format. The active learning techniques discussed included listening practices which help students absorb what they hear, short writing exercises in which students react to lecture material or complex group exercises in which students apply course material to "real life" situations.

Planning and implementing active learning in large classes takes time and energy. But the rewards, both for instructors and students are great. Instructors switch from the role of disseminator to that of facilitator of information and, in this way, renew their commitment to the highest challenges of their calling. And students are given opportunities to recognize and accept their responsibility for lifelong learning and continued personal and professional development.

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Received: 19.10.2006
Approved: 29.09.2007