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Introduction

I have always believed in teaching with practical examples. However, I typically have presented these examples to students in a passive manner (i.e., a traditional lecture format). Because I was not pleased with retention of what I considered important material, I searched for a means to improve retention through more active learning while retaining practical examples. Thus, I first learned about the National Center for Case Study Teaching in Science (http://ublib.buffalo.edu/libraries/projects/cases/case.html) and attended their annual meeting.

Background

The case study method is not new. While it has commonly been used in disciplines such as law, business, and medicine, it has not been utilized to the same extent in science teaching. The primary distinction between lecturing with actual examples and the case study method is the active and cooperative learning that take place with case study instruction.

Case study instructional techniques can range from relatively simple to quite complex. Simple activities may only involve presenting a problem to the class, dividing the class into small teams, giving them five minutes or less to discuss the problem, and then having each group orally present their solution to that problem. Similarly, students can be provided with background material during the class lecture period, and the teams asked to prepare a written report. A more complex approach to instructional methods is an activity such as a debate or "public meeting" where students are assigned a role to play. Interactions between and among students, their discussions and arguments, and their agreement leading to resolution of their problem, all combine to create active learning that leads to better retention of the material presented.

An Example of a Case Study

Let me provide some information on a case that has recently proven valuable.

Even though my primary purpose is to explain the case study method, I do need to provide background information.

The largemouth bass is the most popular sport fish in the United States, and is commonly managed through regulation of anglers, most often with length limits. Our students must understand the difference between a minimum length limit (all fish less than a specified length must immediately be released) and a protected slot length limit (all fish within a protected length range must immediately be released while fish smaller and larger than the protected slot can be harvested). Minimum length limits are typically used to improve the sizes of largemouth bass in a low-density, fast-growing population in which larger fish have been harvested by anglers. The protected slot regulations can be used to reduce the abundance of small largemouth bass through selective harvest, thereby increasing fish growth, and producing more large fish in the population. The objectives of each regulation type are quite different and students must understand these differences so that they can make appropriate management decisions when they are subsequently employed by state or federal natural resource management agecies.

For years, I "preached" the distinction between these two regulations and was frustrated when students could not recall their proper application a year later. This seemed to be a ideal situation in which to encourage a more active learning style.

This particular case is based on work we initiated in 1989 for largemouth bass in a Jones County pond. In 1989, Knox Pond contained a high-density, slow-growing largemouth bass population. To conduct a population estimate, we captured 386 largemouth bass by angling, and an additional 221 were collected by night electrofishing. Of these fish, not one exceeded 300 mm in length. We then implemented a "protected slot length limit" on this largemouth bass population, under which bass smaller than 300 mm would be harvested, while larger fish would be released. Because of the lack of angling in this rural pond, anglers could not be used to harvest the small fish. Thus, we removed the small largemouth bass with an electrofishing boat, and those fish were then moved to other South Dakota waters. We monitored changes in the population through 1993.

Changes occurred, but not immediately. We did not capture our first 300-mm largemouth bass until 1991, and our first 380-mm bass was not collected until 1993. Larger fish were produced after growth of the largemouth bass increased because this simulated regulation resulted in lower bass density. The lower density resulted in more food available per individual fish. In 1989, a 200-mm largemouth bass typically grew only 35 mm in one year. By 1993, a 200-mm largemouth bass grew approximately 105 mm per year.

At this point, the study was concluded, and I used the study results as a teaching example. However, a unique opportunity was then provided to us. In 2000, after the Knox Ranch was purchased by the Turner Foundation, we were invited to sample the pond again in 2000 and 2001. No angling had occurred in the pond between 1993 and 2000.

These new data allowed me to pose a unique, important question to students. Once a largemouth bass population has been restructured with a successful application of a slot regulation, would the population maintain a "balanced" size structure that included larger bass, or would it revert to the original condition of high density, slow growth, with only small bass? Some biologists consistently argue the "maintenance" point of view and believe that larger largemouth bass will prey upon small bass, thereby regulating density. However, other biologists who argue the latter viewpoint (i.e., reversion to high density, slow growth, and decreased size structure) believe that habitat is the key to reproduction and survival of young largemouth bass, and believe that the population will respond to the "exploitation" caused by the removal with increased reproduction and survival, and a high-density population will re-develop.

Students were divided into small groups of two to four and provided with an extensive summary of sampling data for the 1989-1993 time period. Then, I asked them to predict the likely sampling data for 2000 and 2001. After discussing the potential viewpoints within their group, they had to come to a consensus that was orally reported to the rest of the class. Once all groups reported, I then showed them the actual field sampling data from 2000 and 2001.

To date, I have obtained limited feedback on retention using the case study method. From all I have read and learned concerning case study teaching, this active learning style will undoubtedly provide better retention for most students than passively listening to me present the information. In addition, I have had substantial positive feedback from students who appreciate the active learning involved. Older students, especially graduate students and non-traditional students, seem especially to appreciate this method because it validates their belief that past learning and experiences are valuable and appreciated.

Results of the New Method

As a result of our excitement over this teaching method, I am working with a colleague at Virginia Tech University to write a series of case studies for fisheries educators. All cases include both a student version and an instructor version. The student versions include only the minimum necessary background, and students are often asked to read a scientific paper, a book chapter, or perhaps research a topic on the Internet. The students are then asked a question (i.e., the problem), broken in groups to discuss the case, and then asked to report either orally or in writing their resolution to the problem. The instructor version contains substantially more background information and the actual results for the case under study. Thus, after students report the likely solutions to the problem, the instructor can provide full information on what actually occurred.

I have not abandoned the traditional lecture format in my classes. Instead, I use case studies to reinforce important concepts and provide a

break in the lecture format. Current plans involve integration of case studies for our introductory classes, our upper-division undergraduate classes, and our graduate-level classes.

Recommendations and Reflections

Earlier, I mentioned the National Center for Case Study Teaching in Science at the University of Buffalo (New York) and provided their web address. Through a National Science Foundation Undergraduate Faculty Enhancement program grant, this group now maintains a refereed national repository for case studies in science (http://ublib.buffalo.edu/libraries/projects/cases/ubcase.htm).

One of the primary values of this repository is the broad variety in disciplines that are covered, including anatomy and physiology, anthropology, astronomy, chemistry/biochemistry, computer science, ecology/environment, evolutionary biology, food science, geology, mathematics/statistics, medicine/health, microbiology, molecular biology/genetics, nutrition, pharmacy, physics/engineering, plant science, psychology, and teaching. Thus, a wide variety of educators may find this website and the available case studies to be of value in the classroom. Similarly, the website provides articles that provide in-depth analysis of the case study method in science, as well as information on preparing various types of case studies.

EPILOGUE

By the way, at the end of our second analysis the Knox/Turner Pond largemouth bass population had reverted to a high-density, slow-growing population with almost no fish exceeding 300 mm in length.

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BIOGRAPHY

Dave Willis is a Distinguished Professor in the Department of Wildlife and Fisheries Sciences. He has been with SDSU since 1987. Prior to that time period he was employed first as a management biologist and then as a research biologist by the Kansas Fish and Game Commission. He received the F.O. Butler Excellence in Teaching Award from SDSU in 1991, the Award for Excellence in Fisheries Education from the American Fisheries Society in 1997, and the Excellence in Public Outreach Award from the American Fisheries Society in 2003.