Is Your Case a Problem?

Katherine L. Burgess
The Learning Technology Center
Vanderbilt University

. . . problems, not case studies, produce the most powerful learning outcomes for students in technical fields

(Barrows, 1999a, 1999b)

The Difference between Cases and Problems

To fully understand the reasons for Dr. Barrows' statement, one must have an understanding of the difference between a problem and a case study. A problem is a complex task created by the need to design, create, build, repair, and/or improve something. When a person encounters a problem, it is without prior preparation. Often the problem-solver lacks all of the skills and knowledge needed to complete the task. This is why it is a problem and not a practice.

A case study is an *account* of a problematic event(s) that has happened or is happening. A case study necessarily contains information that a previous problem solver (or case author) has structured around the problem. The amount and type of information included in a case reflects the perspective of the problem solver. In the real world of work, a person does not solve case studies. The individual mentally *constructs* cases from the problems he or she encounters in the workplace.

For example, when a doctor examines a person with a medical problem, he engages in problem-solving activities. He reviews the patient's history, conducts a physical examination, and requests laboratory tests. As a result of this activity, the physician constructs a case about the patient. The case necessarily contains information that the doctor has structured around the problem. The amount and type of information included in the case reflects the perspective and experiences of that particular doctor (e.g. the specific questions asked regarding history, the thoroughness of the physical exam, the type of laboratory tests conducted). The case is the product of the doctor's problem-solving activity.

Problem-based Learning

The goal of problem-based learning is to help learners construct their own cases by giving them real problems to solve that require the same problem-solving skills and content that they will need in the real world. Presenting a problem to a student as it actually occurs in the workplace permits the full range of problem-solving processes to be practiced and developed. In solving a problem, the learner relies on his or her prior knowledge to formulate tentative hypotheses. The student selects the resources to use and inquires, experiments, and reasons critically to uncover the nature, cause, extent, and ramifications of the problem. Through this process the learner discovers what he or she needs to learn in order to solve the problem and build a case.

When the learner has solved a problem, the problem has become a case. To achieve the maximum benefit from a problem-based learning experience, the problem-solver needs time to reflect on the newly constructed case. The learner must be encouraged to consider the potential applications of the recently acquired principles and problem-solving processes to new contexts. In addition, the student needs to assess his performance in order to determine what more he needs to learn. Learning occurs "by doing" the problem solving and reflection on that process. When learning scientists speak of the benefits of case-based instruction, they refer to this process.

Giving a learner a case study with the information that a previous problem solver has constructed around the problem deprives the learner of the opportunity to develop his own problem-solving skills. In fact, research studies find little difference in learning outcomes between the use of case studies and traditional classroom lecture (Williams, 1992 p. 389). Barrows provides a concise taxonomy of problem-based learning methods that places the lecture-based case, case-based lecture, and the case method on the lower end of the learning continuum (Barrows, 1986). Problem-based learning methods comprise the upper end of the continuum

In 1999, the Southeast Advanced Technological Education Consortium (SEATEC) held two national forums on the campus of Vanderbilt University. The first forum addressed the design of case studies for technological education. The second focused on best practices in teaching technological content through case studies (TEFATE, 1999). The second event featured an address by an especially distinguished guest, Dr. Howard S. Barrows. Dr. Barrows, often referred to as "The Father of Problem-based Learning," forwarded both a presentation and a paper (Barrows, 1999a, 1999b). In his contribution to the forums, Dr. Barrows' speaks specifically to faculty interested in teaching technical content through case studies. Based his extensive experience in medical education as well as his work with teachers in secondary education, college, and other professional schools, Dr. Barrows concluded that problems, not case studies, produce the most powerful learning outcomes for students in technical fields (Barrows, 1999a, 1999b).

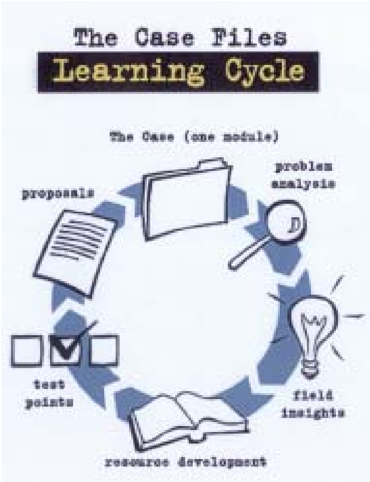

Figure 1. Example of a closed-loop, problem-based learning cycle framework adapted for technological education

in terms of learning outcomes. The criteria that determine learning outcomes include the degree of intervention by the instructor and the degree to which the problem is structured for the learner. According to Barrows, the most effective form of instruction is the "closed-loop problem-based case." This approach includes all of the elements of problem-based learning described above.

The learner encounters a real problem, selects resources and tools to solve the problem, tests the process, revises activity, and finally reflects on the process. Figure 1 represents a framework for developing closed-loop problem-based cases. The original framework was developed at Vanderbilt University (Schwartz, Lin, Brophy, and Bransford, 1999; Bransford, Brown, & Cocking,1999) and was subsequently adapted for use in technological education by SEATEC faculty.

Designing "Authentic" Problem-based Cases

One talks about writing a case study whereas one speaks of designing a problem. In designing instruction around a problem, it is important to differentiate between an authentic account and an authentic experience. A case study may be based on an actual event that has taken place, yet not present an authentic problem to be solved. For example, when a bridge collapsed in Tennessee, SEATEC faculty members seized the opportunity to produce a case study. The case study contained all of the information gathered by a team of engineering consultants who analyzed the possible causes for the bridge collapse. The team discovered that the bridge had collapsed because of an error in the construction process. The case study developed by the faculty members focused on determining the potential causes of the bridge collapse. For the engineering consulting team, this case presented a very real problem. However, for students at two-year institutions studying to become engineering technologists who might work on such a construction site, a more realistic task would be to solve problems regarding technological processes and procedures to prevent a bridge from collapsing. The nature of the problem must directly relate to the goals of the learner.

On the other hand, an event need not have actually occurred to present a realistic problem for the learner. Asking students who intend to become network designers to actually plan and design a network for an imaginary site presents an authentic problem -whether or not such a site actually exists. In fact, the fictitious problem can incorporate significant issues that might be encountered at a number of sites within one problem. For example, flight simulations present common situations and events that have occurred at many different times and places, and under a wide variety of circumstances. Training on the simulator compresses the number of actual flight problems into a more efficient time frame for learning. In short, the problem itself must be authentic and derive from tasks encountered in the real world. However, actual events may or may not be suitable for instructional purposes, depending on the nature of the problem and the goals of the learner.

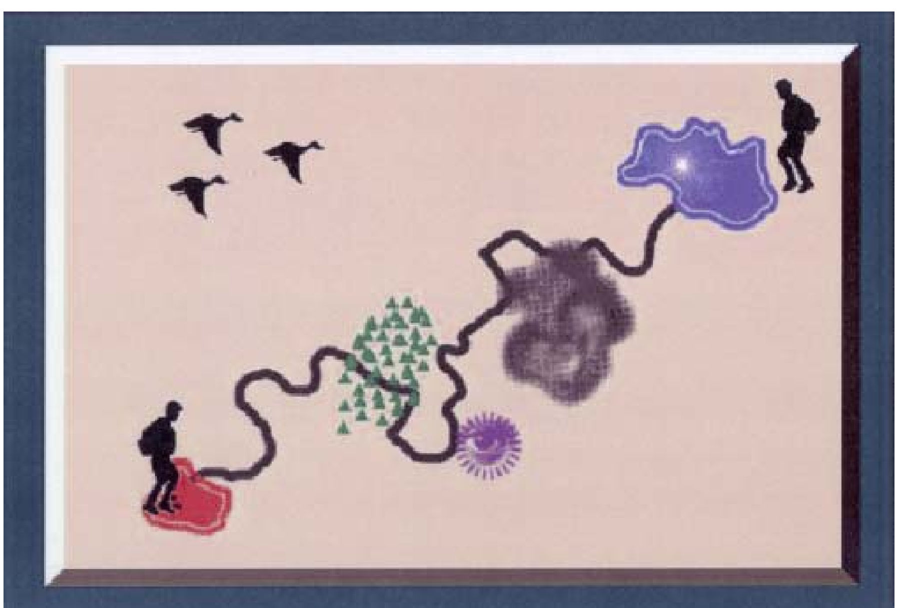
Figure 2. The journey versus the map

The Case Study as the Finished Map

Experts who write case studies often unwittingly insert their own perspectives and problem-solving processes into the structure and writing of the case. This is true because as experts, they have already experienced the events that lead to understanding and expertise. In a sense, the expert has taken a journey of the domain composed of real experiences and insights. As the expert tackles the adventures along the road to expertise, events and their resulting insights are recorded in memory.

As the journey continues, the events recorded in memory become a map. When the expert consults the map, it calls to mind the experiences along the way to expertise. The dilemma is the tendency for the instructor to simply give the finished map (or case study) to their students (Dewey, 1901; Shulman & Quinlan, 1996). When students receive the map without taking the journey, their understanding is incomplete because it is not anchored in experience. From the perspective of problem-based learning, the goal of instruction is to re-create the experiences of the journey by designing problems.

Is Your Case a Problem?

A case study approach to technological education has intuitive appeal. Proponents of case-based instruction claim that problem-based learning environments provide a real world context for abstract theories and formulas, integrate soft skills with hard content, and promote critical thinking skills. From this description, cases would seem to present the solution to the nation's workforce technological problems all wrapped up in a single, easy-to-produce package. One simply identifies a real-world business or industry problem, describes the problem in an engaging narrative filled with authentic details, provides questions that lead to a possible solution(s) and presents it to a class to solve through co-operative learning techniques. With a little effort on their part, the students will unwrap the magical gift of understanding. Unfortunately, the validity of claims for case-based instruction hinges on the answer to a single question*: Is your case a problem?*

Though both case studies and problem-based cases provide a real world context and integrate soft skills with hard content, only problem-based cases promote the critical thinking skills that result in the kind of flexible, adaptable learning that most students seek and instructors try to deliver. This was the message that Dr. Barrows delivered to SEATEC in 1999. As the case study becomes an increasingly popular approach to technological, his message bears repeating.

Katherine Burgess is a Senior Educational Research Associate on the staff of Nashville State Community College. As a researcher with Vanderbilt University, Ms. Burgess participated in the NSF-funded SEATEC (Southeast Advanced Technological Education Consortium) grant and in the planning grant for the newly created CITE-TN (Center for Instructional Technology Education for the Middle Tennessee Region). Ms. Burgess has recently joined Nashville State Community College to continue her work for NSF on problem-based learning in technical education environments. Ms. Burgess has an Ed.M. in Instructional Media and Technology from Columbia University Teachers College and is ABD [for the Ph.D.] in Educational Psychology: Human Cognition and Learning from the same institution.

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