Putting Case-Based Instruction Into Context: Examples From Legal and Medical Education

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Recently, educational theorists have begun to emphasize the importance of situating instruction in meaningful contexts in order to recreate some of the advantages of apprenticeship learning. Cognitive apprenticeship and anchored instruction are two approaches to instruction that provide guidance for teaching in contextualized ways. Cognitive apprenticeship emphasizes the social context of instruction and draws its inspiration from traditional apprenticeships. Anchored instruction provides a model for creating problem contexts that enables students to see the utility of knowledge and to understand the conditions for its use. Together, these two complementary approaches provide a framework for thinking about apprenticeship learning and how it might be transferred to the classroom.

Interestingly, authors who have written about cognitive apprenticeships and anchored instruction have made only passing reference to the case method of legal and business education and the problem-based learning approach to medical education, two well-established methods of instruction that are also based on apprenticeship learning and the study of authentic problems or cases. The detailed description of these two approaches to instruction in this article provides a rich source of information about how to create contextualized learning environments in school settings, and demonstrates that case-based instruction can take on different forms and be used in different domains. Each approach is evaluated employing a framework synthesized from cognitive apprenticeship and anchored instruction; the results of this analysis are used to suggest research questions for case-based instruction as it is currently practiced and areas in which further research is needed to refine educational theories.

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Although national assessments of student performance during the past decade reveal moderate improvement in basic skills, students continue to perform poorly on tests that require more sophisticated problem-solving skills such as forming hypotheses, making inferences, and drawing conclusions (Dossey, Mullis, Lindquist, & Chambers, 1988; Mullis & Jenkins, 1990). During the same period, the rapid expansion of knowledge and sophisticated technology has made greater demands on workers to adapt and learn quickly on the job. The skills of many of today's students fall short of what is needed for today's jobs (Berryman, in press; L. B. Resnick, 1987).

Findings such as these have generated concern about helping students learn to think more effectively and develop problem-solving skills (Bransford, Goldman, & Vye, 1991; Chipman, Segal, & Glaser, 1985; Nickerson, 1988; L. B. Resnick & Klopfer, 1989). Although many of the earlier programs for teaching thinking focused on general skills and did not emphasize content knowledge (e.g., Feuerstein, Rand, & Hoffman, 1979), current work suggests the importance of integrating the teaching of thinking skills and content (Jones & Idol, 1990; L. B. Resnick & Klopfer, 1989).

A number of educational theorists have begun to emphasize the importance of situating instruction in meaningful contexts that recreate some of the advantages of apprenticeship learning. For example, J. S. Brown, Collins, and Duguid (1989); Collins, Hawkins, and Carver (1991); and Schoenfeld (1988) discussed the importance of restructuring teaching and learning to create cognitive apprenticeships. The Cognition and Technology Group at Vanderbilt (CTGV) uses technology to make apprenticeships more feasible by anchoring instruction in videodisc-based problem-solving environments that students and teachers can explore over extended periods of time (see CTGV, 1990, 1991, 1992a, 1992b, in press). In addition, the CTGV provides evidence that this approach can have beneficial effects (e.g., CTGV, 1992a; Goldman, Pellegrino, & Bransford, in press; Goldman, Vye, Williams, & Rewey, 1992; Goldman, Vye, Williams, Rewey, & Pellegrino, 1991; Risko, Kinzer, Vye, & Rowe, 1990; Van Haneghan et al., 1992).

Interestingly, authors who have written about cognitive apprenticeships and anchored instruction have made only passing reference to a century-old approach to education that also attempts to help students learn both content knowledge and problem solving simultaneously. Called the case method, this approach has been employed in legal and business education. More recently, the case method has influenced the design of problem-based learning, an approach to medical education that focuses on identifying and learning about problems found in actual cases.

The goal of this article is to evaluate existing examples of case-based instruction employing a framework synthesized from current educational
theory, and then to apply the results of this evaluation to suggest research questions for case-based instruction as it is currently practiced and areas in which the educational theories are in need of revision or extension. The first section describes and synthesizes two complementary models of contextualized learning: cognitive apprenticeship (Collins, J. S. Brown, & Newman, 1989) and anchored instruction (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990). The second section describes in detail two examples of case-based instruction: the case method of teaching law and the problem-based learning method of teaching medicine. These examples serve three purposes: First, they are a rich source of information about how to create contextualized learning environments in a school setting. Second, because the two methods are dissimilar, they demonstrate that case-based instruction can take on different forms and be used in different domains. Third, they serve as a context for an analysis of case-based instruction. The final section of the article suggests possible changes for existing methods of case-based instruction taken from cognitive apprenticeship and anchored instruction models, as well as new research questions for educational theorists arising from experiences with the case method and problem-based learning.

A FRAMEWORK FOR EVALUATING CASE-BASED INSTRUCTION

Cognitive apprenticeship and anchored instruction are two models for teaching thinking skills in a contextualized way. Because they both emphasize teaching in the context of realistic problems or cases, they can be viewed as forms of case-based instruction. Cognitive apprenticeship emphasizes the social context of instruction and draws its inspiration from traditional apprenticeships. Anchored instruction provides a model for creating problem contexts that enable students to see the utility of knowledge and to understand the conditions for its use. Together they raise important issues that should be considered when thinking about case-based instruction. The following descriptions highlight aspects of each model that will be synthesized into a framework for evaluating examples of case-based instruction.

Cognitive Apprenticeship

Apprenticeship learning is ordinarily thought of as a way to learn a trade; that is, a job that emphasizes physical more than cognitive skills. It is characterized by learning this job in exactly the same context in which it will later be performed (Collins et al., 1989). It is also characterized by a large amount of practice in performing tasks that are real; that is, that have
economic value and are important to the goals of the business. Because apprentices have the opportunity to practice *in situ* the skills to be learned, they spontaneously adopt the practices of experts in the culture; for example, the way experts think about problems and the jargon they use to describe them.

J. S. Brown et al. (1989) suggested that the practices of contemporary schooling preclude students from learning how experts in a domain perform their jobs. Because apprentices learn while using the same tools and materials that experts use and while performing the same type of jobs that experts perform, they do not have to adapt their learning to a new situation once they complete their apprenticeships. In contrast, students in school are expected to imagine situations in which the skills they learn will be useful and to perform them without tools such as calculators, reference books, or the assistance of others. Therefore the skills learned by students must be transferred to unfamiliar settings before they can be used.

In apprenticeships, the teachers are master craftspeople who are experts at the skills to be learned. They can not only model these skills, but they can show apprentices which skill is appropriate for which job. With their expertise they are able to give apprentices valuable feedback (Collins et al., 1989; Lave, 1977; Rogoff & Gardner, 1984).

In classroom learning teachers are experts in education, but are often novices in the domains to be taught. For example, an elementary-school teacher may understand a science lesson as presented in the textbook but still be unable to either relate the concepts in the lesson to situations in which they would be useful or demonstrate how a scientist would think about the problem. As a result, students acquire knowledge of scientific concepts, but they are unable to utilize it to solve problems in the same way that experts are.

Collins et al. (1989) proposed that characteristics of traditional apprenticeship can be adapted to facilitate learning of reading, writing, mathematics, and other cognitive skills. This approach, *cognitive apprenticeship*, emphasizes how experts use metacognitive strategies and conceptual and procedural knowledge to solve problems in their domains.

**Characteristics of Cognitive Apprenticeship Environments**

Collins et al. (1989) provided four dimensions that can be used to construct or evaluate learning environments for cognitive apprenticeship: the content of instruction, the teaching methods, the sequence of lessons, and the social context of instruction. These dimensions and their characteristics are described in the following paragraphs.
Content of instruction. The content of instruction in cognitive apprenticeship is the knowledge that an expert possesses and demonstrates to students. The goal of instruction is for students to acquire this knowledge. Content is divided into four categories. Domain knowledge consists of the facts, procedures, and concepts that are necessary to solve problems. This is the type of knowledge that is the primary focus of schooling today. Heuristic strategies, or "tricks of the trade," are general procedures that are helpful in solving problems (Polya, 1957). Control strategies are the metacognitive processes that a problem solver uses to monitor and regulate the course of problem solving. They involve generating alternative courses of action and evaluating which ones will make more progress toward a solution. They require that the problem solver understand the goals of a problem and reflect on the overall problem-solving process. Learning strategies are procedures for acquiring new knowledge when the knowledge available is not adequate for problem solving.

Teaching methods. Three teaching methods are the core of cognitive apprenticeship. They are designed to help students acquire and integrate the four kinds of expert knowledge just enumerated. Much of this knowledge cannot be described abstractly and can only be observed during problem solving. Therefore students need the opportunity to see experts perform and to practice problem solving themselves. In cognitive apprenticeship, this opportunity is provided through the teaching activities of modeling, coaching, and scaffolding.

Modeling consists of a demonstration by an expert of the process of solving a problem. This demonstration must make the use of cognitive and metacognitive processes explicit. Modeling allows students to obtain a complete mental picture of the process they are learning. By talking aloud or writing on a chalkboard while solving problems, the teacher demonstrates how heuristic and control strategies work. Modeling also reveals that sometimes experts must try many strategies in order to solve unfamiliar problems.

Coaching involves observing students in action and providing immediate feedback. The feedback is not general or abstract, but refers to specific actions of the students as they solve problems. By watching students in action, teachers can identify and correct misconceptions involving concepts and procedures.

Scaffolding refers to providing some kind of assistance so that students can accomplish a task that they would not be able to carry out without help (Vygotsky, 1978). The assistance can be cues such as suggestions or questions from the teacher, or tools such as calculators. Although students may carry out only pieces of the task, the mental model of the entire process
provided by the teacher's modeling allows students to understand where their pieces fit. Fading consists of gradually removing assistance so that students perform the entire task on their own.

**Sequence of lessons.** The *sequence of lessons* should be chosen to support student needs at different stages of learning. Initial tasks are selected so that students acquire an overview before learning details. This is accomplished by initially selecting either a simple problem that students solve alone or a more complex problem, and asking students to carry out only a simple part of the solution. Increasing diversity is an additional method of sequencing tasks. Initial tasks are similar in order to provide an opportunity for practice. More diverse tasks are gradually added so that students learn to recognize the conditions under which certain skills are useful.

**Social context of instruction.** The *social context of instruction* should foster interaction between students and experts so that students do not merely watch an expert perform a task, but are drawn into the problem-solving process. One way of achieving this interaction is through cooperative problem solving in which students work together to solve a complex problem. Computers (Scardamalia, 1991) can also encourage students to share their ideas by posting them on electronic bulletin boards. Another strategy for encouraging interaction is peer tutoring, in which students take turns teaching each other (Palinscar & A. L. Brown, 1984).

**Authentic Activity**

J. S. Brown et al. (1989) distinguished between *school activity* and *authentic activity*. Authentic activities are coherent, meaningful, and purposeful. They represent the activities that members of a culture ordinarily practice. In the authentic activities pursued by traditional apprentices, problem contexts are rich and complex. These problem contexts include tools, other people, and an elaborate setting. The authentic social and physical context provides support for problem solving. When these problems are adapted for use in the classroom, their contexts are changed and this complexity is stripped away.

Students solving classroom problems demonstrate different behaviors from those that are used to solve authentic problems. They may rely on classroom heuristics such as: All the problems in this chapter use the same formula, or the easiest problems are at the beginning of the set (Schoenfeld, 1985). Collins et al. (1989) even purport that the real skills in expert problem solving are unspoken, and thus lost to formal education, because they only arise from solving problems *in situ*. Even if these skills
can be explicitly stated, they are fully understood only in the context of problem solving.

The major limitation of apprenticeship learning is that it produces knowledge useful for solving authentic problems only if it occurs in the context of authentic problems. However, J. S. Brown et al. (1989) and Collins et al. (1989) offer no explicit suggestions for creating authentic problems for the classroom, and few ideas can be drawn from their instructional examples. In order to complete the picture of contextualized learning environments, a model for constructing and evaluating problem contexts must be added. This model can be found in anchored instruction.

Anchored Instruction

The term anchored instruction is used to describe an approach in which the study of many concepts and skills is situated in a single context for an extended period of time (Bransford, Sherwood, et al., 1990). These complex contexts are called macrocontexts. The primary goal of anchored instruction is to overcome the inert knowledge problem. Whitehead (1929) contrasted inert knowledge, which can be remembered only when people are explicitly asked to do so, with a more useful form of knowledge that is spontaneously used to solve problems. When students learn new information while solving a problem, they are more likely to use it to solve other problems (Adams et al., 1988). They understand that the information is a tool for solving problems and know what type of problems it can be used to solve.

Macrocontexts

Students may not learn to carry out authentic activities because the simple problems that they are usually given do not require them. It is not likely that students would see the need to collaborate on a problem whose solution requires only the retrieval of a single memorized fact. Likewise, there is no need to generate and monitor a solution plan when a problem's solution requires only one step. The simple problem contexts used in school tasks often do not demonstrate the usefulness of authentic activities. Macrocontexts provide the opportunity for authentic activities such as collaborating with other students or generating and monitoring a problem-solving plan.

All macrocontexts provide a setting for problem solving that is realistically complex. In this context, the term complex refers to a problem whose solution has many interrelated steps. The individual parts are not necessarily difficult, but the number of steps and their interrelatedness can make problem solving complicated.
Because of their complexity, macrocontexts encourage students to carry out authentic activities such as planning and collaboration by demonstrating their usefulness. These contexts make planning useful, because they present problems that can only be solved by generating and sequencing multiple subgoals. Collaboration is also made meaningful when there are many subgoals to be accomplished, and no one individual possesses the information necessary to accomplish all of them.

Managing Complexity

Complex problem contexts are difficult to communicate, and one reason for the lack of classroom emphasis on these types of problems may be that teachers are unable to present complexity in a way that is understandable and motivating (CTGV, 1991). Macrocontexts are designed with features that make complexity manageable, including using a story format, video presentation, embedded data, and real-world accuracy.

The first feature for managing complexity is that the problem in a macrocontext is presented as a story. Stories involve a format that is relatively well understood, even by middle-school students (Stein & Trabasso, 1982). The story structure includes a main character who has a goal and who encounters some obstacle to achieving the goal. This familiar format makes it easier for students to generate a mental model of the overall situation, and helps them understand and remember the problem. There is one major difference that distinguishes a macrocontext from a well-formed story: No resolution to the main character's problem is initially provided to students. Instead, they must solve the problem and determine for themselves what the outcome will be. After students construct their own solutions to the problem, they can see an expert's solution and compare it to their own.

The second feature of macrocontext for making complexity manageable is the presentation of stories using video rather than text. Teachers who use video macrocontexts comment that they are particularly valuable for students who are poor readers (CTGV, 1991). Students can more easily form a mental model of the problem situation when it is presented in dynamic images rather than text (McNamara, Miller, & Bransford, 1991). Using video, information can be presented through a variety of modes: pictures, sound effects, actions, and written and spoken words. This variety provides an opportunity for students to practice noticing and combining data that is presented via several different media.

The third feature of macrocontexts that reduces complexity is that all of the necessary data for solving the problem is in the story. This is unlike real-world problems in which data may have to be acquired from secondary sources or in which some data may never be available. Making all the data available within the problem context eliminates uncertainty and simplifies the problem.
The fourth property of macrocontexts that reduces complexity is accuracy with respect to real-world knowledge; for example, the weight of objects in a context used for science instruction accurately portrays the weight of these objects in the real world. This accuracy allows students to use background knowledge and information from previously solved problems as tools for solving macrocontext problems.

**Assessment in Complex Contexts**

Because the standardized assessments used by schools test students on factual knowledge and isolated skills, teachers who prepare students to take these tests tend to focus on the same content. These traditional approaches to assessment promote a kind of teaching that is incompatible with the goals of cognitive apprenticeship and anchored instruction (Frederiksen & Collins, 1989; Goldman et al., in press; L. B. Resnick, & D. P. Resnick, 1991).

Apprenticeship learning calls for new kinds of assessment that are anchored in authentic tasks and that test students’ ability to ask important questions and plan solutions to complex problems (Frederiksen & Collins, 1989; Goldman et al., in press). In order for students to learn, initial instruction and assessment must be followed by feedback that includes suggestions for improving performance. This cycle of instruction, assessment, and feedback must then be repeated so students have the opportunity to improve their performance. Once they understand the goals of the assessment, they can begin to assess their own performance. The results of assessment can also be used by teachers to modify instruction during subsequent cycles so that it is better suited to the needs of current students.

**A Framework for Comparing and Evaluating Methods of Case-Based Instruction**

By combining the characteristics of cognitive apprenticeship and the features of macrocontexts of anchored instruction, a framework can be constructed for evaluating instances of case-based instruction. It is intended to be a set of issues raised by the models, against which the case method and problem-based learning approaches can be evaluated. This framework is in the form of 10 questions to be asked about specific examples of instruction.

**Teaching and Learning**

1. Does instruction begin with a problem to be solved?
2. Does the teacher model expert problem solving in the context of a complex problem?
3. Are students given the opportunity to engage actively in solving
problems, and does the teacher provide specific immediate feedback while students are solving problems?

4. What type of scaffolding is used to support students as they solve problems?

5. Does instruction emphasize metacognitive strategies as well as domain knowledge?

6. Are there frequent opportunities for both teacher and students to assess how well learning is progressing? Is the type of assessment used appropriate for measuring the skills that are taught?

Materials and Curriculum

7. Are the problems authentic; that is, are they ones that would be solved by practitioners?

8. Are the problems realistically complex? Do their solutions involve multiple steps? Are the settings rich and detailed? Are multiple skills and concepts linked to each problem?

9. Are the problems presented in a way that makes complexity manageable; for example, using a story format, presenting them on video, and providing all relevant data?

10. Are problems sequenced to support students' needs at different stages of learning?

In the next section, two examples of case-based instruction are discussed and evaluated: the case method of legal education and the problem-based learning method of teaching medicine. In the final section, the issues raised by this evaluation are used to propose possible changes for case-based instruction and, in turn, to suggest areas in which further research is needed to augment or refine educational theories.

EXAMPLES OF CASE-BASED INSTRUCTION

Recent educational theories that emphasize the importance of situating instruction in meaningful contexts have attempted to identify the positive features of apprenticeship learning and use these features as the basis of a new approach to instruction. However, it may be difficult to imagine how this approach could be implemented in a classroom, and how it might work if it were used to deliver all instruction over an extended period of time. The originators of the case method of legal instruction and the problem-based learning method of medical education have also sought to bring the advantages of apprenticeship learning into the classroom. Because these methods have been used for long periods of time and because they deliver instruction in different ways, they provide an interesting variety of ideas for implementation as well as opportunities to learn from experience.
The case method and problem-based learning are described in detail in this section. The discussion of each method follows the same format. First, a history of each method is included in order to show how the method is particularly suited for teaching each domain and how it has been adapted over the years to meet various demands. Next, the method itself is described by presenting a sample case and describing the roles of the teacher and students in solving it. This is followed by a description of the different types of case materials that have been created. The description concludes with an evaluation of the method from the perspective of the teacher, the student, and research. Following this description, the method is critiqued using the framework developed in the previous section.

Legal Education

The predominant method of legal education in the United States is the case method. It began as an informal system of apprenticeship, became institutionalized in the late 19th century, and is now used in almost every law school in the country. The case method is popular because teachers and students believe that it is an effective way to learn an ill-structured domain, that is, one that does not have a consistent underlying theory that can act as a structure for organizing knowledge.1,2

The case method of teaching law is a type of case-based instruction that is characterized by teacher-led, large-group discussions. Students learn the rules of law through the process of preparing briefs of appellate court cases and presenting these briefs in class. The point of view of the student who presents is challenged by the professor. Through questions and comments, the professor highlights the important features of the case, as well as any errors the student may have made. The classroom has an adversarial atmosphere, similar to the courtroom for which the students prepare.

A Brief History of the Case Method

Credit for the creation of the case method is given to Christopher Langdell, who became dean of Harvard Law School in 1870 (Redlich, 1914). The invention of the case method and its widespread adoption by law schools can be traced to two factors: the epistemology of the legal system in the United States and dissatisfaction with previous methods of legal education.

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1There are few modern publications characterizing pedagogy in law school. Therefore, the available information has been supplemented by interviews with teachers, lawyers, and law students, as well as observations of case-method classes.

2The case method has also been adopted for use in business schools in a form almost identical to that in law schools. Because of the similarity, it is not covered in this article. For further information the reader is referred to Christensen (1987) and McNair (1954).
In order to understand how law in the United States is uniquely suited for the case method of instruction, it is necessary to understand how the law is formed. In the United States, law is based upon English common law, a system in which law is made by judges rather than legislatures. Early in the days of English law and courts, there were no written laws. The judges were granted authority by the king to make decisions based on the unwritten laws and customs of the community. When a large number of judges had made the same decision in similar cases, the decision became common law, an unwritten rule that existed only in the records of cases. Concepts in common law are by their very nature inconsistent. Community customs change, and as they do, common law evolves (Holmes, 1923). In the United States, common law has been augmented by the Constitution as well as the adoption of various statutes and codes, but these rules do not make up a well-organized body, nor do they attempt to cover all of the law (Llewellyn, 1930).

Students must go to the cases for the common law because in many situations it is the only record of the law, and because the handling of cases is a practical skill that is required of every lawyer (Redlich, 1914). From an epistemological perspective, law is much like history; it lacks a comprehensive theory that allows a professor to present information easily in an abstract form. In the absence of theory, it is necessary to learn the law through the study of specific cases (Reed, 1921).

The two most prominent methods of training lawyers before the advent of the case method were apprenticeship in a private law office and study at a private law school using the lecture method. The legal apprentice of 1870 worked in the office of a practicing attorney in order to observe the lawyer at work and to read the books in his library. The strength of this training was its practicality, that is, apprentices had a thorough understanding of what the job of a lawyer was like. Its weaknesses were a lack of consistency and completeness. Apprenticeships varied greatly in thoroughness and quality, depending on the teaching abilities of the lawyer, the amount of time devoted to the apprentice, the size of the lawyer's library, and the types of cases that were handled in the office during the apprenticeship (Hurst, 1950; Redlich, 1914; Stevens, 1983). In addition, the training typically lasted only a short time.

Instruction in private law schools prior to 1870 was conducted by lecture and recitation. Although the lecture method was consistent and thorough, it was criticized as lacking in practicality (Stevens, 1983). It was also suggested by some that knowledge presented by lecture was not remembered, whereas knowledge acquired as a result of effort was understood more thoroughly and remembered (Keener, 1892).

The case method was seen by some as a compromise between the two existing forms of instruction, that is, a controlled way of delivering
clinical legal education (Chase, 1981). It did offer fewer inconsistencies than apprenticeship and greater practicality than the lecture, but it was not a panacea. Time revealed that it was not a compromise, but actually a new form of instruction with its own strengths and weaknesses.

Initially the case method was considered to be controversial for many reasons. First, many advocates of the lecture method felt that the case method presented the law in detached fragments. Students needed the overview and explanations that a properly prepared lecture could provide. Second, students just beginning the study of law by the case method went through a much longer initial period of confusion than those learning by lecture (Holmes, 1886; Llewellyn, 1930; Redlich, 1914). Third, learning substantive knowledge via the case method was very slow (Llewellyn, 1948; Reed, 1921, 1928). Fourth, classes were dominated by a small number of more able students, and the majority of students did not benefit as much from class discussion (Redlich, 1914). Finally, the method just was not practical enough. Students learned to think like judges, but they were not trained to handle the identification and definition of problems that lawyers faced as they acquired new clients and new situations (Redlich, 1914).

In spite of all these criticisms, the case method continued to spread. The most important and most incontrovertible reason for adoption of the case method was the feedback both from law schools that used the method and from practicing lawyers who had been educated by it. Even the most avid critics of the case method found it had undeniable strengths. After studies in 1914 and 1921 by the Carnegie Foundation for the Advancement of Teaching, the foundation gave their qualified approval to Langdell’s system. Further criticism only sought to modify or supplement it (Patterson, 1951).

*Teaching and Learning in the Case Method*

Students in a case-method law class acquire basic knowledge of law and the thinking skills important for lawyers by studying selected cases from the records of appellate courts. The classic case-method class uses a “sink or swim” approach in which no preliminary substantive knowledge of law is possessed by students when they approach their first case. Students individually read the assigned cases and prepare summaries of them. Students present their summaries in class and are questioned by the professor to insure that each case is completely covered.

*The case.* Law students’ introduction to the case method begins before their first day of class as they study an assigned case taken directly from the records of an appellate court. These records are written by the presiding judge and contain summaries of the facts of the case, the decision of the
court, and the reasons for that decision. The assignment for each day’s classes is typically 30 to 50 pages of appellate decisions edited to varying degrees. There is no overview, no attempt to place this case within an area of law, and no definition of terms. The assignment directs the students to read the case carefully and prepare a brief.

The following hypothetical case has been created as an example. Although every attempt has been made to make it accurate with respect to the law, it is intended to be used for a pedagogical discussion, and it lacks the level of detail and type of vocabulary found in actual cases.

*State v. Jones*
District Court of Appeal of Tennessee, 1990.

PER CURIAM: By information the appellant was charged with one count of aggravated burglary (T.C.A. §§ 39–14–403). On trial the defendant was convicted. The defendant appealed that conviction.

The defendant Jones was apprehended inside the Brown residence at 7:12 p.m. on September 15, 1990. Brown was in another part of the house, heard a noise, and called the police. When apprehended, Jones surrendered peacefully.

The defendant appeals, contending that the evidence is insufficient to justify the crime of burglary because there was no evidence of theft or intent to commit a theft.

The elements of the crime of burglary are an unlawful entry with intent to commit a felony or theft, or the attempt or commission of a felony or theft. It is almost universally held that a jury may infer an intent to steal from a nighttime breaking and entering when the defendant can offer no other explanation for his presence. [Citations omitted.] This is based on a common-sense rationale that every nighttime burglar, if caught before he could commit the crime, would be guilty only of unlawful entry.

Affirmed.

New law students have no training in preparing a brief. Although they may realize the goal is to summarize the case, the vocabulary is confusing and they are probably not sure exactly what are the issues and relevant information. Scott Turow (1977), in an autobiographical account of his first year in law school, described the experience of preparing his first brief this way:

It was 9 o’clock when I started reading. The case is four pages long and at 10:35 I finally finished. . . . I had no idea what half the words meant. I must have opened Black’s Law Dictionary twenty-five times and I still can’t understand many of the definitions. There are notations and numbers
throughout the case whose purpose baffles me. And even now I'm not crystal clear on what the court finally decided to do. (p. 23)

**Preparing the brief.** In order to complete their assignment, new students must analyze the case to identify and summarize the important information. They must do this with the knowledge acquired before coming to law school. If there are things they do not understand, they are expected to identify, research, and study them before class. The case method, according to James Barr Ames, a professor in the early days of Harvard Law School, is a "virile" system. It does not treat students as children reciting their lines. The case is a problem that they must solve by themselves (Stevens, 1983).

The first source students consult will usually be the casebook itself. Many casebook authors annotate cases with footnotes that highlight important facts or elaborate legal arguments (Ehrenzweig, 1944; Harno, 1953; Inbau, Moenssens, & Thompson, 1987). Most cases will require that the student look for information in places other than the casebook. Another major source is the library, where students can find legal dictionaries, encyclopedias, textbooks, statutes, and treatises to help them understand the case. It is said that law students place more demands on the library than any other type of students (Chase, 1981). Although the use of ready-made or "canned" briefs is frowned upon for beginning students, they are available for many cases (Kinyon, 1971).

The brief is expected to contain the type of action, the issues, the relevant facts, the decision, and the reasons for that decision (Kinyon, 1971; Llewellyn, 1930). The type of action identifies the category in which this case is placed. The example case is a criminal case involving burglary; that is, the state has decided that the features of this case fit the category burglary. In order to understand why this decision was made, students need to find out the exact definition of this category. Although parts of the definition are present in the case itself, they must go to a source outside the casebook to find out all the details of burglary.

The issues in an appellate case are the questions of law that form the basis of the appeal. The issue in the example case is whether or not intent to commit a felony or theft can be inferred without direct evidence. There may have been other issues present in the original trial, but only those stated in the appeal are considered by the appellate court. Therefore, the process of identifying the issues in these cases is already completed for students. Their primary task is to understand the issues, not to find them.3

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3The case method in legal education is regularly criticized because it fails to give students practice in identifying and defining issues (Harno, 1953; Hurst, 1950; Llewellyn, 1930; Wilson, 1989).
A brief must also summarize the facts of a case: Who were the parties and what happened to them? Who brought suit? What happened in the lower court? Who appealed? What were the grounds for the appeal (Kinyon, 1971; Llewellyn, 1930)? Once again, in appellate cases, this process has been largely completed for students. By the time the case reaches the casebook, the facts have been thoroughly sifted (Harno, 1953; Llewellyn, 1930). First, the prosecution and defense lawyers sort the facts, presenting only information favorable to their positions. Next, the lower court judge makes a decision on what is admissible. Then, the lower court judge or jury interprets ambiguities. After appeal, the appellate judge writes the opinion, selecting only those facts important to the opinion. Finally, the casebook author edits the opinion to include the portions important for the pedagogical point being made. After this filtering process is complete, there is little irrelevant information left, and the cases often appear more regular and uniform than real-life cases (Llewellyn, 1930). Given practice in this type of context, it is not surprising that law-school graduates are often inept in dealing with the raw facts (Harno, 1953; Wilson, 1989).

The final part of a brief contains the decision of the appellate court and the reason for that decision. In the example case, the appellate court affirmed or upheld the decision of the lower court. In the example case, the reason given was precedent—previous courts held that if a person entered another person's house at night without consent, it was reasonable to assume that felony or theft was intended. It is important to note that by studying adjudicated cases, students are studying solutions to problems, not how to solve problems (Cavers, 1943). The fact that the answer is provided along with the problem leads to focusing on the substantive aspects of the law and not the solution process (Llewellyn, 1948).

The goal of preparing the brief is to formulate a rule and to understand how it applies to the particular set of facts in a case. If previous cases have been studied, students should try to match them to the new case, note their similarities, and determine if the new rule applies to them. The process of analyzing and studying the cases before they are discussed in class is essential to the case method (Llewellyn, 1941; Reed, 1921).

The class. Typical 1st-year law students meet in class 12 to 15 hr per week in amphitheater-type classrooms with 50 to 200 other students (Cavers, 1943). Discussions are led by a professor who begins by calling upon a student to present a summary of the assigned case (Hurst, 1950). Few students volunteer, and the professor uses a seating chart or class roll to choose a presenter (Stevens, 1973). Writing and presenting a brief tests students’ ability to analyze, summarize, and communicate the important information in a case (Baird, 1978).

After the initial presentation of the case, the professor asks questions of
the presenter or other students to elicit information that may have been omitted or to clarify points that were vague or in error (Cavers, 1943). These questions are designed to test the students' abstraction of the rules of law that are important to the particular case (Hurst, 1950; Llewellyn, 1930, 1948; Redlich, 1914).

Next, the professor asks a series of questions designed to assess the quality of the decision made by the court. For instance, in the example case, if nighttime is required for a jury to infer intent to commit a felony, how can one be sure that it is nighttime at 7:12 p.m. on September 15? The appellate judge in the example case ruled on the basis of the nighttime element without defining it. In this series of questions, the professor moves from understanding what was done to evaluating the quality of the decision. Students are trained not to accept the opinion of a judge as inviolate (Patterson, 1951). Lawyers must be able to identify fallacies in the reasoning and research of lower courts in order to appeal unfavorable decisions.

Last, the professor presents a series of related hypothetical cases that represent variations or perturbations of the original case (Hurst, 1950; Llewellyn, 1948). These hypothetical situations help define the boundaries between those situations where the rules apply and those where they do not.

Here are hypothetical cases related to the example State v. Jones (1990):

1. If the house were a camping trailer, does the charge of aggravated burglary still apply? (Yes, if it were occupied at the time.)
2. If Jones were apprehended on the patio, instead of inside the house, should the charge still be burglary? (No, entry into the house is a required element of the crime burglary.)

The hypotheticals are presented as questions, not as a lecture. Students are called on to apply their knowledge of the rule to the hypothetical case. These questions are extremely important to the case method, because it is here that students have the opportunity to apply their knowledge actively and to explain their reasoning.

Discussion in a case-method class is considered to be an application of the Socratic method (Stevens, 1983; Wilson, 1989). The goal of a Socratic discussion is to reach a true and universal definition of a concept. In a Socratic case-method class, the professor does not lecture but rather asks a series of questions designed to show students that their answers are inadequate. The questions also attempt to lead students from an inadequate definition that applies to only one case to a universal definition. Although the idea that universal concept definitions exist or that humans reason with them has largely been abandoned (see, e.g., Rosch & Mervis, 1975; Smith &
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Medin, 1981), the goal of abstracting a more general rule from a specific situation is extremely important for the transfer of knowledge to new situations. The Socratic method is also intended to demonstrate that every student makes assumptions about a case, and that those assumptions lead to a particular course of action that is often in error. By continually pointing out these assumptions and the errors they cause, Socratic teachers train their pupils to avoid them (Morgan, 1951). Because the Socratic method of questioning is extremely time consuming (Harno, 1953; Stevens, 1983), it is sometimes replaced by summaries following the discussion of the main case. Unfortunately, these summaries rob students of the opportunity to apply their knowledge actively and receive feedback on their performance.

When the professor continually asks questions that students cannot answer adequately, they are often demoralized. Although few professors are as sadistic as Kingsfield in the popular movie The Paper Chase, the method has been criticized for being demeaning and for producing hostility (Stevens, 1983; Stone, 1971). The case-method classroom is adversarial; students must face a critical examiner and in public explain their position, have it challenged, and support their opinions. This training is in many ways similar to the courtroom environment in which the students will later work.

Materials and Curriculum in the Case Method

Cases and casebooks have changed a great deal over the past 120 years. The goals of these changes were either to allow cases to be covered more rapidly, or to make the cases easier for students to understand.

Sequence of cases. When Langdell selected cases for his class on contracts in 1871, he emphasized cases that had contributed to the development of rules of law (Harno, 1953; Ogden, 1984). A primary disadvantage to this approach was that it wasted time, because students would often be required to study cases that had been overturned (Patterson, 1951; Stevens, 1983). In some areas, the chronological approach did not work because the interdependence of concepts did not provide a good starting place (Patterson, 1951).

The curriculum was soon reorganized to change the chronological sequence of cases to one organized around basic concepts. This is illustrated by the nine casebooks written by Ames, a student of Langdell who later became a professor at Harvard Law School. Ames's cases were grouped by concept or subject rather than chronologically, and were chosen for their "striking facts and vivid opinions" (Stevens, 1983, p. 56). This organization is still in use because it saves time. Also, the emphasis on interesting, memorable cases has important pedagogical advantages (Patterson, 1951). Finally, by grouping cases in this way, students have a better opportunity to
generalize concepts. However, this division of case law decreases students' chances of integrating concepts from different areas (Harno, 1953; Llewellyn, 1930) and implies that the acquisition of general concepts is more important than skill in applying those concepts (Bryden, 1984).

Editing of cases. In Langdell's casebook, the entire record of each case, including the arguments of the attorneys, was included. Today, in order to include more cases and to cover them more rapidly, the court records used in casebooks are severely edited (Harno, 1953). This editing makes the cases more abstract and more difficult to understand, especially for untutored students who have only common knowledge to aid in their study (Llewellyn, 1948).

Without detailed fact situations, arguments, and the complete opinion, students cannot follow the reasoning that led to the decision in the case. When they cannot understand the reasoning, the emphasis shifts from analytical thinking to fact acquisition (Harno, 1953). The lack of detail also hampers the professor in the construction of hypothetical cases and other extensions of the cases in the casebooks. One form of casebook that tries to alleviate these problems and still cover a large amount of material is called the case digest. This format contains some full-length cases that are followed by highly abbreviated related cases (Ehrenzweig, 1944).

Annotations and supplementary material. In the early textbooks there was no supplementary material, only the text from the court records. Students who needed assistance consulted textbooks, treatises, or their professor. By the early part of the 20th Century, notes of several types were added to casebooks because professors feared students would merely memorize the cases and be unable to abstract the rules from them (Redlich, 1914). Case-method purists objected to including help in the casebook itself because they believed that students must be taught to figure out the law for themselves (Stevens, 1983).

There has been a general trend to include more noncase material in casebooks. Those who advocate this supplementary material believe that it highlights the complexity of the law and gives students more insight into the forces that shape law and affect its practice. Sometimes, the annotation provides a context for the case material that makes it easier to understand (Harno, 1953).

Annotations to cases have two main disadvantages. First, by highlighting the important parts of a case, students have no need to think for themselves and lose the advantages of generating their own answers. Second, annotations make a casebook inflexible to use and difficult to modify. Professors need to be able to pick and choose cases that are appropriate for their students' ability (Llewellyn, 1941).
Completeness of coverage. When choosing cases for casebooks, authors must be concerned with how completely they cover the subject area. In new areas of law, it is possible to offer complete coverage of concepts; for example, a casebook on the law of insurance published in 1914 was fairly complete. When the second edition of the book was published in 1931, there were 2,000 cases on the books, and they were increasing at the rate of 1,600 per year. At this point, completeness had to be abandoned (Ehrenzweig, 1944). Although completeness has been abandoned in most areas of the law, no standard method of selecting cases to be included has been developed.

Another aspect of completeness is whether or not multiple cases are provided on a single point. As previously discussed, a unique feature of the case method in law is the use of multiple cases of a concept to aid students in the abstraction of general rules. Although it is possible to use hypothetical variations on a real case, some casebooks assist the professor by providing several real cases on important points (Stevens, 1983).

Adoption of other teaching methods. Learning substantive law through cases was slow.4 As the number of recorded cases grew, it was not possible to teach all the material thoroughly by the case method in the time available. Many methods were used to speed up the pace of teaching with cases. Professors and students freely used textbooks to supplement the study of cases (Redlich, 1914). Many presented the basic case and followed it by a summary or a list of other suggested cases (Redlich, 1914). Other activities that allowed instruction to move more rapidly were occasional lectures, a large amount of outside class assistance by the professor, and research in the library (Redlich, 1914; Reed, 1921).

Over the years there has been little modification of the content of the 1st-year curriculum (Powers, 1986) or of the use of the case method as the basis of instruction (Morgan, 1951). Although law schools now claim that the primary reason for using the case method is to teach students strategic rather than substantive knowledge, in the 1st year both are acquired simultaneously through the analysis of cases. In the 2nd and 3rd years, seminars and electives are introduced to allow greater coverage of material (Hurst, 1950).

The Role of the Teacher in the Case Method

In spite of the fact that students are actively involved in the Socratic dialogue of a case-method class, professors are still the authoritative focus

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4It can be shown that the appearance of the case method at a law school was almost invariably associated with a longer program (Stevens, 1983).
of attention (Stone, 1971). The success of the case method is highly dependent on the professor's performance (Morgan, 1951; Reed, 1921). If the professor cannot articulate in advance what the students are meant to learn from the cases and create a context in which they are likely to learn it, then the instruction will fail (Llewellyn, 1948).

In the first semester of law school, there is a period of interest and attention that helps even an average professor to lead a class. This attention begins to fade by the second semester and the professor has to carry the method rather than the other way around (Bunn et al., 1944). At this point, the method becomes a dialogue between the professor and a few bright members of the class who either enjoy improvising or feel that it is necessary (Turow, 1977).

The case method at Harvard was introduced as a practical alternative to the lecture, and, to insure that this was true, the Harvard Board of Overseers always made certain that practitioners as well as professional educators were represented on the faculty at Harvard (Stevens, 1983). When the case method was exported to other schools, this custom was not maintained, and this lack of practical experience in the faculty caused a commensurate lack of practical preparation in the students (Stevens, 1983). In addition to lacking practical experience in the law, most professors lack preparation as educators and find issues of pedagogy largely uninteresting (Wilson, 1989).

The Effect of the Case Method of the Student

The most frequent complaint about the case method is its perceived tendency to demean or degrade the students (Stevens, 1973). Students find that the case-method class is not like the supportive environment they were accustomed to as undergraduates. Most students find the atmosphere hostile and combative, and note that the method creates anxiety for themselves or others.

The next most frequent complaint is a sense of confusion, aimlessness, and inconclusiveness. This complaint is a reoccurring theme in the literature on legal education. It was mentioned by Holmes (1886), and by Redlich (1914), who said, “if first attempts are all difficult, this is especially true of legal education by the case method” (p. 29). Many professors explain that it takes a long while before the good effects of this teaching method are evident. After their first few weeks in law school, students feel that classes begin and end in a jumble. They feel that they are involved in a kind of gameplaying similar to hide-and-seek in that the professor knows what to do but will not tell the students. Many students think that more guidance is needed by the professor, but even those who mention
some of the positive aspects of lectures do not want to adopt them (Stevens, 1973).

Other frequent complaints are that the pace of the case method is too slow (Hurst, 1950; Llewellyn, 1930, 1948) and that the format is repetitive in nature (Stevens, 1973, 1983). A former chairperson of the Association of American Law Schools Curriculum Committee protested that “legal education is too rigid, too uniform, too narrow, too repetitious, and too long” (Stevens, 1973, p. 553).

It is important to note that students, in the beginning, find the case method very stimulating (Stevens, 1983), and it is the exclusive use of this method that causes complaints (Cavers, 1943; Harno, 1953; Wilson, 1989). Boredom with the case method is found primarily in the 2nd and 3rd years (Harno, 1953; Llewellyn, 1930, 1948; Stevens, 1983). Comments on a 1935 evaluation of the curriculum by students at Harvard suggested that the case method should be dropped or modified in the 2nd and 3rd years to include lecture, real discussion, and law review for all students (Stevens, 1983). Many schools have adopted this type of program (Hurst, 1950; Llewellyn, 1930; Ogden, 1984).

Although the goal of the case method is to involve students in the active exploration of problems with the guidance of the professor (Harno, 1953), only a handful of students can actually participate in classroom discussions (Cavers, 1943; Stevens, 1973). If everyone is supposed to benefit from the case method, then an implicit assumption must be that listening to a question followed by a discussion among novices improves everyone’s ability to think. The idea that everyone learns the same thing in a large case-method class is erroneous (Bryden, 1984; Ogden, 1984). For some, the experience is incomprehensible because they do not grasp either the perceptions or misconceptions of the speakers (Bryden, 1984).

Some students are not active in the case method. They do not study the cases or even the textbooks that are suggested to accompany them. Instead, they read “canned briefs,” that is, prepared summaries of the cases and their meaning. In class, they avoid participating in the discussion by not answering when called upon, or by not attending when they think they will be called upon to present the case. They do not always pay attention when they are not the target of the instructor. They do not gain the same cognitive skills when they are not doing the problem solving (Llewellyn, 1930; Wilson, 1989).

The belief that the case method primarily benefits the unusually bright and able who participate in class discussions (Cavers, 1943; Stevens, 1983) creates a problem with respect to educating average students who can handle only the basic brief and simple questions (Cavers, 1943). For many law schools, the answer has been to avoid the problem by raising the entrance requirements (Stevens, 1983).
Assessment in Case Method Classes

There is little variety in assessment in the case-method class. The standard procedure is a written final exam at the end of the semester. Examinations are almost never given during the semester because the large class size makes scoring them prohibitive.

Examinations at the end of the semester usually consist of problems rather than actual cases. Students are asked to apply case law to a hypothetical situation created by the professor (Bryden, 1984; Llewellyn, 1930; Ogden, 1984). The problems are followed by either a list of objective questions or an open-ended question (Llewellyn, 1930). Objective questions are used when the professor wishes either to cover large amounts of material or to constrain the students' answers to a specific topic. An example of an objective question would be, "Are Langdell's briefcase and its contents admissible at a trial against Langdell?" An open-ended question would be, "Discuss the crimes committed by each of the people involved in this situation," or "What advice would you give your client?"

The emphasis is not on creativity. Students are graded on the ability to remember and apply substantive knowledge to the problem (Bryden, 1984). The powers of memory, orderly thinking, and thoroughness are most rewarded (Wilson, 1989).

In order to be licensed, prospective lawyers must pass a bar examination given by the state in which they plan to practice. Most law-school students take this test, so it is not surprising that law schools are interested in how their graduates perform on them and that they try to prepare them to take this test (Stevens, 1983). Bar examinations vary from state to state, but the type of hypothetical problem that is used in case-method classes often is used in the bar examination.

One of the chief complaints that lawyers have about the preparation they received in law school is the lack of written assignments. The large class size makes it impossible for professors to read and give feedback on this type of assessment. Law-school examinations are normally given in 2- or 3-hr blocks of time, and students therefore do not have the opportunity to organize and polish their writing.

Research on Legal Education

Modern empirical research comparing types of legal education is sparse (Stevens, 1983; Teich, 1986), and publications discussing legal education are for the most part polemic (Stevens, 1973). In a survey article, Teich (1986) cited only six published empirical studies since 1960. These studies found little difference in the effects of the case method and lecture. Teich (1986) believed that poor experimental design contributed to the number of comparisons resulting in nonsignificant differences.
Analysis and Critique of the Case Method

**ANCHORING INSTRUCTION IN CASES.** Instruction in the case-method class always begins with a problem to be solved. The method takes an extreme view with respect to this principle and provides no advance instruction on basic skills, as well as very little information on what the student is expected to do. This lack of preparation results in a great deal of frustration on the part of the new student.

**Modeling.** In the practice of law, attorneys take opposing points of view on the same case. When presenting his or her brief of a case in class, a student adopts a point of view and the professor takes an opposing point of view in order to find flaws in the student's argument. Thus, the class itself serves as an informal model for legal debate. (Formal debates conducted in courtrooms have strict rules of procedure that must be followed. Classroom debates are not subject to these rules, so students have no models for this type of argument.) In addition, professors provide a model of legal thinking via the questions that they ask students about case summaries (Morgan, 1951). There are other aspects of the practice of law for which models are not provided as a regular part of instruction; for example, students do not have the opportunity to see faculty interviewing clients or witnesses.

**Active Engagement.** Students in a case-method class are actively engaged in preparing briefs of assigned cases. However, understanding the opinions of judges contained in court records is only one of many skills that students need to learn. Students do not have the opportunity to solve legal problems themselves because the cases they study have already been solved. They have few opportunities to present the briefs that they prepare due to the large number of students in each class. The majority of students simply listen to the discussion, receive no feedback, and soon lose the motivation to prepare for class.

**Scaffolding.** In the case method, the primary scaffolding comes from the questions and comments of the professor. These questions focus attention on important features of the current case and draw connections between the current case and previous cases. A second important source of support comes from group discussions of cases in class. These discussions externalize the problem solving of the professor and other students so that they may serve as models. Class discussions also distribute the responsibility for the solution of problems among all students.

**Metacognitive Strategies.** In order to be successful problem solvers, students need to learn standard strategies for solving problems. Although
good problem solvers exhibit these strategies automatically, it may be necessary to provide direct instruction for some students. The emphasis on metacognitive strategies in the case method is not overt. However, a standard strategy for approaching legal problems is reinforced through the questions of the professor in class discussions. Students learn that there is no right answer and that any point of view they adopt will be opposed by the professor. Therefore, successful students prepare by taking different points of view in order to anticipate the questions of the professor. It has been suggested by Llewellyn (1948) that the majority of students do not internalize the habit of looking for flaws and asking questions as a by-product of observing the professor. He suggested that there should be an explicit focus in 1st-year courses on the acquisition of these skills.

**Assessment.** Students in a case-method class learn to prepare briefs of appellate court cases and to critique the manner in which these cases were prepared and decided. However, they are tested on a different task with hypothetical fact situations that pose legal problems. Their task is to answer open-ended questions about the fact situation such as “What would you advise your client in this situation?” This type of legal problem requires problem identification and definition, as well as other skills that are not taught using appellate court cases.

Assessment in the case-method class is performed only once, at the end of each semester. Students do not always receive feedback on these examinations, and when they do, it is too late to use the feedback to improve their performance on a later test. Assessments are used to evaluate student performance in order to rank them within their class. Employment opportunities are often based on this ranking.

**Authenticity of cases.** The problems used for the case method are actual cases that have been compiled from court records. Although the cases are real, they do not always present authentic problems typical of those that practitioners solve. Cases used in the case method of instruction describe a legal problem after it has been solved. They give the judge's opinion, including a brief summary of the facts of the case; the judge's verdict; and the reasons the verdict was reached. Because knowledge of law is represented in the records of precedent cases, the ability to understand these opinions is an authentic activity for attorneys. However, cases are typically encountered by attorneys long before they go to trial. Skills such as interviewing, gathering data, and negotiating are authentic activities for practicing attorneys, and they are not learned by studying the types of cases used in the case method.

**Realistic complexity of cases.** Although cases used in the case method are real, the format in which they are presented may not commu-
nicate realistic complexity to students. Cases used for instruction in law include very few details. They are taken from opinions written by appellate court judges who record only those facts they feel are relevant to the case. The arguments of lawyers and other details of the trial are rarely included. These abstract opinions are further edited by casebook authors before being included in casebooks.

It is difficult to provide a rich, detailed setting for complex problems. Providing even the minimum information for such problems takes a great deal of effort and expense (Copeland, 1954; Tully, 1954). Because irrelevant information is not included in case-method problem descriptions, students do not have an opportunity to deal with the problem of separating relevant and irrelevant information.

**Managing complexity through case format.** The existence of court records and the format of those records has a strong influence on the format of cases used for instruction. It is important for students to understand information presented in the format used by professionals, but this format may not be the best way to present information to novices. Although the cases used in the case method contain all the data necessary to understand the court's decision and are accurate with respect to real-world knowledge, they are still difficult to understand because of the unfamiliar vocabulary, abbreviations, and notations. The case method could be improved through the use of a variety of case formats, each representing some skill needed by an attorney. For example, some cases may be given from the point of view of a new client, others may depict the interrogation of a witness, and still others may require the creation of a contract or some other document.

As previously mentioned, cases used for instruction in law are adapted from actual court records. These records are in text format, as are the cases. Although prototype video-based systems have been developed for legal education, little is known about the design principles underlying these materials or their effectiveness.

**Case sequencing to support the changing needs of students.** In the legal curriculum, cases are grouped into categories based on the areas of law that they illustrate: constitutional law, tortes, real property, and so forth. Within the basic concept areas, the order of cases is up to the professor. Cases are not sequenced according to their difficulty, and it is often hard to find beginning cases that do not require previous legal knowledge. The grouping of cases by basic area or concept ensures that students have some experience in each area. However, it provides artificial cues to students because they realize that any case presented in a contracts class contains some issue related to contracts. Grouping by concept does not
provide the students an opportunity to learn how multiple concepts may be interrelated within one complex case.

In the next section, another method of case-based instruction is discussed. Although problem-based learning also begins with a case to be solved, the similarity between the two methods seems to end there. Interestingly, however, some similar problems in teaching, learning, and materials do arise when a domain is taught entirely through the use of cases.

Medical Education

In a standard medical-school curriculum, students spend 2 years listening to lectures on basic science concepts and memorizing this information. This is followed by 2 years of clinical work, in which students learn to apply the concepts to the treatment of patients. Studies have shown that much of what is learned from the lectures will be forgotten before students reach the clinical part of their training (Gonnella, Goran, Williamson, & Cotsonas, 1970; Levine & Foreman, 1973). The problem-based learning method of medical education addresses this difficulty by allowing students to learn the basic concepts and when to apply them simultaneously.

Problem-based learning is a type of case-based instruction that is characterized by small cooperative learning groups. Unlike the teacher-directed case method of instruction used in law school, problem-based learning is cooperative and student-directed. As a group, students learn basic science knowledge and the process of making a diagnosis by studying the records of an actual patient. The records are presented in a format that allows students to simulate the process of examining and diagnosing the patient. Instructors provide guidance, but they do not direct. Students learn to monitor their own understanding of problems to determine what topics they need to study. Then they learn how to research these topics by trial and error rather than by being given a prepared list of references. This is similar to the type of research that they must be able to do when they encounter problems after leaving medical school.

Historical Overview of Medical Education

Until the 20th Century, the development of medical education in the United States paralleled that of legal education: Those who could afford to travel studied in the universities of London, Paris, and Edinburgh, and those who could not, apprenticed themselves to practicing physicians. When medical schools were first established in this country, the quality of education was often very poor. A typical curriculum consisted of 4 months of lecture. At many schools, there was no opportunity for clinical education and no requirement for apprenticeships.
In 1908, the Carnegie Foundation for the Advancement of Teaching hired Abraham Flexner to prepare a report on medical education in the United States and Canada. Flexner's scathing description of the existing schools resulted in the consolidation or closing of inadequate schools (Schofeld, 1984). His recommended model for medical education was a curriculum that had been adopted at Johns Hopkins University School of Medicine in 1894, consisting of 2 years spent in the lecture hall and in the laboratory learning basic science, and then 2 years in the school's teaching hospital (Flexner, 1910). This model became the standard for medical schools in this country.

In spite of the growth in population, programs, and medical knowledge since Flexner published his report, there have been few changes in how medicine is taught at most schools. In spite of all the additional material to be learned, the length of medical school and the type of instruction remains the same. The new information is handled by more densely packed lectures and by cutting back on the time spent in the laboratory in order to add even more hours of lecture (Bok, 1989).

Complaints about the didactic type of instruction in medical school surfaced as early as 1847 when a group of Harvard professors complained about the overuse of lectures (Bok, 1989). The following complaints about the lecture method are still heard. First, students are too passive. They are not being trained to be critical thinkers and problem solvers. Second, the lecture method is ineffective. Students do not remember the facts they memorize, and what they remember, they fail to use in practice. Finally, lecturers teach each aspect of scientific knowledge separately, and they present knowledge from the perspective of science rather than medicine.

One of the reasons that medical education has not changed is that the current system of education matches the prevailing view about how doctors solve problems (Bok, 1989). In this view, disease is a scientific phenomenon—a deviation from a biological norm. Diseases are thought to result from a determinate cause or set of causes that doctors can discover through observation and tests, and whose effects they can cure or alleviate through surgery or medication. Doctors seek to make a scientifically certain diagnosis. Because they tend to look on what they know as facts, they are inclined to teach didactically and impart truths that do not warrant discussion. Medical educators who concur with the scientific view of medicine see no reason to change the way they teach.

This view of medicine as the logical application of scientific truths is inaccurate, or at best, incomplete. First, although there are actual deterministic mechanisms that account for the behavior of biological systems, many aspects of these mechanisms are not understood. Even if the mechanisms are understood in isolation, their interaction with other systems may cause their behavior to vary. Students who have been taught
medicine as isolated facts are unprepared to deal with the uncertainty and variation that characterize the problems of real patients.

Another difficulty with the view of medical knowledge as scientific truth is that the diagnosis and treatment of medical problems is related to many factors other than biochemical knowledge (Bok, 1989). For example, psychological problems can cause physical illness, and economic constraints can cause people not to seek treatment. These factors involve the behavioral and social sciences, domains with high uncertainty. An education based on medicine as fact and logic does not prepare students to deal with problems that have high uncertainty.

Even if scientific knowledge were complete and all diseases could be explained in terms of it, the lecture method would still be inadequate to teach medical problem solving, because medical problems are poorly defined (Barrows & Feltovich, 1987; Elstein, Shulman, & Sprafka, 1978). Not only is much irrelevant information present, but relevant information about the case is often missing and does not become apparent until after problem solving has begun (Voss, 1988). The way in which a doctor begins to solve a problem may constrain the final solution (Norman, 1988; Voss, 1988), for example, an early unsuccessful treatment often masks symptoms important for later problem solving.

Although the form of instruction in most medical schools still follows Flexner's original model, some schools that were dissatisfied with the heavy use of lectures have attempted curricular and instructional reform. In creating a new approach to medical education, the designers of problem-based learning borrowed from two sources. The use of patient cases as a stimulus for learning was clearly influenced by the case method of instruction begun at Harvard Law School, and the emphasis on self-directed learning activities was adapted from the discovery-learning approach and the views of psychologist Jerome Bruner (Lipkin, 1989; Schmidt, 1989b).

Because of the resistance of already-established faculty to a dramatic shift in the curriculum, problem-based learning is often established in new schools such as McMaster or Mercer (Heestand, Templeton, & Adams, 1989), or as an additional separate track in an existing school, such as the New Pathways Program at Harvard, the Primary Care Curriculum at New Mexico, or the problem-based track at Michigan State.

**Teaching and Learning in Problem-Based Learning**

Beginning medical students in a problem-based curriculum work in small tutorial groups to diagnose patients' problems and to understand their causes. The problems are constructed from actual patient records and are initially presented to students in the same way that they were presented to
the patient's doctor—as an incomplete set of symptoms without an explanation. Each tutorial group, guided by a faculty tutor, applies a standard clinical reasoning process that includes generating hypotheses, collecting data, and solving the problem. As in the case method in law school, students have no formal knowledge of medicine when they attempt to solve their first problem.

The problem. At the first meeting of a problem-based learning tutorial group, students receive a case or problem that will be the focus of their study for about a week. The case is a description of an actual patient, the patient's presenting problem, and how the problem was diagnosed and treated. It is presented in a format that allows students to simulate the process of examining and diagnosing the patient. This innovative format, called a Problem-Based Learning Module (PBLM; Barrows, 1985; Distlehorst & Barrows, 1982; Waterman & Butler, 1985) consists of two books, the Master Action List and the Patient Encounter Book.5

The Master Action List includes an alphabetic, comprehensive list of history questions, physical examination procedures, laboratory tests, and diagnostic procedures that may be used with any patient. These questions and tests are not specific to the particular patient being discussed but are a standard menu of possible choices that a doctor could use when examining any patient. By using an exhaustive list, the PBLM avoids cuing students as to the appropriate questions or tests for the case at hand.

The Patient Encounter Book contains the history and records of a specific patient organized in a way that is keyed to items in the Master Action List. The first section of the Patient Encounter Book contains a description of the patient's presentation (i.e., the initial complaints and symptoms). The following section contains the patient's responses to history questions, and findings for individual items of the physical examination, laboratory tests, and other diagnostic procedures. Photographs, x-rays, and other visuals are included with the books as appropriate to heighten the reality of the experience. The next section provides students with examples of expert problem solving, the write-up by the physician who treated the patient in real life, and the questions and diagnoses of doctors who agreed to serve, in this case, as expert models for students. The final section includes the concepts or learning issues that the designers of this particular PBLM had in mind when they created it. These learning issues are provided as an aid for self-directed study—a check list for tutors and students to insure that they have thoroughly covered the instructional goals of the PBLM.

5In recent versions of the PBLM, the Master Action List and the Patient Encounter Book have been combined into the same book.
The patient problems used for problem-based learning vary greatly in content and complexity. In the preclinical, or first 2 years, of medical school, problems are chosen that cover the basic science concepts necessary to the practice of medicine. The initial problems presented to students are relatively short and simple, because students need to focus on the clinical reasoning process and what is expected of them as individual students and as members of the tutorial group.

The following hypothetical case might be typical of one used during the first week of the program. Keep in mind that this paragraph is what students are given as they begin a new case and represents only the information that the doctor might have before the examination. Much more information is available for students about this case when they need and request it.

CASE PRESENTATION

The patient, J. Smith, is 50 years old, married, works full time as an elementary school teacher, and attends graduate school. For the past 10 years the patient has smoked 10–20 cigarettes a day. After a late study session the night before a graduate school qualifying exam, the patient ate a large meal at a local fast-food restaurant. Upon returning home and climbing two flights of stairs, the patient experienced a sudden onset of crushing, substernal chest pain.

The group’s assignment is to explain the patient’s current situation. Because one goal of problem-based learning in the preclinical years is to learn basic science concepts, the explanation is expected to be more than a diagnosis. It is expected to contain the important history and laboratory information to support the diagnosis. The relationship between data and diagnosis must be explained in terms of basic biological mechanisms or biochemical disturbances (Barrows, 1985; Lucero, Jackson, & Galey, 1985).

The Tutorial Group and the Problem-Based Learning Process

Students work on patient problems in a small tutorial group of five to seven students and a faculty tutor. They are randomly assigned to groups, and new assignments are made every 2 months (Lucero, Jackson, & Galey, 1985). The number and length of group meetings varies according to the group and the problem they are working on, but a typical group might meet for 2 to 3 hr three times a week. Meetings are held in a classroom equipped with a chalkboard and a small collection of medical dictionaries or texts. There are no assigned texts.

In a group’s initial meeting, the tutor and students introduce themselves
and give their background relevant to the task at hand (e.g., educational experience and areas of expertise). This helps students to identify the potential problem-solving resources within the group. Sometimes the faculty tutor is an expert in the area to be studied, but it is not necessary. The tutor’s function is to guide the group, not to solve the problem for them (Barrows, 1985; Lucero et al., 1985). The group discusses and agrees upon general learning objectives and rules for interaction. The goal is to create an open working atmosphere in which students feel free to offer their opinions or admit their ignorance. They must also be able to give and take constructive criticism from other group members and the tutor. A decision is made to determine which group members will be in charge of the Master Action List and Patient Encounter Book. These people agree to keep the PBLM materials closed and to avoid reviewing the list of possible questions and their corresponding answers until the group agrees upon what actions to take.

The tutorial group begins its study by reading the patient’s presenting problem. The problem is always encountered first, before students study the related basic science concepts. Study before the problem is wasted because students do not know what knowledge will be needed or how it will be applied (Barrows, 1985). Students must also learn to develop confidence in their ability to reason through a problem, identify what they already know, and what they need to learn. Although this metacognitive ability is often already a part of the reasoning skills of many good students (Bransford, Stein, Shelton, & Owings, 1982), working under the guidance of a tutor provides practice that is designed to make these skills automatic for all students.

Problem formulation. In the first phase of problem solving, students discuss the initial information provided in the patient’s presenting problem; list the important facts; and summarize the problem (Barrows, 1985). At this point they are trying to create a working list of important facts on the chalkboard. This list will have to be changed as students learn more about the patient. In the hypothetical example, students may overlook the fact that Smith ate a large meal before experiencing pain. Later they might discover that the type of pain experienced by Smith could be caused by indigestion and that the initial cue of a recent meal was, in fact, important. By maintaining a group list on the chalkboard, students can critique their previous problem-solving process and note where they were wrong.

The second step is to identify the problem that the patient presents (Barrows, 1985). This does not mean that students should try to explain the problem at this point. The tutor may initiate this task by asking a question such as “What is the problem we are facing here?” In the example, Smith has a number of problems—smoking, poor diet, overwork, lack of sleep,
and stress. Smith is also experiencing severe pain. The pain appears to be the most urgent problem, but there is not enough information about it. When the information in the patient's presenting problem description is too vague, students must "ask" the patient questions. The group may decide to ask the patient about the precise location of the pain. They look up the question in the Master Action List, and using the index provided, look up the answer in the Patient Encounter Book. The tutor will ask them to justify any question that they ask the patient.

The next phase of problem solving is a circular process of generating hypotheses with existing knowledge and determining what data should be obtained to establish or rule out each hypothesis. Hypotheses are either explanations of the problem that seem possible or logical descriptions of underlying causes. Because one purpose of problem-based learning is to learn basic science concepts, the ideas that are generated must be ideas about the basic biological mechanisms that underlie a patient's problem, not simply the names of diseases. Hypothesis generation is a creative task in which students are asked to brainstorm, with a minimal amount of concern about how remote the ideas may be, or how correct their use of terminology is. Studies of the clinical reasoning of physicians have shown that hypotheses generated early in the problem-solving process are used to guide further inquiry (Elstein et al., 1978). One analysis showed that if a physician failed to consider the correct hypothesis in the first 5 min, there was only a 5% chance that a correct diagnosis would be reached (Norman, 1988). It is important that students learn to generate as complete a list as possible before beginning to evaluate any specific hypothesis.

Tutors ask students to commit to paper their own list of hypotheses so that they can later compare them with the group's (Barrows, 1985). As the group begins to discuss hypotheses, they are listed on the chalkboard. After a student volunteers an idea about the problem, the tutor asks, "How do you know?", "How sure are you?", or "Is this an area about which you need more information?" This establishes the habit of monitoring the quality of one's ideas. The good tutor questions both correct and incorrect hypotheses so that students will not get clues about the tutor's personal opinion.

After all the hypotheses have been generated, students rank them according to their importance, putting the least likely ones at the bottom of the list. A typical ranking of explanations for chest pain in the example problem might be heart attack, indigestion, anxiety, or muscle strain. Medical hypotheses are usually ranked on the basis of probability; that is, how likely it is that each is the correct explanation. They are also ranked according to seriousness. Treatable problems that are immediately lifethreatening should be considered first, regardless of their probability (Barrows, 1985; Schmidt, 1989b). Students often feel that it is not possible to make decisions without complete information, but learning to make
decisions on the basis of probability rather than a complete set of facts is part of real-world problem solving.

Unlike the creative, unstructured process of hypothesis generation, evaluating hypotheses is a very logical, deductive process. The tutor initiates this process by asking questions such as "What information do you need to establish whether the ideas that the group came up with are correct?" or "How would you determine which is most likely?" As students respond with suggestions for questions to be asked of the patient or tests to be performed, they are asked to explain their requests in terms of basic mechanisms. In the example, if students feel that an electrocardiogram (EKG) might be useful to determine whether or not Smith had a heart attack, they should be able to explain what kind of information an EKG can provide about the heart. Whenever they are unable to do this, a new entry is added to a list of learning issues on the chalkboard. These learning issues are areas in which the students need further study. A possible list for Smith's case could include the following questions (Lucero et al., 1985): What is a heart attack? What causes pain in a heart attack? Which of the known risk factors for heart attack apply to Smith?

After the group agrees on a question to ask the patient, it consults the Master Action List as an index to point to the correct section of the Patient Encounter Book. The answer provided by the Patient Encounter Book is added to the data list on the chalkboard, and the effect of this data on each hypothesis is discussed. If appropriate, the hypothesis list is updated to reflect the synthesis of the new information. Hypotheses may be added or deleted, or the list may be reordered.

At the end of the first phase of problem solving, students have generated three lists on the chalkboard: Facts that are known about the patient; hypotheses about the underlying cause of the problem; and a list of learning needs, or areas to be studied further in order to validate the hypotheses. These lists provide both a record of students' initial attempts to solve the problem and objectives for what they need to learn before they can complete their work.

The learning-needs list sets the agenda for self-directed study, the next phase of the problem-based learning process. Before leaving the meeting, students decide who will research each topic on the list. If the list is short, all students may research all topics. At other times, the list is divided among students, and individual assignments are made. Unlike real-world problem solving where tasks are assigned to people with the most expertise, problem-based learning tasks are assigned to students with the least knowledge in the area. The goal is to learn, not necessarily to solve the problem with the highest degree of speed and accuracy. Before beginning its research, the group agrees on a date for completing it.
Self-directed study. Self-directed study is one of the major objectives of problem-based learning. In the information age, new medical information is discovered; old theories become obsolete; and new technologies are introduced daily. Because of the great immediate impact of this information on their patients' health, responsible doctors must keep track of it. Therefore, medical schools have a responsibility to ensure that their graduates have the skills necessary for life-long learning: how and where to obtain information, how to evaluate it, and how to apply the new information to problems (Walton & Matthews, 1989).

In a problem-based curriculum, almost all of the time outside tutorial group meetings is left free for self-directed study. In a survey contrasting the study habits of preclinical students in a problem-based learning track with those in a conventional track, Saunders, Northup, and Menin (1985) found that both groups of students studied approximately the same amount of time in the evenings, but the problem-based learning students, who were freed from attending lectures, spent significantly more time studying during the mornings and afternoons. Problem-based learning students also spent more time studying in the library using resources that they selected themselves.

Students use two main types of resources to address the learning needs that are established in tutorial sessions: journals and textbooks from the library, and consultations with resource faculty. Initially, finding good resources in the library is difficult, because the material is covered at a level that is too simple to be useful or too technical to be understood (Barrows, 1985).

A problem-based learning curriculum places heavy demands on the medical library and its staff. Librarians are trained to understand the special needs of students in this curriculum and spend time providing instruction in information search and evaluation (Saunders et al., 1985). They also provide lists of resources especially suited for problem-based learning students and help them organize and maintain personal information files of important papers.

The basic-science faculty of the medical school do not teach by lecture as they do in a conventional medical school program. Instead, they maintain office hours for consultations. They have been cautioned not to give mini-lectures or to answer open-ended questions by students but to act as a resource for specific questions that students have. Students are initially hesitant to use resource faculty, and often must be encouraged to do so (Lucero et al., 1985).

In addition to the library and resource faculty, students report using a wide variety of other resources: cadavers, specimens, x-rays, computerized scans, films, and videotapes. They also report attending departmental
seminars and lectures. When compared with conventional students, problem-based learning students study more and use a wider variety of resources that they select themselves (Saunders et al., 1985).

Integration of learning. When they return to the group after their research, students bring back the appropriate information, including extra copies of diagrams and other material to share with the group. They also bring back evaluations of the references that they used. The evaluations include assessments of the quality of the information, its complexity, and its value for solving their specific problem. By completing and sharing this evaluation, students learn to be critical of resources and to share ways of finding answers with other group members.

Students who are successful in finding the answers to their research questions are enthusiastic and often give mini-lectures to each other about what they have learned (Barrows, 1985). This is in opposition to the purpose of problem-based learning, which is to learn new information in the context of problems. Therefore, the tutor guides the group to start at the beginning of the problem again. Students add their new information when appropriate. They also evaluate their former attempts at problem solving, indicating the features that led them astray, the cues that they missed, and what they now know that is enlightening. Through this process, the relationship of new knowledge and old knowledge is understood and remembered.

After analyzing and synthesizing the new information, students attempt to reach consensus on a hypothesis. If this is not possible, another round of self-directed learning will be needed (Barrows, 1986). If they reach a consensus, students use the Master Action List and Patient Encounter Book to request tests to confirm their hypothesis and suggest treatment. Then they can consult the PBLM to see what the final diagnosis actually was, what treatment was undertaken by the physician who treated the patient, and how the patient progressed. They can also compare their problem solving with experts who attempted the problem and whose solutions are included in the PBLM.

Summary phase and evaluation. Before the process is complete, students must summarize what they have learned about basic-science concepts and explain how it relates to the problem that they have solved and how it adds to what they already knew (Barrows, 1985). This process is necessary to abstract out the substantive knowledge acquired while solving the problem. The goal of this generalization is to help students transfer their knowledge to new problems and organize their knowledge for the objective tests contained in licensure examination of the National Board of Medical Examiners (NBME) that they must pass at the end of their 2nd year. During the summary phase, students consult the Patient Encounter Book to
examine the list of learning issues that the designers of the problem had in mind when they developed it. If they have failed to cover these issues, they do so before starting a new problem.

After the summary phase is complete, students evaluate themselves with respect to their reasoning or problem-solving skills, the knowledge they brought to the problem, their study skills, the knowledge gained, and their contribution to the group process (Barrows, 1985). Students do this in front of the group, and other students are encouraged to agree or disagree. If a student's performance is evaluated as poor, the group offers help and suggestions for improvement.

**Materials and Curriculum in Problem-Based Learning**

In addition to the PBLM that was described in the previous section, faculty and researchers at problem-based learning schools have developed other innovative types of problem materials such as simulated patients and focused cases.

**Simulated patients.** Simulated patients are actors with pedagogically useful physical features who are trained to portray a patient's history, personality, emotions, and physical features (Barrows, 1971, 1985). The use of simulations for education is prevalent in situations where the skill to be learned involves high risk, expense, or both. Simulated patients allow the student to practice examining and diagnosing real people without risk of physical or emotional injury to the patient. They also provide the opportunity for a realistic apprentice-like experience that is scheduled at a time and place that is convenient and appropriate for the curriculum. There is no other way, outside the use of real patients, to have students practice physical examinations, interviews, and general communication skills. The simulated patient is paid to tolerate clumsy questions, awkward or inappropriate examinations, embarrassed behaviors, and fatiguing sessions (Barrows, 1985).

**Focused cases.** The faculty of the problem-based learning track at the University of New Mexico School of Medicine developed short, focused cases to elicit problem solving in one specific area. Initially, all cases were complex PBLMs, but students in their 2nd year who had treated real patients in clinics and were fluent in the clinical reasoning process complained that the rigidly controlled format of problem solving with the PBLM was tedious and time consuming. There was also a need to be able to concentrate on areas in which specific students needed help. Focused cases were designed to solve these problems by encouraging learning on a
single topic rather than leading to the generation of multiple, diverse hypotheses.

In addition to problems presented in a text format and simulated patients, students may also see real patients occasionally or serve at rural clinics in their 1st year.

A variety of formats is needed to keep students from becoming bored. Each format is designed with specific goals in mind. The PBLM format provides a full simulation of the clinical reasoning process. Focused cases target specific concept areas. Simulated patients provide practice in interviewing and examining. Whatever format is used, it is essential that the problems are real (Barrows, 1985). The construction of fictional problems is a nightmare, because one can easily fabricate symptoms that cannot coexist. Also, knowing they are working on real problems is motivating for students.

Selection and organization of problems. At first glance, a problem-based learning curriculum looks unstructured, but at the curricular level it is actually well organized (Barrows, 1985). Insuring that the subject matter is covered completely is a major concern of curriculum designers for problem-based learning. Because students acquire substantive knowledge only by studying a series of cases, faculty must select cases so that the assortment of knowledge accumulated through them reflects what is necessary and relevant for the practice of medicine (Lipkin, 1989).

Faculty begin the process of selecting cases by compiling a list of topics that must be covered (Barrows, 1986). Because the curriculum is not divided into disciplines, topics from every area of basic science taught in the preclinical years are combined into one list. Topics on this list are not disease oriented, but symptom oriented, because that is how problems present themselves. Once a complete list has been created, the topics are matched to available cases in which a patient exhibits one or more of the symptoms on the list.

Because the time required to cover a problem may vary from group to group, the entire set of problems may not be covered by all groups. To help students and tutors choose which problems to study, curriculum designers give them a priority ranking. The order of ranking is as follows: Problems that introduce important concepts in basic science; those that are seen most frequently in practice; those that have serious consequences in terms of morbidity; and those that have serious social or economic impact (Barrows, 1985). Often one problem will cover many topics and meet many of these criteria. Because the area of facts covered is circumscribed by the students and tutor, it can be as wide as they choose (Barrows, 1985). If some important concepts do not relate well to patient problems, they can be covered in a lecture or written material, but these are kept to a minimum.
Problems are carefully selected and organized at the level of the overall curriculum to insure that the subject matter is thoroughly covered. However, there is no consensus about how to sequence problems within the problem-based curriculum. However, two prevailing views concerning the sequencing of problems exist.

According to Barrows (1985), PBLMs are order-free and students should be allowed to select which case they would like to study next. He believed that students become discouraged during early problems not because of the problem content, but because everything is unfamiliar: the process, the knowledge, and the terminology. Working through the initial problem always takes an inordinate amount of time. Because much of the knowledge acquired in the early problems is reapplied in subsequent problems, the process will speed up as students learn (Barrows, 1985).

In contrast to Barrow's ideas on sequencing, Waterman and Butler (1985) suggested that the initial problems should be simple so that the students become accustomed to the vocabulary and tasks of problem-based learning, including problem identification and hypothesis generation. The initial cases are made simpler by choosing very high-interest topics in areas about which students are likely to have background knowledge.

In work that has implications for the sequencing of problems within the curriculum, Bordage and Zacks (1984) showed that doctors and medical students can reliably group diseases that have common features into categories. They also demonstrated that prototypical members of a category—those that have the greatest number of features in common with other members of the same category—are more easily recalled than less typical diseases. Because medical knowledge seems to be organized around prototypes, it should be important to select prototypical diseases for students’ initial cases. This sequencing is in line with the findings of Mervis and Pani (1980) showing that concepts are acquired more accurately and easily when prototypical cases are presented first.

**The Role of the Teacher in Problem-Based Learning**

Because problem-based learning is a relatively new and very different form of education, faculty members are generally skeptical about its ability to prepare students for standardized board examinations and professional practice (Moore-West & O'Donnell, 1985). They view the floundering of unprepared students as very inefficient and the possibility of students' sharing incorrect and incomplete knowledge as dangerous. Having had little training in problem-based learning and no role models for tutoring during their own education, they are also uncomfortable with their role as faculty members in this curriculum.

There are three roles for the faculty in the problem-based learning
curriculum: tutoring, serving as a subject-matter consultant for students, and developing curricular materials. Of these roles, the only one for which the scientists on the medical faculty are trained is that of subject-matter consultant. Even in this role, faculty members feel displaced when they are no longer the lecturers (Barrows, 1985). They feel powerless because they must wait in their offices for students to seek them out (Moore-West & O'Donnell, 1985). Once the students do seek them out, teachers are tempted to revert to their traditional didactic roles by giving a mini-lecture or telling students the answers to their questions.

Because the goal of problem-based learning is discovery on the part of students, the tutor was originally seen as passive. Some tutors followed this model so rigidly that they became totally uninvolved, and their groups worked on problems for many weeks without progress or moved through cases so quickly that nothing was learned (Lucero et al., 1985). At some schools, the role of the tutor has been revised to encourage intervention in order to make sure that students follow the process and cover the learning issues that each case is designed to stimulate. This is always done by asking nondirective questions (e.g., asking for summaries, encouraging students to make connections, and asking where the discussion is going).

The tutor is also responsible for observing students and obtaining evaluative data about their strengths and areas that need improvement. Occasionally, the tutor asks students to summarize individually, in writing, the connection between a particular hypothesis and the available data without looking at the board. These summaries are used by the tutor to evaluate each student's understanding of the basic-science concepts related to the problem (Lucero et al., 1985). Students also are evaluated with respect to their problem-solving skills, communication, and interaction with members of the group.

The tutor must also stimulate the self-monitoring process by asking questions such as "Is there something more you need to know at this point?" and "Are you certain of what you are saying or do you feel as though this is something you ought to review?" The goal is that the students will eventually internalize the habit of questioning (Barrows, 1985). Although the skill of the tutor is critical (Barrows, Meyers, Williams, & Moticka, 1986; Walton & Matthews, 1989), faculty members who serve as tutors often have no training in how to teach or tutor (Jason & Westberg, 1982). Because problem-based learning and tutoring are new, few faculty have had relevant models during their own education. They have difficulty finding the proper balance between letting their group wander without any guidance and being overly directive. Because problem-based learning integrates the study of many disciplines into one case, faculty serving as tutors must supervise the study of problems outside of their area of expertise. In this
situation, they feel threatened by having to improvise and to answer students' spontaneous questions rather than asking students planned ones.

Unlike lecture-based education, the time requirement is not spread evenly across the year. In the beginning, tutors must give more supervision to the students. Later, if their group is doing well, they do not have to attend every meeting. A tutor with one group averages 4 to 6 hr per week (Barrows, 1985).

**The Effect of Problem-Based Learning on Students**

Very little has been written about how students react to a problem-based learning curriculum. This may be due in part to the fact that attendance at a problem-based learning school is voluntary; students choose these schools because they prefer the problem-based method of learning. Students for the 20 positions in the University of New Mexico problem-based learning track are selected from a group already admitted to the medical school that have expressed an interest in this curriculum (Martinez-Burrola, Klepper, & Kaufman, 1985). Some of the reasons that students select problem-based learning are: (a) the flexible schedule fits better into the lives of students with families, (b) they thought it would be challenging, and (c) it was similar to previous work or school experiences.

It has been noted (Lucero et al., 1985) that students have initial difficulty with the lack of structure. They need an understanding of how the program works, in general, and more specifically, they need direct instruction in the reasoning process that they are supposed to employ during problem solving. Tutors provide this training by structuring the first few tutorial sessions, then the tutor's control is gradually relaxed (Lucero et al., 1985).

When compared with students in a problem-based learning curriculum, conventional-track students suffered from more stress, found their education less relevant to their future careers, and had more difficulty in clinical rotation (West, Umbland, & Lucero, 1985). On the other hand, problem-based learning students were more likely to feel they lacked knowledge in basic-science content areas.

**Assessment in Problem-Based Learning**

Assessment is a controversial issue in the problem-based learning curriculum. Some schools have no examinations. Instead, assessment is carried out continuously by the faculty tutors who guide each tutorial group. Other schools dislike total dependence on this type of assessment because it is subjective, it fails to prepare students for taking the required NBME objective examination, and its validity cannot be established (West et al., 1985). To overcome some of these objections, several unique means of
assessment have been developed that are consistent with the problem-based approach.

The Clinical Reasoning Training Module (CRTM) is an assessment instrument that is designed to test a student's ability as an individual to solve the types of problems that are presented to the tutorial group in the PBLM (Barrows, 1985). The CRTM test booklet is a modified PBLM that presents a problem that students have not previously encountered. In the first section of this test, students commit themselves to a set of hypotheses, evaluate supporting data, suggest patient questions, order appropriate tests, get results, and give a final hypothesis.

The next part of the CRTM is designed to evaluate students' ability to carry out self-directed study. Students are asked to list topics that they need to study in order to be certain of their hypothesis in the CRTM case. They also list the resources that they plan to use. After a study break in the library to research these topics, students go through their test booklet again, and using a red pen, revise their answers if needed. Finally, students are asked to summarize what they have learned and how to evaluate their own performance. A scoring scheme for this examination has been established and is easily carried out. The CRTM provides an objective way of assessing the clinical reasoning and problem-solving ability of students.

The problem-solving format of the CRTM is very different from the objective-type test that dominates medical education (West et al., 1985). One of the stated reasons for giving objective tests is to prepare students for taking the NBME comprehensive qualifying exam for licensure. Not only must students pass this objective exam before they are licensed to practice, but in many schools they must pass Part I of the exam before entering their third year of medical school. Originally, students in problem-based learning schools did not take objective tests. However, studies indicated that they needed practice in taking them in order to be successful on the NBME exam (Heestand et al., 1989; Moore-West & O'Donnell, 1985). Therefore, in some schools, a third part was added to the CRTM. This part is an objective test covering the basic-science material related to the CRTM. Students at several schools also take practice versions of the NBME exam to prepare themselves.

Simulated patients are used to assess students' communication and physical examination skills (Barrows, 1985). Students individually examine the simulated patients for a fixed period of time. After the examination they are asked to describe the patient's history and condition, give hypotheses about the underlying causes of this condition, and suggest tests and treatment. The student's performance is scored either by faculty observing the examination through one-way glass or by the simulated patient.

The Modified Essay Question (MEQ) method of assessment, developed at the University of Newcastle Medical School in Australia, features a case
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presented as a multistep problem. Each step adds new clinical information and then asks questions requiring an essay-type response. The questions must be answered on a separate page without looking back or turning forward in the booklet (West et al., 1985). Information presented at each step may be verbal, on videotape, an x-ray, or a specimen. The MEQ has been found to be reliable and valid (Feletti, 1980).

Research on Problem-Based Learning

Most of the research comparing problem-based learning and conventional curricula has been reactive, that is, opponents of problem-based learning raise a specific objection to the program’s cost or its ability to prepare students, and advocates of problem-based learning gather data to support their position. Because this data has not been collected by independent researchers, its legitimacy may be questioned. Another major problem with studies comparing conventional and problem-based learning tracks is that students are not randomly assigned to a track.

West et al. (1985) compared students who selected the problem-based learning track at New Mexico with conventional track students. They found that problem-based learning students were significantly older but did not differ with respect to race or gender. During interviews, the problem-based learning students received significantly higher scores from a blind rater on problem solving, maturity, and motivation. On the Myers–Briggs Personality Type Inventory, problem-based learning students were found to be significantly more extroverted, intuitive, and feeling.

Because there are more applicants than there are positions in the problem-based learning track at New Mexico, preference is given to students demonstrating maturity, responsibility, and work experience, rather than to those with higher Medical College Admissions Test (MCAT) scores and grade point averages (GPAs). Academic criteria such as GPA and MCAT scores may ensure high performance in the conventional preclinical curriculum, but they do not correlate with achievement in the clinical years or in the problem-based learning curriculum (Martinez-Burrola et al., 1985). Conventional-track programs are lulled into a false sense of security by admitting students who have high GPA and MCAT scores. These students do well for the first 2 years of the program, but little evaluation is done in the later years of medical school to determine how well these students succeed in clinical rotations or postgraduate professional practice.

The most frequent objection to problem-based learning is that it fails to provide its students with enough knowledge of basic science to prepare them for the NBME examination. At the University of New Mexico, the board scores of problem-based learning students were compared with a
group of students from the conventional track matched for MCAT scores, GPA, gender, ethnicity, and age. Comparing the average results for a 3-year period, there was no difference in board scores. In other studies comparing problem-based learning students and conventional-curriculum students on objective tests of basic-science knowledge (Neufield & Sibley, 1989; Schmidt, 1989a), problem-based learning students showed the same or slightly poorer performance overall. At New Mexico (Moore-West & O'Donnell, 1985) and at Mercer (Heestand et al., 1989), practice in taking objective tests has improved the performance of problem-based learning students to levels comparable to that of students in conventional tracks.

Comparisons of the two groups' performance on problem-solving or clinical tasks are rare. The clinical performance of the problem-based learning track and the conventional track at New Mexico was compared using two different questionnaires (Moore-West & O'Donnell, 1985). In the first comparison, there was no difference when students were compared on overall performance in psychiatry, surgery, or internal medicine rotation. For the pediatric rotation the questionnaire was redesigned and the faculty was asked to grade the student's performance in nine areas: basic-science knowledge, application of basic-science knowledge to clinical problems, ability to review current research, clinical skills, ability to work with a team, ability to work with peers, enthusiasm for learning, ability to work independently, and level of maturity. Using this measure, the problem-based learning students were rated significantly higher on all nine items.

Problem-based learning programs are often criticized for being more expensive than traditional medical education because a greater amount of faculty time is necessary to tutor small groups. Menin and Martinez-Burrola (1986) at the University of New Mexico School of Medicine compared faculty time required for both tracks. Both tracks are served by the same teachers at New Mexico. Teachers estimated the time required to prepare for conventional-track lectures and labs and for problem-based learning tutorial-group sessions. The problem-based learning track required only 3% more time than the conventional track. It should be noted, however, that if the number of enrolled students increases, the time for lectures will not increase, but the time for problem-based learning tutorial-group supervision will.

Interestingly, Menin and Martinez-Burrola (1986) found that faculty in the conventional track spent more of their time (61%) preparing for lectures than having actual contact with the students (39%). In the problem-based learning track, the opposite was true. Faculty in this group spent 72% of their time in actual contact with the students, and only 28% of their time in preparation.
Analysis and Critique of Problem-Based Learning

Anchoring instruction in cases. Problem-based learning as described in this article and by Barrows (1985) always situates instruction in an interactive discussion of cases.6

Modeling. Like the case method, problem-based learning is weak in providing expert models prior to asking students to solve a problem. Both methods begin instruction by having students struggle to solve a complex problem without any idea of what they are expected to do. Modeling is given only in the form of feedback after the students have attempted to solve the problem.

In problem-based learning, after the students have completed the diagnosis of a case, they may read how the patient's attending physician diagnosed the case. The problem-solving performance of the expert under these circumstances functions primarily as feedback for the current problem, rather than as modeling. However, it may be used as a model of expert problem solving for future problems. The primary role of a faculty tutor is to keep the group on track and to assess the performance of group members, not to provide a model of expert problem solving.

Active engagement. Students in a problem-based learning tutorial group do not have the opportunity to solve a case as individuals. They do, however, have the opportunity to participate actively in a problem-solving discussion because the group size is small. During these discussions, students are expected to contribute by supplying information and asking questions. The tutor observes the performance of individuals during this process and gives them feedback. Students are also encouraged to critique their own problem solving and to give feedback to other members of their group.

Scaffolding. Members of the tutorial group rely primarily on each other to define and solve problems during group discussions. As in the case method, the responsibility for solving the problem is distributed among group members. Keeping a record of the group's progress on the chalkboard is a method of externalizing problem solving and helps students to remember and organize their thoughts. The tutor provides some guidance

6There are a variety of instructional approaches that are commonly referred to as problem-based learning (Barrows, 1986). Some of these methods use cases as illustrations following a lecture, or as assignments that precede a lecture. For these methods, the case is not an integral part of instruction, and the term problem-based learning may be a misnomer.
through questions, but is not as directive as the case-method professor in a law class.

Outside of class, students can consult librarians for assistance in locating reference materials. They can also receive assistance by conferences with faculty members who specialize in various fields of medicine.

**Metacognitive strategies.** The metacognitive aspects of solving cases are directly taught to students in problem-based learning. The tutor ensures that problem solving always includes the steps of generating hypotheses, gathering data, and making a diagnosis. Problem-based learning also provides overt training in metacognitive monitoring through the tutor's nondirective questions such as, "How sure are you?", "How would you determine which hypothesis is correct?", and "What kind of information do you need?" The goal is for students to internalize this habit of questioning.

**Assessment.** In problem-based learning, the CRTMs assess individual students using problems that match exactly the format of the problems solved in tutorial groups. These modules ask the students to develop a list of hypotheses, research the hypotheses, and make a diagnosis. These problems also match the types of problems that students will encounter in practice. The use of simulated patients tests students on their ability to interview and examine patients.

In the problem-based learning curriculum, students do not take objective tests on their knowledge of basic-science concepts. Their lack of familiarity with this type of test leads to poorer performance on examinations given by the NBME than students who are trained in a curriculum that emphasizes lectures and objective tests. However, when problem-based learning students have the opportunity to practice taking objective tests, their performance on board exams is comparable.

The goal of self-directed learning, a major component of problem-based learning, is to train students to assess their own problem-solving performance. This assessment emphasizes problem solving, clinical reasoning, and self-directed learning, not just the acquisition of facts (Barrows, 1986). Evaluation is a continuous part of group problem solving. Individual assessments are less frequent.

**Authenticity of cases.** The PBLM case format used for medical instruction represents a problem at the point that a doctor first encounters it because the case describes only the patient's presenting symptoms and asks students to diagnose the problem. The activities that these problems encourage are typical of those that practitioners actually perform—generating hypotheses, collecting data, and choosing a final diagnosis. The use of
simulated patients allows students to learn the skills of interviewing and physical examination.

On the other hand, PBLMs and simulated patients do not afford the opportunity to learn about treatment. There is a general tendency in case-based instruction to focus on planning and not action. Students may receive feedback from the teacher about the probable outcome of their plans, but they do not have the opportunity to get feedback from the environment. In reality, plans often fail and must be repaired, but case-based instruction does not teach the iterative nature of planning.

Realistic complexity of cases. The problems used for problem-based learning are real cases, and acquiring the domain knowledge necessary to understand and solve a case may take several weeks.

The details of cases used for problem-based learning represent information gathered by the attending physician. Because this physician is experienced, it is unlikely that he or she would have asked irrelevant questions or requested unnecessary tests. Students who request unnecessary tests while solving the problem will not find the answers to their questions. The absence of this information in the PBLM is a cue for the student indicating that the information is irrelevant. Simulated patients can provide the answers to irrelevant questions and consequently present the case in a more realistic manner than PBLMs.

In problem-based learning, all of the data needed to solve the case are available as a resource in the PBLM, but are not part of the problem that is initially presented to the student. Therefore, a problem-based learning case is realistically incomplete as presented, but more data are readily available when needed.

Managing complexity through case format. The cases used in problem-based learning have an incomplete story format similar to that used in a macrocontext. The story begins as the main character presents his or her problem, and the students must gather data to determine how the problem was resolved.

Cases used for problem-based learning instruction are primarily presented in a text format. When the necessary information is difficult to describe in words, and supplementary materials already exist, medical-case texts can be augmented with photographs, x-rays, and charts.

All the data acquired during the original solution of the problem are available to the students. If the students solve the problem using the same method as the original problem solver, then they will have the information they need; uncertainty will be eliminated; and the difficulty of solving the problem will be reduced. However, if the students use a different but
equally correct method, they may not have all the necessary data for their method. Therefore, the completeness of the problem description depends on whether or not the problem has more than one solution; which solution is attempted by the student; and whether or not the data is present for the solution that is attempted.

Cases used for problem-based learning are accurate with respect to real-world knowledge. Medical students are often able to use their own experience as patients to help them understand cases.

**Sequencing to support the changing needs of students.** Simple cases that can be solved with common background knowledge are often selected as initial problems in problem-based learning so that students have an opportunity to become accustomed to the tutorial process. Aside from this, there is no commonly accepted method of sequencing or grouping problems.

In a problem-based learning medical school, the curriculum is not divided into courses. The faculty creates a set of cases that, taken together, cover the necessary information. Multiple concepts are integrated within each case. This approach creates a curriculum that is more realistic than grouping cases by diseases or systems within the body. Students have the opportunity to learn that several diseases may have the same features. They also can learn how systems of the body interact. In order to ensure that all concepts in the curriculum are covered, students must solve all problems within the set of cases. Although random selection is more realistic than grouping by concept, it may be more difficult initially, because students are not provided with repetitive practice to facilitate learning a single concept.

Hypothetical cases are not used in medicine. Generalization of concepts only occurs if students encounter the same concept in multiple cases. Because students select their own cases in problem-based learning, generalization is left to chance. Drawing connections between cases is not emphasized.

**DISCUSSION**

The preceding descriptions of the case method and problem-based learning provide examples of case-based instruction that can be used as a source of ideas for developing other applications and as a context for discussions of theories of learning. This section will attempt to further integrate theory and practice by: (a) identifying modifications to the case method and problem-based learning suggested by the theories of learning that underlie cognitive apprenticeship and anchored instruction, and (b) discussing areas of research that are suggested by the experiences with the case method and problem-based learning that can augment and refine these theories.
Modifications to the Case Method and Problem-Based Learning Suggested by the Theories of Learning That Underlie Cognitive Apprenticeship and Anchored Instruction

The case method and problem-based learning have been proven to be effective methods of instruction whose techniques and materials have much that is worth emulating. However, the theories of cognitive apprenticeship and anchored instruction suggest that the following modifications or additions should be considered.

Provide Expert Models

New students in the case method and problem-based learning have limited opportunities to see experts in action, that is, to see experts solving problems in their domain that they have not previously encountered. Students see glimpses of how an expert performs when they receive questions and comments from their professors, or when they study the results of expert problem solving in the records of previously solved cases. Medical students may have an opportunity to observe experts during clinical training, but these experiences typically come late in the curriculum.

Cognitive apprenticeship suggests that students should be given many opportunities to observe expert problem solving. These opportunities provide students with an overall mental model of the task that they are trying to learn, as well as demonstrate how an expert uses domain knowledge and strategies to solve problems. Without good models to emulate, students must acquire skills through trial and error. With good models, students learn effective problem-solving strategies more quickly and are less likely to acquire ineffective strategies that will interfere with later learning. If students learn with less floundering, they may feel less of the frustration that is expressed by novices in the case method and problem-based learning.

Include Cases That Afford Opportunities to Acquire a Wide Range of Problem-Solving Skills

There is a direct relationship between the cases used for instruction and the activities that students can perform. In the case method, the solution to the case is provided, and its results are known. The only activity remaining for students is to evaluate the original problem solution. In problem-based learning, problem descriptions provide the necessary data for planning a solution, but students cannot carry out this plan and evaluate the results, that is, they can perform a diagnosis, but not provide treatment. Neither the
case method nor problem-based learning uses materials that provide opportunities for the entire problem-solving cycle of planning, executing, evaluating, and revising problem solutions.

Anchored instruction and cognitive apprenticeship recommend that the problems used in instruction demonstrate the usefulness of authentic problem-solving skills. Cases used in the case method and problem-based learning provide an opportunity for learning only a subset of the skills needed in everyday practice. Opportunities should be provided for learning the other skills necessary to practice these professions. Also, the repetitious practice of a single problem-solving skill may contribute to the boredom experienced by students during the later stages of the case method and problem-based learning.

Reduce Complexity Through Case Formats

Beginning students in the case method and problem-based learning study cases taken from actual court or medical records. As a result, they are often confused by the unfamiliar vocabulary, notations, and format that are used in these cases. Eventually, law and medical students must learn to use the vocabulary of their profession and to read records in the format that is commonly used. However, in the beginning, learning is difficult and slow because everything is unfamiliar. Anchored instruction suggests that the use of video, a story format, embedded data, and other design principles help novices understand the cases and hence increase their motivation to work on them.

Sequence Cases to Support the Changing Needs of the Learner

Beginning students in problem-based learning and the case method complain that they are confused and frustrated, and advanced students often report being bored. More attention to sequencing cases so that they are appropriate for the knowledge that students possess at different stages of learning might help alleviate both of these complaints. Currently, little attention is given by either problem-based learning or the case method to matching cases to the needs of the learner.

Cognitive apprenticeship suggests that cases should be sequenced according to difficulty and diversity. Diversity is employed to overcome the lack of generalization that is often a problem with case-based approaches. This type of sequencing requires a thorough knowledge of the domain and the available cases. In problem-based learning, new medical students select their own cases based on only short descriptions of the presenting symptoms of the patients in the cases. Although these beginning students may be more motivated to study cases they have chosen themselves, it is difficult for them
to pick an appropriate case given their small amount of knowledge about medicine and the cases.

Once cases are sequenced according to their difficulty and diversity, teachers must know when students are ready to move ahead in the sequence. In the case method, professors are responsible for selecting cases, grouping them into the areas of law being taught, and sequencing them. Although they possess the knowledge necessary to sequence cases within the groups, they may not know the current needs of the students because of the large class size and lack of assessment.

Selecting an appropriate case requires domain knowledge, familiarity with the cases, and knowledge of the current needs of students. Neither the case method nor problem-based learning takes all of these factors into consideration when deciding which cases the students will study.

RESEARCH AREAS SUGGESTED BY THE CASE METHOD AND PROBLEM-BASED LEARNING THAT CAN ENHANCE THE THEORIES OF LEARNING UNDERLYING COGNITIVE APPRENTICESHIP AND ANCHORED INSTRUCTION

Studies of the case method and problem-based learning provide evidence that case-based approaches to instruction similar to those advocated by cognitive apprenticeship and anchored instruction can be successful when used in a school setting as the primary method of instruction. However, knowing that success is possible is not enough. Students in law school and medical school tend to be confident enough, energetic enough, and intelligent enough to compensate for any problems with the case method and problem-based learning. More work must be done to determine if these methods used in professional schools can work in public-school classrooms, and to determine the conditions under which case-based approaches to instruction can be successful.

This review suggests new areas of research that are important for those interested in cognitive apprenticeship, anchored instruction, or other forms of case-based instruction. It also emphasizes the importance of research already under way. These suggestions and research are discussed in the following paragraphs.

Investigate Methods That Help Students Abstract General Principles From the Study of Cases

Novices often are confused by irrelevant information in a case and have difficulty distinguishing unimportant information from the important
aspects of a case. For example, they may find the setting or character in a particular situation more memorable and important than the character's problem. One way to help students learn the difference between important and unimportant features of a particular type of problem is to have them solve several examples of the same problem in different contexts. Using multiple examples can be difficult for anchored instruction and cognitive apprenticeship because the cases are complex and instructional time is limited.

The case method suggests that one way to accomplish the goal of helping students learn to recognize important features of problems and to abstract general principles from them is through the use of hypotheticals. In this method, students learn a concept by studying an actual case. Next, they study hypothetical cases, created by systematically changing features of the original case, to see if the concept still applies. The study of hypotheticals is thought to help students understand the range of problems to which a particular solution can be transferred. Because they represent only slight variations of the original case, hypotheticals do not require as much time as studying entirely new cases.

Research in anchored instruction has begun to investigate the use of hypotheticals. In an initial study, when a hypothetical was used as an assessment following instruction, data indicated both positive and negative effects of prior experience with the case (Williams, Bransford, Vye, Goldman, & Carlson, 1992). Students who had received instruction anchored in a single, complex case had fewer misconceptions about the hypothetical formed from that case and made fewer procedural errors than those who had not studied the original case. However, the similar surface features of the original case and the hypothetical were confusing, and this confusion sometimes led to the inappropriate use of problem-solving strategies. Research is in progress to determine how instruction using hypotheticals can help students overcome this confusion and improve the development and transfer of general principles. If it can be shown that the use of hypotheticals in instruction facilitates transfer, then this technique must be evaluated to determine if the benefits outweigh the time that it takes to study the hypotheticals. In addition, other instructional techniques that help students abstract general principles from cases must be devised and tested.

Focus on Learning to Learn

In traditional instructional methods based on the transmission of knowledge from teacher to student, the teacher identifies the facts and skills that a student needs to know and tells the students these facts and demonstrates how to carry out the skills. In contrast, students in the case method and
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problem-based learning are actively involved in identifying which aspects of cases they do not understand and in finding answers to their own questions through library research and consultation with experts. They are learning to learn in a way that will be useful in solving real problems with real-world resources. Therefore, the case method and problem-based learning seem to be better than traditional methods in preparing students for a fast-changing world in which they must constantly acquire new skills and knowledge.

Successful students are likely to know which questions to ask and how to find answers. Because law and medical students are successful, highly motivated students, they are able to take responsibility for their own learning when taught by the case method or problem-based learning. Researchers must determine how less successful students can acquire the skills and confidence necessary to attempt new problems without the aid of a teacher. This is particularly important for children who define their goals in terms of completing schoolwork, rather than having learning as the goal of their work. In the past, anchored-instruction and cognitive-apprenticeship studies have concentrated on the design of materials and the role of the teacher. The role of students in choosing what they will study is now receiving more attention (see Bereiter & Scardamalia, 1989; A. L. Brown & Campione, 1990).

Develop Materials That Afford Opportunities for Action

As mentioned previously, neither the case method nor problem-based learning allows students to plan a solution to a problem and then execute, evaluate, and revise their plan. In a classroom setting, it is difficult to give students opportunities for executing their plans. In order to accomplish this, environments must be created to carry out students’ recommended problem solutions and provide feedback in a realistic way. In the case method and problem-based learning, these environments are traditionally provided by means of internships and clinics. For younger students, they are often provided by field trips, laboratory experiments, and projects. Research using technology offers promising alternatives for realistically simulating environments in which students can solve problems and observe the results of their actions (see, Shute & Glaser, 1990; White & Frederiksen, 1986). It remains to be seen if these simulations are realistic enough for students to transfer appropriately what they learn to real problems.

Create Appropriate and Efficient Methods of Assessment

The review of assessment methods used in the case method and problem-based learning indicates several problems. The first problem with assess-
ment mentioned prominently in the problem-based learning literature is that students are assessed on skills different from the ones previously taught. In problem-based learning, students are trained to solve problems, but in order to be certified by the NBME, they are tested by objective tests on their ability to remember facts. In order to be successful on this exam, problem-based learning students must receive additional training in taking objective tests.

Approaches such as anchored instruction and cognitive apprenticeship face similar problems because they train students in problem solving, but students' performance is often measured by objective, standardized tests administered by the school system. In general, these objective tests do not measure problem-solving and metacognitive strategies (see Goldman et al., in press). There is enormous pressure for students to do well on these tests. Until standardized methods of assessing problem-solving performance are created, teachers will continue to use classroom time to train students in taking objective tests.

A second problem with assessment noted by teachers using the case method is that written tests of problem-solving performance are time consuming to administer and score. In the case method, this problem is exacerbated by the large number of students in each class. Because of the time required, tests are only given once at the end of the semester. At this point, instruction on the material covered by the test is complete, and it is too late for students and teachers to use the feedback provided by the test to improve their performance. Anchored instruction and cognitive apprenticeship call for more frequent assessment to help both students and teachers measure their progress (Frederiksen & Collins, 1989; Goldman et al., in press), but at this time there are few suggestions for how this can be accomplished given a limited amount of classroom time.

A third problem with assessment mentioned by those involved with the problem-based learning method is that assessment of problem-solving performance, such as ratings of performance by a tutor, tends to be subjective. Theorists agree that the most direct assessments of problem-solving performance do tend to be subjective, and that scoring these assessments requires judgment and experience (Frederiksen & Collins, 1989). Once appropriate methods of assessing problem solving are developed, training for teachers and others who score these assessments will be necessary.

Researchers in anchored instruction and cognitive apprenticeship are currently studying these and other problems with assessment (Goldman et al., in press). The experiences of the case method and problem-based learning underscore the importance of this research and provide some innovative examples such as the simulated patient, CRTM, and Modified Essay Questions.
Explore the Effectiveness of Combining Anchored Instruction and Cognitive Apprenticeship with Other Forms of Instruction

Schools using the case method and problem-based learning often combine these methods with other types of instruction. This is done for two reasons: Students become bored when only one method is used, and these methods are too slow to cover the domain knowledge that students are required to learn.

Researchers in cognitive apprenticeship and anchored instruction have not reported the problem of boredom. On the contrary, students are very enthusiastic about these forms of instruction (Pellegrino et al., 1991). This may be because studies of cognitive apprenticeship and anchored instruction typically are inserted into a curriculum composed of more traditional types of instruction. These new methods are a novelty and are not the only form of instruction. Problems with the slow speed of these methods have not been reported either. Again, this may be due to the fact that cognitive apprenticeship and anchored instruction methods are not used for all instruction and researchers are not responsible for teaching all of the required curriculum.

Because researchers in cognitive apprenticeship and anchored instruction have not encountered the problems of boredom and poor coverage attributed by the case method and problem-based learning, to the exclusive use of case-based instruction, they have not addressed the question of whether or not case-based methods should be used for the entire curriculum, or combined with other methods of instruction. If cognitive apprenticeship and anchored instruction are combined with other means of instruction, it is important to know which type of instruction should be used with which domains, tasks, and populations. Although adding alternate means of instruction may improve attitudes and increase coverage of the curriculum, it will affect what is learned. This trade-off must be examined.

Determine How Case-Based Instruction Works for Different Populations

Students in graduate programs such as law and medicine have proven themselves to be successful in school. In addition, they have had at least 20 years to acquire background knowledge and skills that can help them solve the cases they encounter. Unfortunately, not all students have the qualifications and experience possessed by students enrolled in highly selective graduate programs.

Anchored instruction and cognitive apprenticeship advocate the use of case-based instruction with younger students. There is much to be done to determine how this type of instruction works with children. Its effects must
also be tested with those who lack motivation and good learning strategies. Initial data suggest that middle-school students who work with video-based cases show gains in problem solving and develop positive attitudes toward the subject matter (e.g., Bransford, Vye, Kinzer, & Risko, 1990; CTGV, 1992a; Van Haneghan et al., 1992). In preliminary studies, these effects held across achievement level and gender (Pellegrino et al., 1991).

AFTERWORD

Case-based instruction has a long history of demonstrating effectiveness in professional education. In general, the method holds promise for improving the problem-solving skills of all students. However, the adaptation of this method for large numbers of students with a wide range of ages and abilities will require a better understanding of the method itself, as well as the development of more refined theories of learning and of new instructional techniques, materials, and assessments.

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