Problem Based Learning and Instructional Theories

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Abstract

The need for reform in medical education has been widely discussed in recent years. In response, some institutions have begun using problem-based learning in an attempt to increase students' acquisition and retention of relevant information and their ability to solve clinical problems, treat patients sensitively, and work as members of a team. With this method, students work through a series of problem cases, meeting in small groups and working independently. The authors discuss the congruence between this method and various instructional theories. Elements of behavioral, cognitive, developmental, and humanistic theories all are apparent in problem-based learning, which warrants further study.

Introduction

The literature in medical education is rife with calls for educational reform worldwide. A particularly compelling statement is made in the World Conference on Medical Education Report (1988), which calls for significant change in the orientation of medical education towards greater relevance to the needs of societies throughout the world. Included in the report's recommended strategies at the institutional level is consideration of the extent to which teaching methods involve problem solving rather than traditional didactic methods. In fact, in the medical education literature, the most frequently mentioned innovation is problem-based learning. Many medical schools around the world have adopted this approach, including Southern Illinois University (USA), the University of Limburg (Netherlands), McMaster University (Canada), Suez Canal University (Egypt), and the University of Newcastle (Australia). While some schools use problem-based learning in special track, parallel programs, several schools are using this format exclusively. Howard Barrows (1983), the primary spokesperson for problem-based learning in the United States, advocates it to remedy several problems. The first is the information overload that faces medical students. The knowledge and technology explosion in medical science has resulted in a bloated and rigid curriculum, with students expected to memorize more and more facts in order to pass multiple choice exams (Ludmerer, 1985). Barrows notes that there is little retention of information beyond the exams, and that medical education seems to have little concern for students' capacity to understand, absorb, retain, and then use their knowledge. Barrows (1983) also advocates problem-based learning as a means for teaching clinical problem solving. Norman (1988), however, disputes Barrows's claim that the problem solving process inherent in this method teaches problem solving per se, noting that it is knowledge retention that is the critical component of problem solving ability. Norman advocates problem-based learning on the grounds that students retain more of what they learn and enjoy the learning process more. Most importantly, it is reflective of medical practice in that the problems presented to students do not have clear boundaries, but instead incorporate medical science as well as epidemiology, psychology, sociology, and other behavioral sciences. Despite these claims for the value of problem-based learning, little research on its effect has

been reported to date. Mennin and Martinez-Burrola (1986) found that problem-based learning is no more expensive than other methods. Schmidt, Dauphinee, and Patel (1987) reviewed fifteen studies that compared outcomes of problem-based curricula with those of regular programs and drew three tentative conclusions: 1) in some cases, students in problem-based programs perform slightly lower on traditional tests, 2) larger proportions of graduates of problem-based programs enter primary care fields, and 3) problem-based curricula foster an inquisitive style of learning. Except for one study by Schmidt (1983) that assessed problem-based learning in terms of an information processing model, however, nothing has been done to assess it in terms of instructional theories or principles. This paper, therefore, reviews problem-based learning in relation to a spectrum of such theories to identify its possible theoretical bases.

Problem Based Learning: A Description

Problem-based learning has several objectives. These include increased knowledge retention, acquisition of clinically relevant cross-disciplinary information, ability to solve clinical problems, the ability to learn in an independent, self-directed way, and increased sensitivity to patients' needs. The patient problems used for cases are carefully chosen, constructed, and sequenced to cover necessary content (Barrows, 1983). As described by Barrows (1983), Barrows and Tamblyn (1980), and Clarke (1988), problem-based learning is an upwardly spiralling process. Students, working in small groups of five or six, are presented initially with a problem case describing a patient. The presentation of the problem first is a significant departure from traditional education, which assumes that all the elements of prerequisite knowledge must be learned before they can be applied to a problem. Students must analyze the problem presented, state and discuss various hypotheses, identify the information they need and its sources (e.g., faculty, library, specimens, community agencies), independently gather the information, and meet again to discuss their findings. In the discussion process, new hypotheses and information needs and sources are identified, and the cycle is repeated. Eventually, the students reach a consensus about the mechanisms responsible for the patient's problem and attempt to summarize and integrate what they have learned. The teacher acts only as a facilitator by asking questions to emphasize or redirect. The small group format is used primarily, although some programs have experimented with problem-based learning within the lecture format. Problems are presented via various media, e.g., print, video, simulations, live patients, and computer based instruction. Assessment of student performance is carried out continuously during the group problem solving process as well as with standardized simulations, essay examinations, and objective structured clinical examinations at the end of the instructional experience (Barrows, 1983; Clarke, 1988). In addition, in most programs, students take standardized national certifying examinations.

Congruence with Instructional Theories

As pointed out by Fuhrman and Grasha (1983) and by Brookfield (1989), learning is a complex

process, and the appropriateness of an instructional approach depends on several elements within the instructional context. In order to determine an optimal approach, medical educators should consider the interactions among the nature of the subject matter, characteristics of the students and program, and the instructional environment. Elements of many different instructional theories can serve as a basis for an approach such as problem-based learning.

1. Behavioral Theories.

Behavioral theories, with their emphasis on setting objectives, mastery learning, and extrinsic reinforcement are those most often associated with professional education. This is particularly true, as pointed out by Brookfield (1989), in settings in which there is a great imbalance in knowledge between teacher and students. Obviously, medical education is one such situation, which may help to explain the concerns that so many faculty have with problem-based learning. They wonder how adequate coverage of content can be achieved by using such an unstructured approach to knowledge acquisition. They worry about having little control over the information that students learn and how they will know if the students have learned enough. Proponents of problem-based learning point to several factors in response to such concerns. First, cases are carefully chosen and constructed to lead students in discovering the knowledge that the case developers intend. Second, no student can learn everything, but at least problem-based instruction helps students deduce what they need to know and how to find it. Third, this method reflects the fact that there is more to medicine than discrete pieces of information, and thus is better than "banking" (lecture) instruction to illustrate the unbounded nature of medical science. Finally, as Brookfield (1989) notes, adhering rigidly to a preplanned format and objectives can be inimical to learning. Several elements of behavioral theory are consistent with problem-based learning. First, behavioral theory and problem-based learning both stress that the learner must be active and engaged during the learning process. Second, when done well, problem-based learning results in reinforcement for the learners. Although this reinforcement is less contrived than the reinforcement advocated by most behaviorists, it nevertheless explains some of the success and motivational value found in problem-based learning. Third, in guiding the students in problem-based learning, the instructor uses cues and prompts to facilitate and guide the students' progress. Such cues and prompts are more general and less frequent than in programmed instruction based on behavioral theory. A final point of agreement between problem-based learning and behavioral theory is that students are let to master of the content. Certain aspects of problem-based learning are inconsistent with behavioral theory. For example, problem-based learning begins with a problem rather than with the presentation of information. The instructional sequence is not a simple linear one. The students move freely, under their own control, through the problem and associated information. Although both problem-based learning and behaviorally based instruction use learning objectives, the objectives in the former are more broadly stated. As Beard and Hartley (1984) point out, behaviorism is too simplistic and mechanistic to fully explain the human

learning process. Nevertheless, some of its elements are relevant to and apparent in problem-based learning.

2. Cognitive Theories.

There is a clear and strong correspondence between problem-based learning and aspects of cognitive theory. Bigge (1982), for example, describes the effectiveness of the reflective teaching and learning process, which begins with a problem and then requires that students formulate hypotheses, gather information, and identify solutions. Anderson (1985) stresses the importance of having the learner actively organize and structure the content. Ausubel, Novak, and Hanesian (1978) emphasize the importance of learners' building on their existing knowledge structures to make them more elaborate. Bruner (1961) advocates that teachers use problem solving and learning through discovery to make a student "as autonomous and self-propelled a thinker as we can" (p. 23). Discovery learning proponents, such as Bruner, believe that learning through discovery encourages intrinsic motivation, taps into one's competence motive, and allows one to receive gratification from coping with problems. Beard and Hartley (1984) note that cognitive theorists suggest that learning is made more meaningful when it is integrated into existing knowledge. An instructional method based on clinical case problems can help in this process by providing students with a framework to which new learning can be anchored (Clarke, 1988). Schmidt (1983) reiterates this in his discussion of the congruence of the problem-based method with information processing theories. In addition, he notes that learning is more effective when the context of learning is similar to the context in which the knowledge will be used. Brown (1983) reviews studies on student learning conducted by Marton and extended by Entwhistle and others. They have investigated the context dependence of learning and the significance of "deep" (intrinsic, meaningful) vs. "surface" (extrinsic, reproducing) learning. Problem-based learning clearly encourages deep learning, thereby increasing retention. Giving students control over the sequence of instruction as is the case in problem-based learning also is consistent with cognitive theories. Reigeluth (1983) suggests an instructional sequence that focuses on the whole, then a specific part, then the whole, and then another specific part. The student moves freely from a broad to a focused view. Problem-based learning requires that students try out their emerging concepts and principles and receive corrective feedback in order to develop more sophisticated conceptualizations. This is consistent with the cognitive theories' approach to concept learning. Beard and Hartley (1984) point out several principles with which the problem-based method may not be congruent. Presentation of stimuli, for example, is important. After the initial presenta tion of the case, students acquire the information they need on their own. Depending on individual skill, they may or may not do this effectively. Teachers do not give students explicit cognitive feedback on how well they have accomplished a task. As Barrows (1983) explains, however, after students complete a case, they critique both the process and product of their work to determine how the problem could have been better managed.

3. "Bridge" Theories.

As pointed out by LeFrancois (1982), Bandura and Gagne have developed theories that attempt to integrate the behaviorist and cognitive traditions. Bandura's ideas that are pertinent to problem-based learning are that people learn and retain more by using self-generated cognitions and that modeling is an effective teaching strategy. In problem-based learning, the students observe and model the problem solving behavior of others. Seeing their own and others' successes can enhance their feelings of self-efficacy. Gagne and Driscoll (1988) see the teacher's role as one of designing and managing events so that learning processes are activated. Although they imply a more concrete, active role for the instructor than is the case with problem-based learning, their conceptualization is congruent with the problem-based method.Gagne and Driscoll suggest also that certain critical conditions for the learning process exist. Problem-based learning clearly supplies these conditions: a meaningful context (for learning of verbal material); attention to distinctive features (intellectual skills); opportunities for practice (cognitive strategies); and giving feedback (attitudes). Gagne (1985) distinguishes several different domains of instructional outcomes that require different instructional conditions. He indicates a distinction between teaching information, such as facts, and teaching intellectual skills, such as problem solving. Problem-based learning, in contrast to the lecture method, provides a better opportunity for students to master intellectual skills, and as such is consistent with Gagne's theory. Gagne also presents a model for instruction that is based on an information processing model and that describes nine specific instructional events. Problem-based learning embodies most of the specified events. The clinical problem gains the learner's attention. Learning objectives, though perhaps broader than Gagne would like, are stated clearly. The instructor stimulates recall of prior knowledge when introducing the case, and information about the case as it unfolds constitutes the new stimulus information. Both instructors and fellow students can provide learning guidance to the student. The students are actively engaged in learning. Feedback is provided, and student efforts are evaluated. Finally, the use of clinical cases in problem-based learning provides for retention and transfer of learning. Another benefit is the potential for increased intrinsic motivation to learn that results from the use of concrete examples relevant to professional practice, student control of the learning process, and generalizability of learning to other settings (Gagne and Driscoll, 1988). Students are motivated not only by their desire to do well on an examination, but also by the desire to actively participate in problem solving. Deci and Ryan (1985) would agree, noting the importance of interesting activities and active participation for the development of intrinsic motivation, as would Franken (1982), who refers to extrinsic motivators (e.g., test scores) as the enemies of exploration. The development of and reliance on intrinsic motivation can be crucial in the development of lifelong learners.

4. Developmental Theories.

Problem-based learning also acknowledges and reflects the importance of developmental tasks

and the nature of adult cognition. Although developmental theorists disagree on the nature and processes of development, they agree that individuals do change and grow throughout adulthood as they confront various tasks and demands. Havighurst (1953), for example, in describing stages of adult development, views establishment in an occupation as a necessary task of early adulthood. Chickering and associates (1981) relate adult life cycle challenges to specific educational program responses, focusing primarily on content. In contrast, Schlossberg (1981) suggests that adults develop as they encounter transitions, and that the degree of success they have in adapting to a transition depends on the strength and nature of a constellation of personal characteristics and environmental supports. As medical students confront the task of taking on a professional role and coping with the transition it entails, the case discussions of problem-based learning help model necessary task-related competencies. Learning occurs in a supportive, small group setting. Schöen's (1987) ideas about the importance of a reflective practicum serving as a bridge between the educational program and professional practice indicate a recognition that adult students need support as they change and take on new tasks and roles. Piaget (1964) describes various stages in the development of cognitive structures at different ages, with most adult thinking being in a stage characterized by exploring all logical possibilities and approaching problems systematically. Labouvie-Vief (1980) extends Piaget's conception of adult cognition, noting that adult responsibilities require reasoning that is tied to specific, concrete contexts and that is specialized andpragmatic. In sum, problem-based learning embodies many developmental concepts and addresses issues of transition and of psychosocial and cognitive development.

5. Humanistic Theories

Several important principles of adult education rest on a foundation of humanism. The humanistic theories, in contrast to other instructional theories, are less empirically based, more philosophical and based on the needs of individual learners. Knowles (1980), a primary spokesperson in adult education in America, suggests that experience forms the basis for adult learning and that adults are, or have the capacity to be, self-directed learners. He sees adults as being able to contribute as learners, wanting to see the relevance of what is being learned, needing to control more of their own learning, and having strategies for doing so, all of which are addressed in problem-based instruction. The focus is on the experiences of a person, the meanings of those experiences, and the dignity and worth of the individual (Darkenwald & Merriam, 1982). Maslow (1954) and Rogers (1969) have been major humanistic theoreticians, writing that personal growth is a natural and desired state for adults, who do not need to be coerced in order to learn. Rogers sees education as an opportunity to promote individual growth and development, with the result being a fully functioning, fully actualized person. The learning process, however, needs to be personally involving and meaningful, self-initiated, and self-evaluated. Students need to participate in structuring their own learning. These humanistic ideas are readily apparent in problem-based learning. Motivation to learn grows out of the

student's desire to reach his or her potential, not out of the desire to pass a test. Active participation in structuring and carrying out a learning task and freedom to incorporate material in a personally meaningful way both are possible. The emphasis is on clinical problems that have direct relevance to students' professional lives. In addition, teaching is conceived as facilitating learning, not as transferring information. Brookfield (1986, 1989) sees the value of collaborative programs, with teachers as facilitators who empower and promote self-direction. Brookfield is careful to point out that facilitation does not have to be a passive process, and that challenging learners is often necessary. In medical education, this would require considerable content knowledge, which contradicts the assertion by some that facilitators do not have to be experts in medicine, or even have a medical or scientific background.

Conclusion

Problem-based learning has a strong base of theoretical support. Rather than being the narrow embodiment of one particular instructional theory, problem-based learning incorporates aspects of the behavioral, cognitive, developmental, and humanistic traditions. In addition, the integrated approach of problem-based learning is congruent with the needs of a changing health care system. As White (1988) points out, the narrow biomedical approach is no longer sufficient. Medicine must adopt a more holistic paradigm that includes recognizing the importance of the behavioral and social sciences, the need for working as part of a health care team, and the need for a patient-centered approach. As Vevier (1987) notes, to develop compassion, students must be treated compassionately. Certainly the small group and independent learning methods of problem-based learning treat students more compassionately than traditional education that packs a few hundred students into a large lecture hall to hear a lecturer tell them what is already written in the syllabus. In spite of its theoretical support, however, several barriers prevent the widespread implementation of the problem-based method. The most significant is the attitudes that many faculty members have toward students and learning. Many feel that students want and need to be spoon fed, and many think about education only in outdated behaviorist terms. In addition, the strength of individual departments within a medical school mitigates against central integration of the curriculum, a necessity in a problem-based approach. Looking at problem-based learning on the basis of the content it permits (integrated, cognitive as well as affective) and the process it permits (self-directed, responsible, active), it appears to be a valuable approach to learning, and one that might produce the critical thinkers that Ludmerer (1985) sees as essential to keeping science and technology under control. As Ludmerer states, medical educators have often failed miserably in their attempts to foster critical thinking, but "it is absolutely essential that they not abandon the effort" (p. 280). Decisions about teaching methods in medical education should be based, at least in part, on theories of instruction. As instructional theories evolve, so should medical education; however, current advances in theory, particularly cognitive theories, are not generally reflected in the curriculum. Problem-based learning holds

promise because it is more closely based on instructional theories than is much of medical education and as such warrants further study to gauge its effectiveness, efficiency, and acceptance by faculty and students.

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