Health Science Education: Reviewing a Framework for Problem-Based Learning

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Abstract: Although problem-based learning (PBL) has become one pedagogical approach to gain currency in recent decades, its foundational underpinnings have remained obscure. This investigation seeks to elucidate the theoretical framework or assumptions upon which PBL operates. We have situated core PBL principles in the larger context of health science education, which underwent dramatic changes at the beginning of the twentieth century. The fundamental problem at that time in dental education was moving beyond a lecture-based and apprentice curriculum (students memorizing facts) to a critical thinking-based curriculum. We trace these developments and especially the principles that one thinker, who does not easily fit into any one school of thought, used to frame the problem. We found that the principles underlying the idea of PBL have existed for over a century in varying academic alleys outside of dentistry (including constructivist thought). Despite our technological advances, many of the core challenges of a century ago remain challenges today. Although PBL is certainly not the only way to provide dental students an opportunity to best develop critical thinking, it nevertheless provides an environment in which the learning process may be enhanced.

Keywords: problem-based learning, health science education, constructivist thought, dental education

The health science curriculum we know today has its roots in changes that occurred in nineteenth-century American medical education. These changes coincided, of course, with the Industrial Revolution, as well as the revolution in understanding pathology, anesthesia, antisepsis, and surgery; this history is foundational for the health sciences. Before then, what constituted medical education was merely a hodgepodge of proprietary schools, which were out to make a profit for their benefactors. There were no common standards, few accreditation bodies, and variable requirements for admission. A prospective student need not know anything in the arena of medicine or dental medicine; money was all he or, very rarely, she needed. Private practitioners formed the medical schools, ran them, and created the curriculum. Clinical proficiency and practical application were the omnipresent banners under which the schools rallied.

In the wake of advancements in medical science during the 1800s, physicians recognized the need to promote higher standards since so much had changed. But what were the standards to be? And how were those standards to be policed? These questions were not only open for debate, but they were also points of contention as various influential doctors had various answers. In the end, the idea of subsuming medical schools and dental schools within the framework of a university won out. The transition from proprietary to university-based medical and dental education was uneven, but it provided the foundation upon which our current health science educational system developed during the twentieth century.

Nonetheless, “the medical profession was never united in its view of how the medical school should be changed.” Vying factions of physicians jockeyed to control the curriculum in their own ways, interminably dividing the profession. In much the same way, “different interest groups compet[ed] for dominance over the curriculum” at the primary and secondary levels of education at the turn of the
twentieth century. One scholar has described the transformation of health science education, dental education included, this way:

At its root, the development of American medical education involved a conceptual revolution in how medical students should be taught. With the introduction of laboratory and hospital [or clinical] work, students were expected to be active participants in their learning process, and the new goal of medical training was to foster critical thinking, not merely the memorization of facts. These were the same educational ideas as those associated with the progressive education movement. Medical [professors] began advocating these concepts a generation before leaders of elementary and high schools did so, and it was in the medical schools that progressive education was to have its most enduring impact in America. Indeed, the goal of producing critical thinkers remains the primary objective of medical educators today. This ideal has always been very difficult to achieve in practice, but in an era of medical specialization and rampant technology, it has become more important than ever.¹

By 1910, when Abraham Flexner published his landmark survey on the conditions in American and Canadian medical schools known as the Flexner report, the system in its main outline was already in place. The idea that Flexner launched the modern medical curriculum is somewhat misleading since his report actually marked the culmination of changes that had begun much earlier. Again, medical professors began advocating these concepts a generation before leaders of elementary and high schools did so, and it was in the medical schools that progressive education was to have its most enduring impact in America.

For health science educators, progressive education meant that the learning should be active and foster critical thinking. While this was the goal, in practice it was not often reached. Even after medical schools, dental schools, and others in the health sciences were brought into the university system, the old system of part-time physicians’ teaching when they were not encumbered by patients and presenting material in lecture format lingered. As a growing proportion of doctors gradually became full-time professors, things slowly changed. The health science curriculum, although transformed, still looked more like an apprenticeship and served as a lecture-based way of learning than anything else.

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The Scientific Habit of Mind and Problem-Based Learning

In a seminal article in *Science*, John Dewey observed that “science has been taught too much as an accumulation of ready-made material with which students are to be made familiar, [and] not enough as a method of thinking, an attitude of mind, after the pattern of which mental habits are to be transformed.”² This was certainly the case at the beginning of the twentieth century and continues today in varying degrees. Dewey argued that the “possession of knowledge is no guarantee for the ability to think well.”³ “So far,” Dewey wrote, “mankind . . . has been ruled by things and by words, not by thought, for till the last few moments of history, humanity has not been in possession of the conditions of secure and effective thinking.”³ Mere facts were both abstract and remote and, as such, did not constitute what should properly be called knowledge. For Dewey, “only by taking a hand in the making of knowledge, by transferring guess and opinion into belief authorized by inquiry, does one ever get a knowledge of the method of knowing.”³ The processes of critical thinking or problem-solving embody what Dewey termed “a scientific habit of mind.” Stated simply, “learning is active,”⁴ and it constitutes proper thinking. It is the process of the mind, “and not the subject-matter which determines both [the] quality and quantity of learning.”⁴

For the last two decades, problem-based learning (PBL), which embodies these ideas, has blossomed in the health sciences. According to Subramaniam, “a paradigm shift” has occurred over the last twenty years with regard to medical education.⁵ He says the traditional method of teaching medical students has largely been displaced and “is being replaced by an approach based on integrated problem-based learning.” A century ago, Dewey proposed that “the future of our civilization depends upon the widening spread and deepening hold of the scientific habit of mind; and that the problem of problems in our education is therefore to discover how to mature...
and make effective this scientific habit.” This is the goal of PBL.

In the most concise form, PBL is founded upon “active learning in small groups, with clinical problems used as the stimulus for learning.” Instructors, with missions to facilitate (in contrast to lecture), guide students in their study of case scenarios in “small-group learning sessions.” Students are expected to marshal their own existing knowledge in order to solve problems and must identify deficiencies or special interests that will become personal learning objectives. The hope is that students will assimilate knowledge (new and old) while taking the time to reflect not only on their new understanding but also on the processes that contributed to their learning—and the group’s learning as a whole.

PBL assumes that knowledge is interconnected and interdependent. At Harvard, in 1931, Dewey characterized well that knowledge does not exist in a vacuum. Rather, he argued that there is a context to that knowledge; in other words, things are interconnected. More than that, the process of learning is learning. The “scientific method is not just a method which it has been found profitable to pursue in this or that abstruse subject for purely technical reasons. . . it is thinking,” he wrote. It is our intention here to explore and review a framework for PBL in the language of John Dewey.

Knowledge Actively Constructed

Let us first examine the idea that knowledge is not passive, but instead is actively built. There seem to be two ways in which this is true. First, we must do something in order to gain knowledge (e.g., read, study, analyze). Second, we must also reexamine or reassess what we already know to be true in light of new understanding. This makes the active process of learning dynamic. For example, particle physicists try to understand the nature of nature at the smallest scales possible. For a long time, they believed that atoms represented the smallest unit of matter. Today, we know that atoms do not represent the smallest unit of matter. Particles called quarks and leptons seem to be the fundamental building blocks—but perhaps there is something even smaller. Dewey wrote that “active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends, [distinctly] constitutes [intellectual] thought.” Ultimately, knowledge is not passive. It does not simply come to us; we must seek it out. We must construct it. We must be active in scrutinizing and reconsidering what we know.

Problem (Cognitive Question) and Purpose Essential in Learning

The next idea we consider is that of our adaptive cognition. We must first have a cognitive question. Dewey would call it simply a problem or a perplexity. Every intellectual operation requires that there is something that “challenges the mind so that it makes belief [or knowledge] . . . uncertain.” Dewey gives an example of this principle. There is a man traveling in an unfamiliar territory who suddenly finds a fork in the road en route to his destination. The man is uncertain as to which road he should take, but there are only two options. “How shall [this] perplexity be resolved?” Dewey asks. The man must either whimsically pick a road “trusting to luck for the outcome” or “discover grounds for the conclusion that a given road is right.” If this man is to “decide the matter [i.e., gain knowledge] by thinking,” it will require “inquiry into other facts,” by memory, further observation, or both. “He may climb a tree; he may go first in this direction, then in that, looking, in either case, for signs, clues, indications,” says Dewey. “He wants something in the nature of a signboard or a map, and his [intellectual operation] is aimed at the discovery of facts that will serve this purpose.”

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Constructivism: A Framework for PBL

This scientific habit of mind or this method of knowing is the crux of constructivist thought. Constructivism serves as the theoretical framework within which PBL works. By understanding constructivist principles, we will understand more clearly what our goals for PBL should be and what PBL actually is. According to Savery and Duffy, constructivism consists of three major notions. First, knowledge itself is “an individual construction.” In other words, knowledge is actively built by the learner; it is not passive. Second, the goal of the learner or the cognitive question (something that does not make sense in light of what is already known) is the stimulus by which understanding is constructed. Third, new learning is the result of facing alternative viewpoints by interacting with others. What they mean is that there is a social dimension to the second point.
When we are presented with a dilemma, there lies the stimulus for thinking. “Difficulty or obstruction in the way of reaching a belief [i.e., gaining knowledge] brings us . . . to the suspense of uncertainty,” says Dewey, which leaves us the choice to actively, and metaphorically speaking, climb a tree in order to see the question in the broadest light possible. By actively seeking an answer to our question, we “may decide how the facts stand related to one another.” On the other hand, “where there is no question of a problem,” there is no knowledge that is gained, only “suggestions [that] flow on at random.” “But a question to be answered,” as Dewey so eloquently states, is “an ambiguity to be resolved, [which] sets up an end and holds the current of ideas to a definite channel.” Thus, intellectual activity, or the cognitive process, produces responses to stimuli that are not only adaptations to the environment but also of preexisting knowledge. It is a constant mental process in which human action can once again proceed in light of the construction of evidence from the environment where adaptation has occurred, thus producing new knowledge.

A learner’s overall purpose or goal is especially crucial for stimulating the learning process. “Demand for the solution of a perplexity is the steadying and guiding factor in the entire process of [intellectual operation],” says Dewey. Our overall purposes may be different or nuanced, but they inspire and motivate us to seek the answers we need. For example, as Dewey writes, “a traveler whose [goal] is the most beautiful path” forward will be looking for “other considerations,” or different considerations, in terms of deciding which road to take. It may be irrelevant at the time to arrive in the most efficient manner. Again, there must be an overall object in mind. As Dewey puts it, speaking of moving toward the acquisition of knowledge, “thoughts are concentrated not by being kept still and quiescent, but by being kept moving toward an object, as a general concentrates his troops for attack or defense.” Furthermore, he says that “holding the mind to a subject is like holding a ship to its course; it implies constant change of place combined with unity of direction.” Notice how the parts of the process of gaining knowledge are all inextricably tied together. Constant change, i.e., adaptation, is tied to direction or one’s overall purpose, object, or goal. Our purpose must guide our thinking.

Social Conditions Facilitate Learning

One of the most interesting facets of constructing or building our knowledge involves whether or not it is an individual or social process (social constructivism has a different emphasis). The answer is that it is both, but in specific and unique ways. It would probably be more correct to say that it is an individual process within a social context or environment. If we lived in a vacuum, there would be no alternative viewpoints unless we changed our own mind! Dewey declared that “thinking cannot, of course, go on in a vacuum.” Humans do not live alone. We are people with familial, professional, and civic connections that never go away.

As Dewey states, “up to a certain point, the ordinary conditions of life, natural and social, provide the conditions requisite for regulating the operations of inference. The necessities of life enforce a fundamental and persistent discipline for which the most cunningly devised [teaching methods] would be ineffective substitutes.” He shows this by pointing out that “the burnt child dreads the fire; the painful consequence emphasizes the need of correct inference much more than would learned discourse on the properties of heat.” Most importantly, he says, “social conditions also put a premium on correct inferring in matters where action based on valid thought is socially important.” In a sense, one’s objective can become shaped by social conditions, which, as we have already pointed out, are the guiding factor in acquiring knowledge.

Social Conditions Inhibit Learning

On the other hand, Dewey warns that the social tint to the acquisition of knowledge is a double-edged sword: “Social conditions tend to instigate and confirm wrong habits of thinking by authority, by conscious instruction, and by the even more insidious half-conscious influences of language, imitation, sympathy, and suggestion.” Education, he continues, must “undermine and destroy the accumulated and self-perpetuating prejudices of long ages.” He hopes for a day “when social life in general has become more reasonable, more imbued with rational conviction, and less moved by stiff authority and blind passion.” Only then may educational agencies “be more . . . constructive.” Ultimately, Dewey argues, “the work of teaching must not only transform natural tendencies (e.g., self-interest and willy-nilly thinking)
into trained habits of thought, but must also fortify the mind against irrational tendencies current in the social environment.” Thus, there are two sides to the social environment coin in constructivist thought—it is a double-edged sword.

The Purpose of Purposeful Learning

As noted above, learning is best facilitated when individual and societal structures are optimized, which sounds great in the abstract. But in practice, why should we learn? Historically and even today, there are situations wherein individual or societal learning is and has been actively discouraged, such as cases involving social, political, or religious tyranny as well as in cases of individual indolence.

However, individuals are ultimately agents unto themselves, and the acquisition of knowledge and understanding has been shown to not only enhance individual happiness, but also to be of great benefit to society, whether it involved learning how to farm or how to design and create the first automobile. One example from our own profession is that of Horace Wells, a dentist, introducing anesthesia to the world in 1844, whose efforts have been recognized by the American Dental Association and the American Medical Association. Wells’s contribution revolutionized the health professions and helped society by greatly decreasing overall mortality. Indeed, the British Medical Journal reported that 11,000 physicians surveyed worldwide judged that the three greatest advances in health care since 1840 were sanitation, antibiotics, and anesthesia. The profession has therefore benefitted society in untold ways because of purposeful learning.

As educators, we have a vested interest in enhancing the learning experience, even if we do not want to admit that we learn more than we might expect from our students’ fresh and innovative points of view, despite different educational paradigms.

Encouraging Reflective Thought

It behooves educators to understand, therefore, that what constructivists “call knowledge do[es] not represent some ultimate truth, but [is] simply the most viable interpretation of our experiential world.” Of course, “all views, or all constructions, are not equally viable”; constructivism “is not a de-constructivist view in which all constructions are equal simply because they are personal experiences.” Within PBL, the dental school curriculum should therefore provide opportunities for a student’s knowledge to be tested against what is known and what his or her classmates think.

Note especially this idea of habits of thought. It is something that continues to come up in Dewey’s works, albeit in slightly different forms, but with the same meaning. Early on, Dewey called it the scientific habit of mind, secure and effective thinking, and even the method of knowing. Later, he called it intellectual operation or the operations of inference. Ultimately, he used these terms interchangeably while calling the process reflective thought.

There are really four major parts to reflection. There must be a cognitive question, a suggestion of a possible solution (i.e., a working hypothesis), the development by reason of the suggestion’s implications, and further observation and experiment leading to acceptance or rejection of the hypothesis. “The difficulty,” says Dewey, “resides in the conflict between conditions at hand and . . . intended result, between an end and the means for reaching it.” Dewey observes that “the object of thinking is to introduce congruity between the two.” The problem then is “the discovery of intervening terms which when inserted between the remoter end and the given means will harmonize them with each other.” The “discovery” of these “intermediate qualities . . . which bind together otherwise incompatible traits” is the key. Put another way, one must “seek for intermediary terms which will connect, by regular linkage, the seemingly extraordinary [observations] with the conditions known to follow from the processes supposed to be operative.”

One of the most vulnerable junctions for error in the reflective process is that nexus where a problem has been recognized but an individual is so skilled that a conclusion is reached prematurely. Dewey gives an example of a doctor who is called in to examine a patient. The doctor is very knowledgeable. In the examination, “the patient tells him some things that are wrong [i.e., the chief complaint]; [and] his experienced eye, at a glance, takes in other signs of a certain disease.” Dewey argues that “if he permits the suggestion of this special disease to take possession prematurely of his mind, to become an accepted conclusion, his scientific thinking is by that much cut short.” The competent practitioner must “prevent the acceptance of the first suggestions that
observe this fact. In other cases, “experiment is re-
quired.” If “the experimental results agree with the
. . . rationally deduced results, and if there is reason
to believe that only the conditions in question would
yield such results, the confirmation is so strong as to
induce a conclusion.”12 This is the way it works. Of
course, Dewey understood that contrary facts could
potentially come to light, necessitating a revision of
the knowledge gained. Nonetheless, this habit of the
mind led to the best conclusion possible.

Notice that “observation exists at the beginning
and again at the end of the process: at the beginning,
to determine more definitely and precisely the nature
of the difficulty to be dealt with; at the end, to test
the value of some hypothetically entertained con-
clution.”12 As Dewey explains, “between those two
termini of observation, we find the more distinctively
mental aspects of the entire thought-cycle”—namely,
inference, the suggestion of an explanation or solu-
tion,” and “reasoning, the development of the . . . im-
lications of the suggestion.” Of course, “reasoning
requires some experimental observation to confirm it,
while experiment can be economically and fruitfully
conducted only on the basis of an idea that has been
tentatively developed by reasoning.”12

In the end, says Dewey, the scientific habit
of mind is the “aim of the educative process” and
constitutes “the mind able to judge how far each of
these steps needs to be carried” out.12 There are no
“cast-iron rules.” Rather, “each case has to be dealt
with as it arises,” while exaggerating any step in the
wrong direction, depending on the circumstances,
could lead to “foolish” and “illogical” conclusions.
Dewey muses that, “at one extreme, almost any con-
clusion that insures prompt and unified action may
be better than any long delayed conclusion; while at
the other, decision may have to be postponed for a
long period—perhaps a lifetime.” Finally, he asserts
that “the trained mind” is best equipped to deal with
and “profits the most, in future thinking, by mistakes
made in the past.” Ultimately, the mind must be sensi-
tive to problems and perplexity, and an expert in the
method of knowing. PBL provides ample opportunity
and guidance for this “habit of mind” to flourish.

That critical errors have been made in medical
problem-solving is common knowledge. One must
be especially alert for such errors based on opinion,
not objective scientific study. For example, it took
fifty-two years (and billions of unnecessary antibiotic
doses) to correct antibiotic prophylactic recommen-
dations regarding infective endocarditis (IE) that
the American Heart Association endorsed.15,16 The
general argument against antibiotics has for a long

For Dewey, the very heart of inference is sug-
gestion: “Inference goes beyond what is actually
present, it involves a leap, a jump.”12 Synonyms for
suggestion include “supposition, conjecture, guess,
hypothesis, and (in elaborate cases) theory.” Since
“postponement of a final conclusion pending further
evidence depends partly upon the presence of rival
conjectures as to the best course to pursue or the
probable explanation to favor, cultivation of a variety
of alternative suggestions is an important factor in
good thinking.”12

What comes next are the implications of the
potential solutions. “An idea [that] is inferred from
given facts,” says Dewey, is what he calls reasoning.12
This step in the reflective process guards against “ac-
ceptance of the suggestion in its first form.” This is
important because “conjectures that seem plausible
at first sight are often found unfit or even absurd
when their full consequences are traced out.” Dewey
continues, “Even when reasoning out the [implica-
tions] of a supposition does not lead to rejection,
of the idea, it ends up making it more [relevant]
to the problem.” This part of the process cannot be
underestimated because, he says, it “helps at least
to supply the intervening or intermediate terms that
link together into a consistent whole apparently
discrepant extremes.”12

The final or “conclusive step” is a “kind of ex-
perimental corroboration, or verification, of the con-
junctural idea.”12 Dewey writes that “reasoning shows
that if the idea be adopted, certain consequences
follow.” At this point the conclusion is conditional.

But, he continues, “if we look and find present all the
conditions demanded by the theory, and if we find
the characteristic traits called for by rival alternatives
to be lacking, the tendency to believe, to accept,
is almost irresistible.” Sometimes we can simply
observe this fact. In other cases, “experiment is re-

The problem before it attempts to solve it. “This, more
than any other thing,” Dewey implores, “transforms
mere inference into tested inference, suggested con-
clusions into proof.”12
time now favored avoiding prescription antibiotics since we are becoming much more resistant to the life-saving medications that could help us if we were in real trouble. The risks of taking this approach are virtually nonexistent. One study reported that a comparison between strains of viridans group streptococci recovered from patients with IE from 1971 to 1986 and those strains of IE from 1994 to 2002 revealed that none of “the strains of viridans group streptococci were penicillin resistant in the early time period.” By contrast, 13 percent of strains were intermittently or fully penicillin resistant during the later time period. From the early period to the late period, macrolide resistance also increased by 15 percent, while clindamycin resistance increased by 4 percent.

More recently, it has been shown that penicillin-resistant viridans streptococci are actually causing IE by colonizing more virulent bacteria. Since viridans group streptococci are the causative microorganisms in 40%–60% of cases of community-acquired, native-valve endocarditis, this has the potential of becoming quite lethal. Many researchers have now recognized this alarming trend. If a dentist were to continue prescribing a patient antibiotics for which there is no evidence of efficacy in protecting against IE preventively, and if the evidence is now overwhelming that different strains of viridans streptococci have evolved to strongly resist penicillin or its derivatives, and if the new strains are now known to cause IE, that dentist would be predisposing the patient to the very thing the dentist was trying to prevent.

Therefore, once the health professions have started down an injudicious path, the time and effort needed to reverse course are exponentially higher than would have been the case had proper conclusions been drawn. Clear thinkers who can hold judgment in abeyance are at a premium.

PBL Provides Complex Environment for Learning and Other Benefits

The PBL “process is designed to aid the students in developing the hypothetico-deductive problem-solving model which centers around hypothesis generation and evaluation.” It is also different from case-based methods. The majority of case-based methods test for content (facts). The case is examined by students after these content topics are covered in coursework. In pure PBL, all learning is generated by grappling with the problem itself. The problem is the stimulus to learning.

PBL really puts the burden of learning on the student and provides a complex problem or environment in which students must actively construct knowledge by assessing and examining the evidence before them. The problem provides the student a focus around which learning can be anchored. Working in small groups provides a social element to constructing knowledge in that students may bounce their ideas off other colleagues. If PBL is really working, students must truly understand that they do not have all the answers and that what was taught in dental school this year may be revised, refined, and even overturned in the future. As students reflect, they must force themselves to suspend judgment. They must not be so willing to come to a conclusion without mulling over seemingly viable hypotheses and reasoning out which ones are not viable. Finally, students must corroborate, to the extent that is possible, what they have determined to be the answer. Instead of shying away from a complex environment, PBL seeks to facilitate learning within this framework. Dentists will treat patients the rest of their career and will be faced with a variety of complex situations. This is precisely why Barrows, who originally formulated PBL for medical schools, “worked with the presenting physician in gathering details on the” patient.

Perhaps no curriculum theory is foolproof. But constructivism seems to account for a broad spectrum of holes in the learning conundrum. The more difficult thing for constructivists probably lies in the implementation of the grand ideas. So how does PBL fare, taking Savery and Duffy at their word that PBL is “one of the best exemplars of a constructivist learning environment”? Medical schools have been experimenting with PBL for the last thirty years and have achieved measurable success. For example, “research on outcomes of problem-based versus traditional instructional methods indicate[s] that [PBL] was associated with greater student satisfaction; higher faculty evaluations; better clinical functioning; [and] better performance on Part III of the medical board examinations (the problem-solving segment),” although students performed less well on Part I, which was strictly fact-based.

The original question of whether PBL works has been superseded by questions of whether we can really tell or whether the positive effect is large.
enough to justify the cost in terms of resources. That said, some researchers are now saying that there is “no convincing evidence” that PBL is effective, “at least not the magnitude of effectiveness that would be hoped for.” But they admit that “the results are . . . surprising” and perhaps best explained by “imprecise” theoretical concepts lacking the “explicit descriptions” so desperately needed in rigorous statistical analysis. Given our labored exposition on the principles of constructivism, the theoretical framework, as far as frameworks go, is probably as precise and concrete as it will ever be. Perhaps the confusion lies in the fact that many do not fully comprehend the framework of PBL. Whatever the case, most extol its virtues. Indeed, seven independent research groups have tested the assumptions that PBL leads to improved academic achievement and that it enhances the learning process. These “investigators have found that [PBL] enhanced group members’ self-efficacy, motivation to learn, and perception of social support and diminished their test anxiety.” Interestingly, graduates of a school that teaches with PBL have seemed to distinguish themselves in research and “are more likely to be involved in teaching,” most likely explained by a greater ability to think independently. Furthermore, recent findings from two medical cohorts indicate that PBL “was more successful in terms of students’ academic performance than the traditional course, and this suggests that the change to a PBL course is worthwhile.”

**Conclusion**

Dentistry is in a singular position among the health professions. As members of our profession, we cannot lose sight of the fact that the analytical component of dentistry should remain preeminent, as any work that rises to the level of a profession requires the use of the mind. Dentistry, of course, is not subsidiary to medicine, but a profession in its own right. Historically, the profession has fought to not only emphasize the highly technical surgical aspects of its art, but also to enthrone its intellectual component. We must continue to do so. Despite the inability of some to measure the underlying framework of PBL and its effects, the evidence suggests that it does provide students with an environment in which the learning process may be enhanced.

We must add one important point: we are not defending PBL per se as much as we are reviewing how it may be a viable educational paradigm. Specifically, we are reviewing historical ideas that fit its ideal. This article may thus be characterized as a “natural history” of the ideas that provide a framework for PBL.

**REFERENCES**


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