Special Article

Medical Education From a Theory–Practice–Philosophy Perspective

Susan A. Kirch, PhD1 and Moshe J. Sadofsky, MD, PhD2

Abstract
Medical schooling, at least as structured in the United States and Canada, is commonly assembled intuitively or empirically to meet concrete goals. Despite a long history of scholarship in educational theory to address how people learn, this is rarely examined during medical curriculum design. We provide a historical perspective on educational theory–practice–philosophy and a tool to aid faculty in learning how to identify and use theory–practice–philosophy for the design of curriculum and instruction.

Keywords
education theory, instructional methods, medical education, pedagogical inquiry, theory–practice

Received July 20, 2020. Received revised December 06, 2020. Accepted for publication December 27, 2020.

Medical educators around the world are turning to various approaches to shift their instruction from transmission styles to more student-centered, pragmatic, and agentive styles among others. Educators have several motives for making these shifts such as increasing student engagement in learning, pursuing personal interests in education, and helping to ensure medical students are prepared to improve future patient’s life quality and to meet school accreditation requirements. In response to a study of medical education,1 the Liaison Committee on Medical Education called for schools to standardize learning outcomes through competency assessment and offer self-directed learning opportunities as individualization (Standard 6).2 This second wave of reform (Abraham Flexner’s report3 being the first) is happening at a time with more highly developed learning theory–practice–philosophy than ever before. We navigate an ever-growing number of philosophies or paradigms (eg, constructivism, behaviorism), theories of learning (eg, peer-assisted learning), and instructional technologies (eg, flashcard-based learning app). Medical educators have access to more than 150 theories, technologies/practices, and philosophies. Each speaks to how the learner makes sense of the world and how they contribute to, as well as coauthor, a shared body of knowledge.4,5 Each has implications for teaching, whether intended for children, youth, or adults.

In this paper, we present a broad overview of educational theory–practice–philosophy commonly found in medical education today. We aim to show how particular instructional formats make sense only in the context of certain learning theories or philosophical approaches. We then provide a heuristic to be used for pedagogical inquiries examining one’s theory–practice–philosophical stance for teaching together with how the stance influences student learning. We end with questioning how we make curricular decisions. Herein, we will not refer to theory alone unless we are referring to the proper name of a theory (eg, critical theory). Instead, we use the term theory–practice–philosophy to reflect their dynamic, interconnected, and inseparable relationship to each other.

1 Department of Teaching and Learning, New York University, New York, NY, USA
2 Department of Pathology, Albert Einstein College of Medicine/Montefiore Medical Center, Bronx, NY, USA

Corresponding Author:
Susan A. Kirch, Department of Teaching and Learning, New York University, 239 Greene Street, Suite 400, New York, NY 10003, USA.
Email: susan.kirch@nyu.edu

Creative Commons Non Commercial No Derivs CC BY-NC-ND: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 License (https://creativecommons.org/licenses/by-nc-nd/4.0/) which permits non-commercial use, reproduction and distribution of the work as published without adaptation or alteration, without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (https://us.sagepub.com/en-us/nam/open-access-at-sage).
An Overview of Educational Theory–Practice Philosophies of Teaching–Learning That Underpin Contemporary Curriculum and Instruction Practices

Medical education is a specialized discipline within education in general but still follows principles that apply to any learning culture. There are many important features to a medical education often conceptualized as the science (eg, genetics, biochemistry, pathology) and the social (eg, professionalism, team activity, human interaction skills). Committing and contributing to any of these can be understood through theoretical–practical–philosophical foundations of education largely explored over the past 150 years. Four major theoretical–practical–philosophical viewpoints are described below, consistent with approaches widely used today. These have generally been studied in the context of human growth, development, and education, but these philosophies have been the major influence on our understanding of learners of all ages.6–8

Nativist (aka Innate, Maturational) Approach

This is perhaps the oldest school with active adherents in education and psychology. Francis Galton, the 19th century founder of eugenics, claimed that intelligence is inherited. The contemporary nativist, Jerry Fodor, went further to suggest that the vast majority of our actual knowledge and skills (eg, ideas/concepts, beliefs/attitudes, faculties/capacities) are inborn.9 A popular computer analogy suggests we are hardwired from birth to know and be able to do certain things. Learning can be thought of as acquiring software we need to use or access intrinsic abilities. For example, when researchers use imaging (eg, fMRI) to report on structures in the brain associated with particular mental activities, they draw upon the related doctrine that our software depends upon our hardware.10 The essential principle that persists today is that heredity is the major (or only) determinant of human development. Nativists assert that the developing mind organizes experiences by means of inherent underlying structures (eg, behavioral genetic studies of intelligence11; violence12; and linguistics.13,14) Nativist ideas present in our educational system include IQ testing and early tracking of students, which both argue for inherent fixed capacities.

The New Nativism, according to Dorothy Roberts, must be understood within the context of the eugenics movement. In the 19th century, immigration policy was influenced and connected to keeping “genetically inferior people out.”15(p132) For her, this single toxic and humiliating policy is at the core of New Nativism today, also known as xenophobic nationalism.15–17 In education, New Nativism is often referred to as racist nativism because this educational philosophy victimizes children and youth of color.18 For example, nativists explain almost any individual or population difference with the idea that children’s learning and development is genetically predetermined (eg, IQ or poor academic performance). Therefore, inheritance explains anyone or any group standing out (eg, race, gender, sexuality, ethnicity, and so on). This thought destroys opportunities for children and youth of color to finish school, attend college, and eventually become doctors and thought leaders. Understanding the mutating nativist thought that still permeates all our social practices and institutions is a vigilance worthy of our time.18–24

Behaviorist (aka Environmental) Approach

In opposition to Nativism, behaviorists (aka, environmentalists) developed the idea that newborn children are a blank slate. A child’s learning and developmental outcomes arise from environmental conditioning. According to many under the umbrella of behaviorist thought, inheritance is not the determining component, agency and freedom do not exist, and the environment external to the child determines development. This is one area where the nature (genes) versus nurture (environment) debates are still ongoing. Burrhus Frederic Skinner and Edward Thorndike were major developers of this psychological area.

Skinner and others demonstrated learning through conditioning experiments on animals.25–27 Learning occurred in test organisms when new associations between stimuli and responses were created from practice and reinforcement. Practice was trial and error, reinforcement was an immediate reward. One of Skinner’s colleagues, John B. Watson, famously stated “Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I’ll guarantee to take any one at random and train him to become any type of specialist I might select.”28(p82) Detractors refer to contemporary approaches that use modern conditioning practices as drill and kill methods because the learner practices through drills and in the process their interest in learning is killed. Skinner’s Behaviorism lost its popularity after cognitive science challengers demonstrated conditioning could not explain all of learning.29–32

Behaviorist ideas are still broadly used in psychology, education, and beyond even though Behaviorism is no longer fashionable in philosophy or psychology. Contemporary teaching methods include behavioral modification, mastery learning, and programmed instruction, and technologies of behaviorism include slot machines, online games, and flashcard-based learning apps (eg, Spaced Education).33,34 Audrey Watters called Skinner the most important theorist of the 21st century because his work on teaching machines has permeated all fields of education.35 Watters explained that after visiting his daughter’s fourth grade classroom in 1953, Skinner reported that all students were given the same math problem set (which some finished early, while others struggled inordinately) and none received immediate feedback (right or wrong answers).36 According to his theorizing, the student’s environment should be arranged such that stimuli (eg, mathematics instruction) occur in ways designed to instill the desired stimulus-response chains. This view suggests his daughter’s teacher should have presented lessons in small, manageable, pieces (instructional stimuli), asked students to complete a related task (eg, responses to math problems comparable to instruction), immediately
assessed their performance, dispensed reinforcement determined by students' task performance, and provided encouragement along the way. This would be repeated until the students became conditioned to give the right answers. Skinner invented a technical solution to what he saw in his daughter’s class—referred to as programmed instruction or a teaching machine—with the “effect... of a private tutor.”36(p37) This solution would ultimately make teachers obsolete and change the very nature of education.35 Most (medical) educators manage instruction in this way, to some extent, through: recalling facts, defining and illustrating concepts, applying explanations, memorization based on repetition, drill and practice exercises, employing token economics, and employing classroom management strategies.35 All students including medical students have plenty of past experience with the methods of Skinner's programmed instruction. We will return to its use in medical curricula as an element of team-based learning (TBL) exercises.

**Constructivist (aka Interactional) Approach**

Constructivism, also referred to as interactionism, represents a large, heterogenous body of theoretical approaches. In contrast to the nativists’ and behaviorists’ view of the child as a passive object, Jean Piaget and his colleagues developed a radical (now sanctioned) response. According to Piaget, children are not controlled by internal or external development-generating forces. Instead they are young research scientists driven by innate curiosity to explore the external world.37(p27) Piaget developed much of his constructivist philosophy and developmental theory—practice—philosophy from observing Maria Montessori’s classrooms.38 Montessori believed children should educate themselves within a rich educational environment developed by an expert teacher. She argued children are constantly learning in their everyday lives and what the child absorbs depends on what information and experiences cross their paths.39,40

In the course of their explorations, children come across new environmental phenomena and try to assimilate them into mental schemas (ie, into their existing ways of thinking). These new environmental phenomena, however, often do not fit exactly into children’s schemas, which creates an uncomfortable disequilibrium between children’s schemas and the external world. This pressure leads to the elaboration of these schemas as well as the development of new schemas. As a result, a new temporary equilibrium between children’s schemas and the external world is achieved, which lasts until a new state of disequilibrium is created when the children come across new environmental phenomena. This is learning, constructed by the learner with little intervention needed.41

While Piaget viewed children as active constructors of their cognition, he also postulated a limit on their abilities. Piaget (like Montessori) created the idea of universal cognitive development stages, which he later retracted, but are still popular.42 These appear in a fixed sequence, in accordance with a timetable universal for children in all countries and all cultures. For example, an 8-year-old cannot progress from the concrete operational stage (eg, think logically about concrete events) to the formal operational stage (eg, abstract logic, moral reasoning) until she is about 12 years old (or older). The upshot is neither children themselves nor their parents or teachers can make any difference in their development. The fixed developmental progression demands the learner experience and struggle with the disequilibrium, then discover a resolution.38

Although they were trying to challenge nativism, Piaget and Montessori’s constructivist theories and their educational implications echo elements of nativist philosophy: leave learners alone, provide them with the opportunities to explore the environment, but do not bother interfering with their explorations because you cannot promote or accelerate a child’s development.

One of the major criticisms is that the process is considered inefficient. In other words, students of all ages can spend a lot of time without a teacher resolving the disequilibrium. Another is the students’ search for answers may never arrive at the new conceptual targets they set for themselves (never mind a goal the teacher may have). They can develop misconceptions in the teaching–learning process that are never corrected.7 Furthermore, young learners cannot escape a particular stage other than through biological progression. Constructivism is in widespread use as a philosophical approach to teaching–learning in pK–12 schools, but there are plenty of examples in adult education including: problem-based learning (PBL), self-directed learning, and independent learning. We will return to the use of constructivist approaches in medical curricula in the form of team-based and problem-based learning exercises.

**Vygotskian (aka Cultural–Historical) Approach**

According to Vygotsky, learning and development are neither predetermined by heredity, as nativists hold; nor determined by conditioning, as behaviorists hold; nor the result of learner’s independent explorations, as constructivists hold.43 Rather, learning and development are the result of mediation. Vygotsky’s revolutionary idea was learning can lead development. This means teachers do not wait for a learner to be ready (biologically or otherwise), instead we structure or scaffold teaching–learning such that the learner can master symbolic, cultural mediators through their “appropriation and internalization... of inner psychological tools.”44(p24) One term, the zone of proximal development (ZPD), captures part of the teacher’s role in scaffolding45 the next outcome for learning.

Sociocultural theories are numerous and fall under the philosophical umbrellas of socioculturalism, social constructivism,46 socio-interactional constructivism, cultural–historical, activity-based constructivism,47 and sociocultural transformative activist stance,48 among others. Since its introduction by Lev Vygotsky and his students (eg, Aleksei Leontiev, Alexander Zaporozhets, and Alexander Luria) in 1930s Stalinist Russia and by Jerome Bruner and Michael Cole among others in the 1970s West, the development and use of socio-cultural–historical theories has substantially expanded in all fields of education.
Numerous scholars have written about Vygotsky’s theory of learning.

**Ascending from the abstract-to-the-concrete.** The social context is where the intrapersonal and the interpersonal are mutually transformed and where concrete understandings of cultural tools and practices are agreed upon. Vygotsky argued processes and contents may exist initially outside an individual in a shared space, plane, or mind. We learn first on the **social** plane before individualizing. This plane is where our teachers, tutors, or peers externalize, share, and coauthor tools of the mind with us (eg, inflammation or cocreating a differential diagnosis). On this plane, one works with others to transform this new tool into something we can make our own, through internalizing and individualizing by ascending from abstract to concrete (see below).49,50

Most teachers (and students) think it is necessary to teach isolated facts through concrete examples before teaching the underlying content-based generalizations, or abstractions, that explain them (eg, a class might study how objects fall in a variety of situations before being presented with the idea of gravity). Vygotsky argued that “initial mastery of [meanings and operations] provides the basis for the subsequent development of a variety of highly complex internal processes in children’s thinking.”51(p90) This was termed ascending from the abstract to the concrete and is a “method of theoretical thought.”51(p98) It means that the formation of content-based generalizations (eg, the meaning of inflammation) requires that learners discover and master the abstraction (ie, generally what do we mean in medicine when we claim a role for inflammation in a diagnosis) before they attempt to master the concrete and particular (ie, identifying, creating, and/or evaluating claims of inflammation). This is more efficient and robust than discovery through the constructivist approach and supports the internalization of the underlying big concept.52,53

**Cultural tools and human mediators.** Vygotsky’s notion of culture refers to what is human-made and what makes us human—our physical and symbolic tools referred to as cultural tools or tools of the mind.54 Cultural tools include concepts, theories and ideas (such as, professionalism, team consciousness, wellness), and schema or routines (such as, taking a patient history or performing sterile technique). In Vygotsky’s world, these are learned through mediation in the form of organized learning activity in the company of teachers and more able peers.45,49,55 When a human mediator creates activities in interaction with a learner the function of a cultural tool is transferred from the learner’s ZPD to their zone of actual development.44 A great number of studies have demonstrated that learners, with the help of human mediators, can become involved in activities more complex than those they can initially master.44,53,56-58 Joint activity on a shared object with mediators results in that object being appropriated by the learner. Since Vygotsky developed this theory, researchers have been working to understand how the transfer from the interpersonal to the intrapersonal plane works. To date, we know various types of human mediators (eg, apprenticeship, guided participation, and appropriation), a great number of forms (eg, modeling, feedback, praise, and critique), and numerous techniques (eg, facilitating first steps in problem-solving). Although we are still learning why and how the interaction works, we do know mediation of cultural tools does matter for human development. In contrast to behaviorist and constructivist approaches, where simple teaching materials may stand alone, Vygotsky argued human mediation is always essential. Unfortunately, “many teachers [still] believe that the meaning embedded in [highly structured learning] materials is sufficiently transparent to students and . . . therefore does not warrant intensive mediation.”44(p23)

The Vygotskian philosophy can be realized in cultural–historical instructional approaches including developmental instruction,59 case-based learning (CBL), pedagogy of discovery,60 teaching for discovery,61 inquiry teaching,62 peer tutoring, reciprocal teaching,63,64,66 reflective teaching, object-based learning, cognitive apprenticeship55 as long as instructors deliberately consider how they cocreate and use modeling, scaffolding,45 and ZPD for learning to provide rich experiences for learners. Possible examples in medical education: meaningful curriculum (from basic science of medicine to simulated patients to scaffolding during rotations and residency until basic competencies are met). Task-based learning per Vygotskian and neo-Vygotskian curriculum designers ought to dominate the approach throughout.

Students construct their learning together with teachers, peers, tutors, and other learning partners. A key teaching–learning goal is to “co-create tools of agency for each learner’s unique voice and stance in co-authoring the world with others.”66 Authorship refers to the process of taking up shared activities “via contributing to changing them, by individuals qua actors of society and history in always creative, novel, agentive, and transformative ways.”56(p439) Through Vygotskian theoretical–practical philosophical approaches, the technical criticisms often leveled at Piaget’s constructivism were resolved. Both, teachers and students matter.

**Value of Theoretical–Practical–Philosophical Underpinnings of Medical Education**

Why should we, educator–researchers, consider what theory–practice–philosophy we are using when we design, use, or evaluate a particular instructional format, curriculum, or pedagogy? Some responses include:

1. **The adopted theory–practice–philosophy greatly determines what methods we use when educating or studying education.**43
2. **Making explicit the theory–practice–philosophy we use in our curriculum and pedagogical commitments facilitates integration and learning**57 as well as providing a rationale for teachers’ thinking and judgment while planning bespoke lessons.58
Table 1. Heuristic for Pedagogical Inquiry.

| Prompts       | Questions for pedagogical inquiry (stance refers to theory–practice–philosophy stance, position, or viewpoint, taken to teaching–learning) |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Key theorists | What educational theory–practice–philosophy is cited? Who invented the stance? When and Why? |
| Nature of knowing | How is knowledge and knowing understood and described (eg, finished, complete and static or ongoing, incomplete, and dynamic)? |
| Key description of learning | What is the description of learning represented and/or used in the stance? |
| Keywords Stress on | What keywords best describe the stance? What does the stance accentuate? |
| Future outcome | What should the learner be able to do as a result of taking this stance? |
| Role of teacher | What is the role of the teacher who (un)willingly takes this stance? |
| Role of learner | What is the role of the learner who (un)willingly takes this stance? |
| Agency Power | How is agency described? Who has agency? What do we do with this stance (eg, curriculum, instruction design)? Do I recognize a pedagogy of social control represented by this stance? Can I use this stance to teach critically? Where did this stance come from? What social practices are expressed in this stance? What views of power does this stance embody? Whose interests seem to be served by taking this stance? How are students treated? How do students feel about the prospect of learning? etc |

3. We must identify theory–practice–philosophy that is detrimental or harmful to our students or ourselves, conversely determining a theory–practice–philosophy leads to improved educational practices through understanding learners and learner perspectives.

4. Providing guidance for planning, integrating, and reflecting on teaching–learning.

The earlier approaches presented here, nativism, behaviorism, and constructivism provide some understanding of learning in the short term. However, they do not address objectives that benefit the learner, such as (a) tools of agency and self-determination (necessary for taking a stance on knowledge including being able to know and think for themselves), (b) purposeful and meaningful tools of the mind (necessary objects and structures, both material and immaterial which serve as mediating means embedded in the interaction between human beings and the world but also shaping the interaction), and (c) intrinsic motivation (desire to learn for the sake of learning and to shape one’s own learning).

Pedagogical inquiries into instructional programs, professional development materials, and research presentations are common but inquiries into the theory–practice–philosophy stance(s) embodied in these performances are not. We developed a heuristic (Table 1) for inquiries designed to help faculty identify an implicit stance and shift from one to another as desired.

Instructional Formats Commonly Used in Medical Education and Their Underlying Theoretical–Practical–Philosophical Ideas

We can use the heuristic in Table 1 to examine teaching formats commonly employed in medical curricula. The American Association of Medical Colleges has compiled survey responses from most of the medical schools in the United States and Canada. While approximately 51.1% of all instructional hours are used in lectures, the remaining 48.9% of hours are spent in a variety of other activities (eg, small and large group discussions, laboratories, self-directed learning, simulation, etc). Nearly 10% of the remaining time (on average) is spent in 1 of 3 instructional formats: PBL (1.90%), CBL (5.62%), and team-based learning (2.21%). Next, we use the heuristic to examine the theoretical foundations underlying these 4 methods (outlined in Table 2).

Lecture

The lecture format is quite old and has roots in transmission of oral history or biblical prophecy. Lecture is not tied to any of the philosophical groups but can support aspects of each. Students are passive and easily succumb to boredom unless the speaker entertains them. Current recommendations in medical education broadly favor active methods for student engagement. As we demonstrate next, active approaches are also not typically explicit about a theory–practice–philosophical stance.

Problem-Based Learning

Howard Barrows, the key architect of PBL in medicine, did not draw on theory–practice–philosophy in educational psychology, cognitive science, critical pedagogy, feminist thought, and so on. According to Alan Neville, the rationale for the curriculum Barrows and his colleagues proposed was “it would make medical education more interesting and relevant for their students.” Since then, Neville wrote, a remarkable widespread adoption of the McMaster approach followed “without any real evidence at the time that the PBL-trained learner would become a better doctor.”

In PBL, according to Barrows, learners develop problem-solving skills by solving problems. Learning is student-centered and self-directed activity; teachers are facilitators or guides (eg, a tutor) and students work in small groups. Problem-based learning is designed with 4 possible educational objectives in mind and organized around the acquisition of a knowledge base that is (a) integrated, (b) “structured around the cues presented by patient problems,” (c) an “effective and efficient clinical problem-solving process” similar to that used in clinical medicine, and (d) acquired through self-directed learning and team skills.
Table 2. Theory–Practice Analysis of Dominant Approaches Used in Medical Education.

| Prompt                          | Lecture (atheoretical)                                                                 | Problem-based learning                                                                 | Team-based learning                                                                 | Case-based learning                                                                 |
|--------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Key theorists                   | The practice of lecture was developed in medieval schools. “To read” (lege) became “to teach,” and “reading” (lectura) became a “lesson.” A professor commented on the authorities by reading lines from a text in philosophy, grammar or theology, and provided various types of explanations.70 | Originators were John Evans, Bill Spaulding, Bill Walsh, Jim Anderson, and Fraser Mustard.71 | Larry Michaelsen and Michael Sweet72 created a bricolage of the following ideas: Piaget (equilibration), Vygotsky (ZPD), Bandura (self- and group-efficacy), and Wiggins and McTighe (backward design) | Originators were James Lorrain Smith, Rudolph Virchow, and Karl Rokitansky among others.73 |
| Nature of knowing               | Having, possessing facts and skills                                                    | Having, possessing facts and skills; Belonging, participating, and communicating66 [inferred] | Having, possessing facts and skills; participating and communicating (ie, applying knowledge acquired)74 | Having, possessing facts and skills; belonging, participating, and communicating66 [inferred] |
| Key definition of learning      | Learning is exact memorization of the works of others for later retrieval and application | “Learning is the recognition that one is not able to solve the problem, but has to learn something new sets in motion a learning process whereby the individual changes his capacity for learning while also learning something specific”79[p108] [inferred; grounded in Piaget’s approach] | Learning exists in 2 forms (1) the “acquisition of new information or new responses restricted to a specific situation” (memorization), (2) the “acquisition of general thought structures which apply to many situations”76[p218] (transferable knowledge) | “Children’s learning and development are the result of adult mediation—the engagement of learners in relevant activities, in the context of which adults promote the development in learners of new motives and teach them new tools of thinking, problem-solving and self-regulation.”43[p9]49 [inferred; grounded in Vygotsky’s approach] |
| Key words                       | Memory, repetition, reward, transmission, and receiver                                 | Open inquiry; independent, small groups; self-directed; learning issues                 | Guided-inquiry, team development and dynamics, accountable, timeliness, and readiness | Guided inquiry; social; scaffolding; shared responsibility (ie, learning collective) |
| Stress on                       | One-way transfer between instructor and student; transmission of information (facts, views, beliefs); independent study of textbooks | Student-centered learning by trial and error (student-environment interactions dominate) | Team dynamics (cohesiveness, coalitions, time), accountability (accountability to others through preparation, contribution, and reliability), peer assessment, timely feedback, assignments that promote team development and learning, manageable team interactions, efficient problem-solving | Student–teacher centered learning in collaboration with more able peer (mediation and scaffolding) |

(continued)
| Prompt               | Lecture (atheoretical)                                                                 | Problem-based learning                                                                 | Team-based learning                                                                 | Case-based learning                                                                 |
|---------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Future outcome      | Ability to solve particular problems efficiently and correctly                       | Curious life-long learners with broad appreciation of the complexity of medicine<sup>77</sup> | Appreciation of the value of teams for solving complex problems; achieve a depth of understanding about a problem that can be useful in the future<sup>78</sup> | Structured approach to clinical problem solving; efficient learning; goal directed<sup>77</sup> |
| Role of teacher     | Expert; to know what is best for the student; to transmit information                 | Passive role; provide minimal support, do not redirect or guide the learner or discussion; allow misperceptions to persist<sup>77</sup> | Guided inquiry provide advanced preparation (i.e., the problem and the readings). Teacher is expert; to know what is best for the student; to transmit information<sup>78</sup> | Guided inquiry provide advanced preparation; work with students to solve problems; redirect incorrect answers with guiding questions and corrections<sup>77</sup> |
| Role of learner     | Novice; to understand teacher knows what is best for the student; to assimilate information quickly; to accept the assertions of instructor; to receive the dictum of authority; passive learning receiver | Creative problem solving without advanced preparation (i.e., few tools); determine what is explored and what is learned alone and with peer, but not skilled other [inferred] | Creative problem solving with advanced preparation (many tools); work with peers (and teachers through assessments) to solve problems (use tools; new tools learned)<sup>78</sup> | Creative problem solving with advanced preparation (many tools); work with peers and teacher to solve problems (use tools; new tools learned) [inferred] |
| Agency              | Instructor is agentic, student is passive                                            | Student could be agentic or passive; teacher is peripheral and generally passive<sup>77</sup> | Teachers are agentic; define the problem spaces; experts on the periphery during the problem-solving period. Students are controlled with limited agency [inferred] | Both students and teachers are agentic [inferred] |
| Power (analyzed: emancipation, technical rationality, hegemony, discursive power) | Teacher is the dominant power bloc; technical rationality is ideology; hegemonic structure has the power to create inequalities; language of assimilation | Teacher is more dominant than learners (e.g., grader); learners dominate during the problem-solving activities; potential for humanitarian or oppressive purposes; linguistic power determined by group could be used for regulation, oppression or co-construction [inferred] | Teacher is more dominant than learners, however, there is potential for shared power; models humanitarian over oppressive purposes; linguistic power is of co-construction [inferred] | Teacher is more dominant than learners; however, there is potential for shared power; models humanitarian over oppressive purposes; linguistic power is of co-construction [inferred] |

Abbreviation: ZPD, zone of proximal development.
description of PBL illustrates how the nature of student work resembles constructivist ideas (student-directed learning, self-directed learning):

[PBL is] a case of learning ‘stuff’ as students work their way through a clinical problem… Information is gradually assembled in a helter-skelter way as the student reflects on the clinical problems. Each student and each group may choose to reflect on different issues in a problem. Note that it is not necessary to ‘solve’ the problem… in order to engage in PBL. You can enter anywhere, leave anywhere, and leave the poor paper patient in a state of suspended animation or inevitable demise if you choose. The primary objective of problem-based learning is to accumulate the concepts of medicine in the context of a clinical problem.\(^8\)\(^{p282}\)

This method resembles Piaget and Montessori’s constructivist landscapes in which an expert teacher designs a stimulating learning environment (ie, a clinical problem) and when students come across new phenomena they try to assimilate. Other investigators have applied a variety of theoretical concepts in support of PBL. These include concepts from cognitive psychology (e.g., learning as memorization: acquisition over time facilitates pattern recognition and similarity of context facilitates recall) as well as broader theories of learning (e.g., contextual learning theory, information processing theory, cooperative learning theory, self-determination theory, control theory). The result is a hodgepodge of proposals. Information processing is a theory of memory, cooperative learning is based on social interdependence theory (a socio-cultural approach), self-determination theory is a motivational theory, and control theory is a sociological theory used to describe the behavior of systems of individuals. This makes evaluation and change challenging.

Overall, a PBL session typically uses facilitators to shepherd the students through the process, but these tutors do not provide explicit answers to questions of content. Rather, as constructivist principles dictate, the students (individually or in small groups) are required to define their own objectives, then achieve them before reporting back to complete the session. This approach has practical benefits because the school does not need a stable of content experts available simultaneously (i.e., it scales well). PBL also appeals to students who enjoy the detective or scavenger hunt style of answering questions (ie, they know the answers are out there somewhere). As mentioned above, the process can be inefficient, the students do not know enough to set objectives beyond their own expertise, they may get stuck in blind alleys or end the session with misinformation.

Team-Based Learning

According to Larry Michaelsen and Michael Sweet, faculty in business education, TBL has 4 essential elements: (1) Groups, properly formed and managed; (2) Accountability, students must be accountable for the quality of their work through multiple assessments; (3) Feedback, students must receive frequent and timely feedback; and (4) Assignment design, promotes learning and team development. We will try to unpack the theory–practice–philosophical stance Michaelsen and Sweet might intend when we use TBL.

First, a typical TBL class period is comprised of individual advanced preparation followed by the Readiness Assurance Test process, which include individual and team close-ended multiple-choice scratch tests, written appeals, and instructor feedback. Readiness tests are followed by team searches for answers to specific questions and another team test. Near the end of the course, content learning is reinforced with exams, instructors recognize effective team interactions, and students perform peer evaluations. Without the inclusion of additional theory–practice–philosophical explanations, an educator would likely interpret TBL as a combination of behaviorist and constructivist approaches to learning. Learning is viewed as acquisition, operating by logical rules, which is controlled by testing in an environment of rewards and punishments.

Groups. The purpose of the team is to improve students’ ability to become self-managed and ‘highly effective learning teams.’\(^78\)\(^{p10,12}\) To this end, instructors are to control 3 variables: Ensuring groups have adequate resources, ensuring intragroup coalitions do not interfere with groups developing cohesiveness, and ensuring groups develop into learning teams. Michaelsen and colleagues draw on the literature of group dynamics to create quality interactions through “ensuring that members contribute time and effort to group work.”\(^78\)\(^{p11}\) As the teams continue to work together over time, the authors intend that the multiple group assignments will “improve learning and promote the development of self-managed learning teams.”\(^78\)\(^{p7}\) The assumption here is learning depends on group dynamics.

Feedback. According to Michaelsen and Sweet, feedback provides two instructional “levers.”\(^72\)\(^{p11}\) First, to drive content learning and retention and second to shape group development. The authors created a bricolage of ideas from constructivist, cultural–historical, and social cognitive theories of learning and development to explain how each element of the Readiness Assurance Process (the feedback system) supports these simultaneous goals. They do not, however, draw on these theories to understand learning specifically.

Next, we examined, from Vygotskian cultural-historical stance, Michaelsen and Sweet’s\(^72\) interpretation of the ZPD. Who recognizes and creates the ZPD in TBL? The readiness assurance process provides the group with information about potential, current, and future ZPDs. In other words, it helps the group rank students (from least to most knowledgeable), determine who is the more knowledgeable other, decide who can be trusted, as well as how “less knowledgeable members… ask for help.”\(^72\)\(^{p39}\) It is left to the emergent or best student in any team to lead in some way. Vygotsky would want that person to become the teacher and help those who are less knowledgeable, but that process is not scaffolded in a TBL.\(^45\)
Thirdly, Michaelson and Sweet borrowed from a social constructivist approach. They used Albert Bandura’s ideas of perceived and collective efficacy (an individual or group’s perception of its capacity to accomplish a goal) to explain how team roles are taken or assigned based on the member(s) “most likely to provide accurate corrective modeling on any given topic.” As with creating and resolving the ZPD for learners, the team does not receive instructions for how to apply a concept of efficacy to their own learning. The authors argue the readiness assurance process can help teams identify and select leaders based on “accumulate[d] experience with each other and feedback from the environment.”

**Accountability.** Teams and individuals are held accountable to their peers and the instructors for the quality and quantity of their individual work. Individuals are also expected to contribute time and effort to group work. From Michaelson and Sweet’s description, the readiness assurance process includes two aspects that hold teams accountable in these ways. One is “using assignments that require teams to create a product that can be readily compared across teams and with ‘expert’ opinions.” The other is “using procedures to ensure that such comparisons occur frequently and in a timely manner.” The authors do not outline the role of “accountability ground rules” in any specific theory-practice-philosophy of learning, which could aid medical educators (and students) in assurance process design and integration.

**Assignment design.** At the heart of any theory–practice–philosophy for teaching–learning is the nature of the learning materials used by the learner. In TBL, the authors argue assignments ought to emphasize group interaction. High-level interactions are those that “require teams to use course concepts to make decisions that involve a complex set of issues.” The TBL Collaborative offers instructions for how practitioners ought to design student-centered, process-oriented guided inquiry learning activities (POGIL). Inquiry learning approaches from constructivist philosophy include materials designed to engage students in defining or developing a particular concept, pose critical thinking questions crafted “to lead students to make inferences and conclusions,” and provide students with additional practice in problem-solving. In POGIL, group work “promotes the negotiation of and develops a mutually shared meaning of knowledge.”

According to Michaelson and Sweet, TBL has several advantages including cost-effectiveness (multiple content experts are not required) and user satisfaction (faculty form more personally rewarding relationships with their students, and students learn how to solve difficult and complex problems in the company of a team of peers).

So what theory–practice–philosophy stance did Michaelson and Sweet take on learning? Based on the emphasis on constructivist and cognitivist approaches, we can infer they believe learning ought to be viewed as acquisition through construction and consensus. Their object of learning is 3-fold (a) team-building, (b) problem-solving in groups, and (c) course content. Their preferred learning activity is a problem-solving approach. Instructors interested in shifting behaviorist stance(s) to a more agentive stance(s) ought to monitor their use of the readiness assurance process. Educators wanting to make this shift ought to take care not to use these tests for reward or punishment for the purpose of manipulating individual or group behavior. A variety of formative assessments guided by constructivist (or other) approaches are available (eg, dynamic assessment). Tests can also be designed by and with students and take various formats.

**Case-Based Learning**

James Lorrain Smith, a pathology professor at the University of Edinburgh, introduced what he called the “case method of teaching pathology.” This method built upon earlier precedents in pathology (eg, Virchow, Greenfield, Rokitansky, and others). Lorraine Smith’s major contribution to the case method was the presentation of pathological investigation together with clinical observations (ie, theory–practice). Prior to his approach, most European medical education separated clinical and pathological studies. Lorraine Smith argued a cooperative and dialogical relationship ought to exist between pathologist and clinician and was essential for the practice of pathology itself. This was modeled in his approach to case study, which included elements from clinical, pathological anatomy, and histology in addition to the latest developments in pathologic science. Students were given a full set of source material on a patient case (eg, clinical and pathological findings with special reference to the disease and its development), a series of jars with the affected organs, a series of microscopic preparations, and access to various records and specimens outside of scheduled class time. After an introduction to the case and its materials, students were expected to pursue their own studies and ultimately “prepare a full account of the naked-eye and microscopic characters of the specimens, a review of the case, and [to] discuss the post-mortem findings in relation to clinical history.” They worked collaboratively but prepared individual written reports. According to Sturdy, from the beginning, then, the students were expected to see each case as representing a particular ‘clinico-pathological situation,’ and they received feedback from staff on their ability to achieve such clinico-pathological point of view, both orally in class and in their written reports on the selected cases.

While a variety of CBL approaches vary on the contents of the case, they are not too dissimilar to Lorraine Smith’s original approach. Ostensibly, Lorraine Smith was not guided by a known educational philosophy or theorizing other than his dialogic theorizing intended to help students build a clinical–pathological stance toward problem-solving. Again, without an obvious educational philosophy behind the development of the CBL approach, integration will always reflect a given class of instructor(s) and students.
Present-day CBL, as represented in Table 2, is an approach whose practice does use various elements that could be inferred as cultural–historical if an instructor and students were to interpret them that way, such as guided inquiry, shared responsibility, structured approach to problem-solving, redirect incorrect statements, goal direction, and advance preparation with resources (ie, tools). On the other hand, these elements could be interpreted through the lens of a range of learning theories and educational philosophies as illustrated below.

A structured approach to problem-solving could reflect the cultural–historical idea of scaffolding or mediation as long as it is helping learners move back and forth with an overall trend of ascending from the abstract to the concrete. Instead, it could also refer to a behaviorist learning program (eg, a structured environment). Based on the published examples and discussions of CBL, its treatment of learning resembles cultural–historical stance more than behaviorist or constructivist. Learners can be content experts (eg, encouraged to use cultural tools to solve new problems, carry out debates, or discussions), and facilitators can be guides who create scaffolding for learners (eg, able to correct inaccurate assumptions or answers as well as ask guiding questions to help students focus on key points of the case).

Case-based learning’s advance preparation element refers to the work students do in advance of a lesson without the instructors. Students generate their own problem spaces by reading 1 or more core articles about the case topic. They read in the company of others or alone. This reading is usually provided with directions from the instructor (ranging from very specific to open-ended), and sometimes students are also presented with specific learning objectives they are expected to learn. Without grounding in any particular theory–practice–philosophy approach to learning, the advance preparation can be (and is) conceptualized in ways that have very little to do with learners and learning but everything to do with teachers. In other words, the selections of those advanced preparation readings and objectives by the instructor are significant for the CBL experience, but these choices are often made by instructors without theory–practice in mind. For example, an instructor who is creating an advance preparation for students from an unconscious behaviorist/environmentalist model will produce an assignment that looks quite different from an instructor who is trying to consciously design using a specific sociocultural model. The format, CBL, does not determine the practiced theoretical structure of the lesson, the instructor and students do.

The idea of shared responsibility could be a behaviorist concept (eg, the instructor or programmer is responsible for creating an effective instructional program and the learner is responsible for completing it successfully) or it could be a cultural–historical concept (eg, the instructor and learner coauthor their responsibilities on the social plane where the instructor will externalize and the learner will internalize). As with the other concepts, if the idea of shared responsibility does not address learners and how they learn, then it becomes an empty practice underpinned by unconscious theorizing that cannot be tested, expanded, revised, or discarded.

Connections to Contemporary Ideas and Movements in Medical Education: Benjamin Bloom, Competency-Based Education, Active Learning, and Adult Learning

So, where do overarching contemporary ideas and approaches in medical education belong? For example, where does an idea like Classification of Educational Goals by Bloom et al? (aka Bloom’s Taxonomy) fit in our theory–practice story? What is the nature of the umbrella term active learning? Do adults need teaching and learning approaches distinct from children and youth? Where does the idea of competencies belong? We conclude with a few ideas.

Competency-Based Education

In an analysis of teacher education (a professional certification with structural overlaps to medicine), van Huizen, van Oers, and Wubbel, described three paradigms that dominate the field including competency-based teacher education:

Competency-based education defines a public (supra-personal) standard for teaching as a framework for teacher education, that it is explicit about objectives and assessment criteria, and that it emphasizes the need for teacher education to bear fruit in effective performance in the daily practice of teaching. This paradigm has been criticized for reducing the teacher’s role to that of a ‘technician’ or ‘executive.’ (p268)

Replace teacher education with medical education and the story is similar. Competency-based education in any field regulates all aspects of education. It (a) defines a public standard for what it means to be a professional, (b) defines the framework for what professional education ought to deliver based on the public standard, (c) expects that professional educators will be explicit about the objectives and assessment criteria, (d) emphasizes that professional education organizations be held accountable for the performance of its graduates, (e) uses the public standard for public accountability, and (f) recognizes effective performance in the daily practice of the profession as a response to the professional–legal relationship. In other words, the use of a public standard permeates the system and is used to shape and control subject, objects, interactions, roles, rules, and tools of the system.

The competency-based education we know today has its roots in the early Flexnerian revolution—a turn from a structure and process-based curriculum to a competency-based and evaluation of outcomes approach in the late 1940s after WWII. The idea of further organizing and standardizing was stimulated by the works of Frederick Taylor and his scientific management approach to industry; BF Skinner and his demonstration of operant conditioning; and Benjamin Bloom (with numerous colleagues at the American Psychological Association) for the idea of measurable learning behaviors. The idea of competencies and competency-based education belongs squarely in the philosophical camp of the behaviorist/
environmentalist and the emerging models of that period. A key driving force behind the most recent turn to competency-based approaches is accountability to the public “in light of the reliance on public funding.”

Recently, Frank et al\(^\text{90}\) reimagined and defined competence and competency. Prior curricula were time-based, teacher-centered, and passive. In the approach by Frank and colleagues, competency-based education has a focus on outcomes, an emphasis on abilities, a de-emphasis of time-based training, and the promotion of learner centeredness. Competency, in their approach, has a “multi-dimensional, dynamic, developmental, and contextual nature.”\(^{99(p64)}\) It is important to avoid a technocratic management system that promotes a lowest common denominator of sufficient.

**Active Learning**

Just as Frank and colleagues are suggesting, Bloom and Skinner were keen on teaching and learning that was developmental (ie, tracked the learners progress) and promoted higher order thinking and problem-solving.\(^{36,86}\) Neither psychologist was interested in students just memorizing information (ie, the banking model of education later described and challenged by Paulo Freire\(^{91}\)). In the late 1940s, amidst the turn to competency-based evaluation was also a call for a shift from passive to active learning.\(^{88,92}\) But what did active learning look like at the time? It was being defined by the likes of Skinner, Chomsky, Bruner, Piaget, and Montessori—who were developing the idea from wide-ranging frameworks. Today, Prince explains, active learning is an umbrella term that generally means,

> ... any instructional method that engages students in the learning process. In short, active learning requires students to do meaningful learning activities and think about what they are doing.\(^{92}\) While this definition could include traditional activities such as homework, in practice active learning refers to activities that are introduced into the classroom. The core elements of active learning are student activity and engagement in the learning process. Active learning is often contrasted to the traditional lecture where students passively receive information from the instructor.\(^{93(p223)}\)

Attributions are given to a new gamut of theorists: Paulo Freire, Lev Vygotsky, Gilbert Ryle, Jean Piaget, John Dewey, Maria Montessori, and Jean-Jacques Rousseau. Active Learning could mean learning at your own pace through real-world situations (eg, Montessori, PBL) or by working with a teaching program that tracks and responds to your current level of understanding/development with new, gradually more difficult, tasks at your level (eg, Ryle,\(^{94}\) Skinner, flash cards, School of One\(^{85}\)).

**Adult Learning**

It is worth noting that many of the theory–practice–philosophies presented here and elsewhere partly originate in research on early human development. That said, all of them have been, and continue, to explore adult learning as we’ve seen so far.\(^{36,97}\) Approaches that have been attractive to medical educators are those advanced by Malcolm Knowles (Andragogy) and Jack Mezirow (Transformative Learning). In his autobiography, Knowles\(^{98}\) described influences from behaviorism (Thorndike), constructivism (Piaget and Kolb), Socrates, life-span developmental psychology (Goulet and Baltes), pragmatism and learner experience (Dewey), field theory (Lewin), democratic teaching (Hewitt and Mather), and more.

Knowles’s andragogical model has 6 elements regarding the need to know, the learner’s self-concept, the role of the learner’s experience, readiness to learn, orientation to learning, and motivation to learn. These elements have undergone some evolution over the years to their present appearance, but they are straightforward. Appealing to medical educators may be the learner centeredness at the heart of the ideas. Andragogy could be recognized as a member of the constructivist family of approaches to teaching and learning; therefore, an educator who is considering this approach might want to analyze it and revise it from that stance.

Mezirow draws on a smaller number of philosophers to develop his approach to teaching and learning, these include but are not limited to the theoretical-practical-philosophical works of Thomas Kuhn and Paulo Freire. However, the major credit goes to the German philosopher Jürgen Habermas (1981)\(^{95,100}\) for his theory of communicative action. According to Mezirow, this theory is “an important contribution to contemporary social theory [and] also suggests a new foundation for understanding adult learning and the function and goals of adult education.”\(^{101(p65)}\)

One of Mezirow’s appeals to medical education is the idea that (a) adult learners ought to recognize that thinking “as an autonomous and responsible agent is essential for full citizenship in democracy and for moral decision making in situations of rapid change”\(^{99(p7)}\) and (b) education ought to involve group deliberation and problem-solving and it ought to be learner-centered, participatory, and interactive. Mezirow’s approach is also centered around the strongly metaphorical–abductive logic of Habermas (and Marx), which roughly means (a) the learner moves from the abstract to the concrete (metaphorical) and (b) in communication we try to understand what someone else means by drawing upon our experience to explain theirs (abduction).\(^{101}\) An educator considering Mezirow might want to compare his approach to others in the cultural–historical and critical pedagogy philosophies.

**Exploring Learning Theory–Practice–Philosophy in Medical Education**

We recommend that all educators take a stand and state their philosophy of education and/or their theories of learning in any curriculum or pedagogical endeavor—revealing the theory–practice–philosophy held by an originator obviating the need...
to unpack the language used and the practices described. Interconnected statements of theory–practice–philosophy (not simply a statement of practice or theory) can help an educator know whether or not they want to adopt an approach, and if so, how they might integrate the approach in ways that make learning possible. An interconnected stance can lead to productive pedagogical inquiries that continue to transform and expand a particular approach.

The heuristic for pedagogical inquiry (Table 1) was designed to help identify theory–practice–philosophical influences on curriculum and instruction. We have provided an abridged overview of 4 influential educational philosophies in medical education in the United States and Canada today. The instructional formats we choose have theoretical implications, and the philosophies we choose have practical implications because theory, philosophy, and practice are inseparable. For example, students may have a difficult time learning to become caring professionals (eg, physician as advocate in community) when we incorporate behaviorist principles (eg, frequent multiple-choice assessments of fact-based knowledge and a practice of awarding points to reinforce particular views of the world). In short, we cannot teach love with a stick. It should not come as a surprise when we use grades and money as rewards throughout the medical system that we get medical professionals who compete for grades and salary because these are the markers of success. For physicians to be able to coauthor caring and agentive identities for themselves and their colleagues, pedagogical approaches are needed that rely on humanistic, emancipatory, critical, and daring theory–practice–philosophies.

We are aware that medical educators may be under specific pressures that could limit the pedagogical inquiries they can undertake in their departments and classrooms including students’ desires to perform well on their board exams (controlled by United States Medical Licensing Examination), appeals from residency admissions officers to provide grades for discriminating between applicants, financial constraints that limit numbers of teaching staff or computing resources, and faculty commitment to maintaining a status quo. The pedagogical inquiries outlined by the heuristic (Table 2) include a range of involvement (from one person to an entire system) to accommodate some of these limitations. One solution is to use critical approaches to inquiry, which involve all necessary stakeholders (students, faculty, administrators, consultants, etc) in an effort to find solutions that work for individuals and groups. Whatever approach an inquiry team uses it ought to question (or commit to) sought after theory–practice–philosophical commitments to critical, emancipatory, agentive curricula, and instruction.

We all want more—to achieve competency in performance, to coproduce agency for students and their patients, and to advance social justice ideals. Particular teaching methods do not advance these goals, one must operate at a level of theory–practice–philosophy to build this future.

Declaration of Conflicting Interests
The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding
The author(s) received no financial support for the research, authorship, and/or publication of this article.

References
1. Irby DM, Cooke M, O’Brien BC. Calls for reform of medical education by the Carnegie foundation for the advancement of teaching: 1910 and 2010. Acad Med. 2010;85:220-227. doi:10.1097/ACM.0b013e3181e88449
2. Liaison Committee on Medical Education (LCME). Functions and structure of a medical school: Standards for accreditation of medical education programs leading to the MD degree. 2020. Accessed January 28, 2020. https://lcme.org/publications/
3. Flexner A. Medical education in the United States and Canada. Bull World Health Organ. 2002;80:594-602.
4. Bakhtin MM. Problems of Dostoevsky’s Poetics. Ardis; 1973.
5. Stetsenko A. Creativity as dissent and resistance: transformative approach premised on social justice agenda. In: Lebuda I, Glaveau VP, eds. The Palgrave Handbook of Social Creativity Research. Springer-Verlag GMBH; 2019: 431-445.
6. Noddings N. Philosophy of Education. Routledge; 2018.
7. Karpov Y, Haywood HC. Two ways to elaborate Vygotsky’s concept of mediation: implications for instruction. Am Psychol. 1998;53:27-36. doi:10.1037/0003-066X.53.1.27
8. Vygotsky LS. The development of scientific concepts in childhood. In: Rieber RW, Carton AS, eds. The Collected Works of L.S. Vygotsky: Volume 1 Problems of General Psychology Including the Volume Thinking and Speech. Vol 1. Plenum Press; 1987: 167-241.
9. Cowie F. What’s Within? Nativism Reconsidered. Oxford University Press on Demand; 1999.
10. Elliott ML, Knodt AR, Ireland D, et al. What is the test-retest reliability of common task-functional MRI measures? New empirical evidence and a meta-analysis. Psychol Sci. 2020; 31: 792-806. doi:10.1177/0956797620916786
11. Plomin R, von Stumm S. The new genetics of intelligence. Nat Rev Genet. 2018;19:148-159. doi:10.1038/nrg.2017.104
12. Ferguson CJ, Beaver KM. Natural born killers: the genetic origins of extreme violence. Agress Violent Beh. 2009;14:286-294. doi:10.1016/j.avb.2009.03.005
13. Chomsky N. Approaching UG from below. In: Sauerland U, Gärtner H-M eds. Interfaces + Recursion = Language? Chomsky’s Minimalism and the View from Syntax-Semantics. Vol. 89 of Studies in Generative Grammar. Walter de Gruyter; 2008. https://doi.org/10.1515/9783110207552-001
14. Chomsky N. Aspects of the Theory of Syntax. MIT press; 2014.
15. Roberts DE. Who may give birth to citizens—reproduction, eugenics and immigration. Rutgers Race & L Rev. 1998;1: 129-135.
16. Friedman U. What is a nativist? And is Donald Trump one? The Atlantic. 2017. Accessed January 28, 2020. https://www.theatlant
tic.com/international/archive/2017/04/what-is-nativist-trump/521355/
17. Giroux HA. White nationalism, armed culture and state violence in the age of Donald Trump. Philos Soc Crit. 2017;43:887-910. doi:10.1177/0191453717702800
18. Huber LP. Discourses of racist nativism in California public education: English dominance as racist nativist microaggressions. Educ Stud. 2011;47:379-401. doi:10.1080/00131946.2011.589301
19. Muñoz SM, Vigil D. Interrogating racist nativist microaggressions and campus climate: how undocumented and DACA college students experience institutional legal violence in Colorado. J Divers High Educ. 2018;11:451-466. doi:10.1037/dhe0000078
20. Muñoz SM, Vigil D, Jach E, Rodriguez-Gutierrez M. Unpacking resilience and trauma: examining the “Trump effect” in higher education for undocumented Latinx college students. Assoc Mex Am Educ J. 2018;12:33-52. doi:10.24974/amae.12.3.405
21. Schueths AM. ‘It’s almost like white supremacy’: interracial mixed-status couples facing racist nativism. Ethnic Racial Stud. 2014;37:2438-2456. doi:10.1080/01419870.2013.835058
22. Sotto-Santiago S. Time to reconsider the word minority in academic medicine. JBPHPD Res Educ and Policy. 2019;12:72-78.
23. Washington HA. Medical Apartheid: The Dark History of Medical Experimentation on Black Americans From Colonial Times to the Present. Doubleday Books; 2006.
24. Kendi IX. Stamped From the Beginning: The Definitive History of Racist Ideas in America. Random House; 2017.
25. Skinner BF. Two types of conditioned reflex and a pseudo type. J Gen Psychol. 1935;12:66-77. doi:10.1080/00221309.1935.9920088
26. Huitt WG, Hummel JH. Skinner box. In: Darity W, ed. International Encyclopedia of the Social Science. 2nd ed. Macmillan Reference; 2008.
27. Skinner BF. Baby in a box. Ladies Home J. 1945;138:135-136.
28. Watson JB. Behaviorism. Routledge; 2017.
29. Simonton DK. Greatness: Who Makes History and Why. Routledge; 2017.
30. Chomsky N. The case against BF Skinner. New York Rev Books. 2011:43:887-910.
31. Chomsky N. A review of BF Skinner’s Verbal behavior. Language. 1959;35:26-58.
32. Chomsky N. The case against BF Skinner. New York Rev Books. 1971;17:18-24.
33. Miller GA. The cognitive revolution: a historical perspective. Trends Cogn Sci. 2003;7:141-144. doi:10.1016/S1364-6613(03)00029-9
34. Kerfoot BP, Baker H, Jackson TL, et al. A multi-institutional randomized controlled trial of adjuvant web-based teaching to medical students. Acad Med. 2006;81:224-230.
35. Matos J, Petri CR, Mukamal KJ, Vanka A. Spaced education in medical residents: an electronic intervention to improve competency and retention of medical knowledge. PloS One. 2017;12:1-8. doi:10.1371/journal.pone.0181418
36. Watters A. BF Skinner: the most important theorist of the 21st century. Hack Education: The History of the Future of Education Technology. Vol 2019. Audrey Watters; 2018.
37. Skinner BF. The Technology of Teaching. Prentice-Hall; 1968.
38. Piers MW. Play and Development. W.W. Norton & Co; 1972.
39. Mooney CG. Theories of Childhood: An Introduction to Dewey, Montessori, Erikson, Piaget & Vygotsky. Redleaf Press; 2013.
40. Montessori M. The Absorbent Mind. Holt Rinehart & Winston; 1967.
41. Piaget J. Structuralism. Basic Books, Inc.; 1970.
42. Piaget J. Intellectual evolution from adolescence to adulthood. Hum Dev. 1972;15:1-12.
43. Karpov YV. Vygotsky for Educators. Cambridge University Press; 2014.
44. Kozulin A. Psychological tools and mediated learning. In: Kozulin A, Gindis B, Ageyev VS, Miller SM, eds. Vygotsky’s Educational Theory in Cultural Context. Cambridge University Press; 2003; 15-38.
45. Wood D, Bruner JS, Ross G. The role of tutoring in problem solving. J Child Psychol Psyc. 1976;17:89-100.
46. Gergen KJ. Exploring the postmodern: perils or potentials? Am Psychol. 1994;49:412-416.
47. Vianna E, Stetsenko A. Embracing history through transforming it: contrasting Piagetian versus Vygotskian (Activity) theories of learning and development to expand constructivism within a dialectical view of history. Theor Psychol. 2006;16:81-108. doi:10.1177/095934306060108
48. Stetsenko A. Transformative activist stance for education: inventing the future in moving beyond the status quo. In: Corcoran T, ed. Psychology in Education: Critical Theory-Practice. Springer; 2014: 181-198.
49. Vygotsky LS. Mind in Society: The Development of Higher Psychological Processes. Harvard University Press; 1978.
50. Vygotsky LS. Thought and Language. MIT Press; 2012.
51. Davydov VV. Types of generalization in instruction: logical and psychological problems in the structuring of school curricula. In: Kilpatrick J, ed. Survey of Applied Soviet Research in School Mathematics Education. Vol 2. National Council of Teachers of Mathematics; 1990.
52. Kozulin A. Cognitive aspects of the transition from a traditional to a modern technological society. In: Pedro RP, Spencer S, ed. Vygotsky in 21st Century Society: Advances in Cultural Historical Theory and Praxis With Nondominant Communities. Peter Lang; 2011: 65-86.
53. Vygotsky LS. The Collected Works of L.S. Vygotsky (vol. I-VI). Plenum; 1987.
54. Bodrova E, Leong D. Tools of the Mind: A Vygotskian Approach to Early Childhood Education. 2nd ed. Pearson Prentice Hall; 2007.
55. Rogoff B. Apprenticeship in Thinking: Cognitive Development in Social Context. Oxford University Press; 1990.
56. van der Veer R. Lev Vygotsky. Vol 10. Continuum; 2007.
57. Schmittau J. Cultural-historical activity theory and mathematics education. In: Kozulin A, Gindis B, Ageyev V, Miller SM, eds. Vygotsky’s Educational Theory in Cultural Context. Cambridge University Press; 2003: 225-245.
58. Davydov VV. The influence of LS Vygotsky on education theory, research, and practice. Educ Res. 1995;24:12-21.
59. Davydov VV. Problems of Developmental Instruction: A Theoretical and Experimental Psychological Study. Nova Science Publishers; 2008.

60. Stetsenko A. The Transformative Mind: Expanding Vygotsky’s Approach to Development and Education. Cambridge University Press; 2017.

61. Bruner JS. Toward a Theory of Instruction. Vol 59. Harvard University Press; 1966.

62. Schwab JJ. The teaching of science as inquiry. B Atom Sci. 1958; 14:374-379. doi:10.1080/00963402.1958.11453895

63. Brown AL, Palincsar AS. Reciprocal Teaching of Comprehension Strategies: A Natural History of One Program for Enhancing Learning. Ablex Publishing; 1987.

64. Rosenshine B, Meister C. Reciprocal teaching: a review of the research. Rev Educ Res. 1994;64:479-530.

65. Collins A, Brown JS, Holum A. Cognitive apprenticeship: making thinking visible. Am Educ. 1991;15:6-11.

66. Stetsenko A. From relational ontology to transformative activist stance: expanding Vygotsky’s (CHAT) project. Cultural Stud Sci Educ. 2008;3:465-485.

67. Sandars J, Patel RS, Goh PS, Kokatailo PK, Lafferty N. The importance of educational theories for facilitating learning when using technology in medical education. Med Teach. 2015;37:1039-1042. doi:10.3109/0142159X.2015.1019438

68. Orchard J, Winch C. What training do teachers need? Why theory is necessary to good teaching. Impact. 2015;2015:1-43. doi:10.1111/(ISSN)2048-416X

69. Curriculum Inventory Committee. AAMC curriculum inventory. 2020. Accessed June 10, 2020. https://www.aamc.org/what-we-do/mission-areas/medical-education-curriculum-inventory

70. Verger J. Lecture. In: Vauchez A, ed. Oxford Encyclopedia of the Middle Ages. James Clarke & Co; 2005.

71. Schmidt HG. Foundations of problem-based learning: some explanatory notes. Med Educ. 1993;27:422-432.

72. Sweet M, Michaelsen LK. How group dynamics research can inform the theory and practice of postsecondary small group learning. Educ Psychol Rev. 2007;19:31-47. doi:10.1007/s10648-006-9035-y

73. Sturdy S. Scientific method for medical practitioners: the case method of teaching pathology in early twentieth-century Edinburgh. B Hist Med. 2007;760-792.

74. Lave J, Wenger E. Situated Learning: Legitimate Peripheral Participation. Cambridge University Press; 2005.

75. Beck S. How we learn: a critical-constructive discussion of Piaget’s and Vygotsky’s theories of teaching and learning and their reactions to each other. In: Qvortrup A, Wiberg M, eds. On the Definition of Learning. University Press of Southern Denmark; 2016: 101-124.

76. Ginsburg H, Oppen S. Piaget’s Theory of Intellectual Development. 2nd ed. Prentice-Hall; 1979.

77. Srinivasan M, Wilkes M, Stevenson F, Nguyen T, Slavin S. Comparing problem-based learning with case-based learning: effects of a major curricular shift at two institutions. Acad Med. 2007;82:74-82. doi:10.1097/01.ACM.0000249963.93776.aa

78. Michaelsen LK, Sweet M. The essential elements of team-based learning. New Dir Teach Learn. 2008;2008:7-27. doi:10.1002/tl.330

79. Barrows HS. Problem-based learning in medicine and beyond: a brief overview. New Dir Teach Learn. 1996;1996:3-12.

80. Neville AJ. Problem-based learning and medical education forty years on. Med Prin Pract. 2009;18:1-9. doi:10.1159/000163038

81. Norman GR. Problem-solving skills, solving problems and problem-based learning. Med Educ. 1988;22:279-286.

82. Lerner JS, Tetlock PE. Accounting for the effects of accountability. Psychol Bull. 1999;125:255-275.

83. Process-Oriented Guided-Inquiry Learning (POGL). 2019; Accessed June 20, 2020. https://www.pogil.org/

84. Farrell J, Moog RS, Spencer JN. A guided-inquiry general chemistry course. J Chem Educ. 1999;76:570-574.

85. Spencer JN. New directions in teaching chemistry: a philosophical and pedagogical basis. J Chem Educ. 1999;76:566-569.

86. Bloom BS, ed. Taxonomy of Educational Objectives: The Classification of Educational Goals (Cognitive Domain). Longmans, Green and Co Ltd; 1956.

87. van Huizen P, van Oers B, Wubbels T. A Vygotskian perspective on teacher education. J Curriculum Stud. 2005;37:267-290. doi:10.1080/0022027042000328468

88. Carraccio C, Wolfthal SD, Englander R, Fentz K, Martin C. Shifting paradigms: from Flexner to competencies. Acad Med. 2002;77:361-367.

89. Doughty HA. Blooming idiots: educational objectives, learning taxonomies and the pedagogy of Benjamin bloom. College Quart. 2006;9:1-23. Accessed May 25, 2020. http://collegequar terly.ca/2006-vol09-num04-fall/doughty.html

90. Frank JR, Snell LS, Cate OT, et al. Competency–based medical education: theory to practice. Med Teach. 2010;32:638-645. doi:10.3109/0142159X.2010.501190

91. Freire P. Pedagogy of the Oppressed. Continuum; 2005.

92. Bonwell CC, Eison JA. Active Learning: Creating Excitement in the Classroom. George Washington University; 1991.

93. Prince M. Does active learning work? A review of the research. J Eng Educ. 2004;93:223-231.

94. Ryle G. The Concept of Mind. The University of Chicago Press; 1949.

95. Kemple JJ, Segeritz MD, Cole R. Assessing Early Impacts of School-of-One: Evidence From the Three School-Wide Pilots. Society for Research on Educational Effectiveness; 2011.

96. Mukhalalati BA, Taylor A. Adult learning theories in context: a quick guide for healthcare professional educators. J Med Educ Curric Dev. 2019;6:1-10. doi:10.1177/2382120519840332

97. Taylor DCM, Hamdy H. Adult learning theories: implications for learning and teaching in medical education: AMEE Guide No. 83. Med Teach. 2013;35:e1561-e1572. doi:10.3109/0142159X.2013.828153

98. Knowles MS. The Making of an Adult Educator: An Autobiographical Journey. Jossey-Bass Inc; 1989.

99. Mezirow J. Transformative learning: theory to practice. New Dir Adult Cont Educ. 1997;74:5-12.

100. Calleja C. Jack Mezirow’s conceptualisation of adult transformative learning: a review. J Adult Contin Educ. 2014;20:117-136. doi:10.7227/JACE.20.1.8

101. Mezirow J. Transformative Dimensions of Adult Learning. Jossey-Bass Inc; 1991.
102. Martimianakis MAT, Michalec B, Lam J, Cartmill C, Taylor JS, Hafferty FW. Humanism, the hidden curriculum, and educational reform: a scoping review and thematic analysis. *Acad Med.* 2015; 90:S5-S13. doi:10.1097/ACM.0000000000000894

103. Hills M, Watson J. *Creating a Caring Science Curriculum: An Emancipatory Pedagogy for Nursing.* Springer Publishing Company; 2011.

104. Kincheloe JL. *Critical Pedagogy Primer.* Peter Lang; 2008.

105. Baum F, MacDougall C, Smith D. Participatory action research. *J Epidemiol Commun H.* 2006;60:854-857. doi:10.1136/jech.2004.028662

106. Bang M, Vossoughi S. *Participatory Design Research and Educational Justice: Studying Learning and Relations Within Social Change Making.* Taylor & Francis; 2016.