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Hello Entering Class of 2023!

We are now less than one month away from the start of your first-year coursework. I hope your summer has been a restful one!

When you arrive at the Pritzker orientation and throughout the next 4 years, you will encounter the term "growth mindset" again and again. I am encouraging you to read a bit about how Pritzker thinks about growth, and the powerful impact such an attitude can have on one's performance and outlook. Please find attached a recent paper describing related efforts that students, staff and faculty have pursued over the last decade with the goal of improving performance, wellness, diversity, and inclusion at the Pritzker School of Medicine.

Best wishes and welcome!

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Beyond Compliance: Growth as the Guiding Value in Undergraduate Medical Education

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Abstract

Adhering to the paradigm of the natural sciences, much of undergraduate medical education (UME) in the United States remains committed to objectivity, compliance, and standardization in its approach to teaching, evaluation, student affairs, and accreditation practices. The authors argue that, while these simple and complicated problem solving (SCPS) approaches may be valid for some highly controlled environments of UME, they lack rigor in complex, real-world environments where optimal care and education is not standardized but is tailored to context and individual needs. This argument is supported by evidence that "systems" approaches, characterized by complex problem solving (CPS, differentiated from complicated problem solving), lead to better outcomes in patient care and student academic performance. Examples of interventions implemented at the University of Chicago Pritzker School of Medicine from 2011 to 2021 further illustrate this point.

Interventions in student well-being that emphasize personal and professional growth have led to student satisfaction that is 20% higher than the national average on the Association of American Medical Colleges Graduation Questionnaire (GQ). Career advising interventions that augment the use of adaptive behaviors in place of rules and guidelines have yielded 30% fewer residency applications per student than the national average while simultaneously yielding residency "unmatched" rates that are one-third of the national average. Regarding diversity, equity, and inclusion, an emphasis on civil discourse around real-world problems has been associated with student attitudes toward diversity that are 40% more favorable than the national average on the GQ. In addition, there has been an increase in the number of matriculating students who are underrepresented in medicine to 35% of the incoming class. The article concludes with a review of philosophic barriers to incorporating the CPS paradigm into UME and of notable pedagogic differences between CPS and SCPS approaches.

> The expert tends to make his subject the measure of life, instead of making life the measure of his subject.
>
> —Harold Laski, *The Limitations of the Expert* (1931)

Undergraduate medical education (UME) remains committed to the scientific paradigm as illustrated by its emphasis on objectivity, compliance, and standardization in its approach to teaching, evaluation, student affairs, and accreditation practices. Medical schools are sanctioned by the Liaison Committee on Medical Education for failure to comply with detailed operational standards.[1] Students are evaluated and graded using objective methods anchored by standardized behaviors.[2] Increasingly, techniques such as objective structured clinical examination and standardized simulations are used for both instruction and summative evaluation.[3] Furthermore, we contend that when the strategy of compliance yields educational outcomes of questionable rigor, equity, or well-being, the medical education community's response is often to strengthen centralized rules, policies, and standardization.[4]

In this article, we raise our concern regarding the single-minded commitment of UME to the traditional scientific paradigm and suggest a more adaptive paradigm with the goal of enhancing the quality of UME and better supporting patient-centered care.

Learning, Teaching, and Practice as Complex Problem Solving

Two problem-solving paradigms

In the 20th century, modern medical practice emerged as the systematic application of evidence derived from biomedical research.[5] This paradigm sees patient care as a simple or complicated problem (characterized by consistent and discoverable cause-and-effect relationships) and therefore as reasonably approached through strategies of prediction and standardization (see Table 1 for examples). Over the last 40 years, this view has led to a marked proliferation of clinical practice standards and accreditation elements.

In 2000, the Institute of Medicine's *Crossing the Quality Chasm: A New Health System for the 21st Century* formally introduced the concept of an alternate paradigm: systems thinking.[6] The systems thinking paradigm aimed to improve patient care by closing the gap between scientific knowledge and the complex realities of patient care. The hallmark of this newer paradigm is complex problem solving (CPS), manifest as responsiveness to the larger system through continuous growth and improvement (note that "complex" denotes a problem that is characterized by inconsistent or undiscoverable relationships and is not synonymous with "complicated").[7] Table 2 displays characteristics that distinguish CPS from simple and complicated problem solving (SCPS). According to this paradigm, evidence is not a fixed strategy

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Table 1

Examples of Simple, Complicated, and Complex Problems as Typically Conceived in Undergraduate Medical Education: Definitions and Associated Behaviors

Type of problem	Definition	Behavior	Role of expertise
Simple	• Problems with clear cause-and-effect relationships and one "right" answer • Example: Boiling an egg	• Predictable • Linear	• Sufficient for achieving predetermined success
Compli-cated	• Problems with discoverable cause-and-effect relationships and multiple "right" answers • Example: Repairing a car engine	• Predictable • Conditional	• Sufficient for achieving predetermined success
Complex	• Problems with emergent patterns and no "right" answer • Example: Raising a child	• Unpredictable • Emergent	• Insufficient for defining and achieving success

Table 2

Components of Simple and Complicated Problem Solving as They Apply to Undergraduate Medical Education, Compared With Complex Problem Solving[a]

Attribute	Simple/complicated problem solving	Complex problem solving
Definition	The achievement of discrete predetermined goals in stable and predictable environments using established solutions or algorithms	Self-regulated activities necessary in dynamic environments to achieve goals that may need definition and cannot be reached by routine actions
Assumptions	System is homogeneous, transparent, stable, and closed	System is heterogeneous, only partially transparent, dynamic, and open
Values	Compliance, detached objectivity, reproducibility, precision/perfection, "one right answer"	Growth, engaged improvement, responsiveness, learning, contextually appropriate solutions
Tools	Reductionist knowledge (facts), rules, expertise, technologies, standardized behaviors	Evidence, feedback/discourse, teamwork, judgment, tailored behavior
Strategies	Tight control of system using knowledge-based rules	Adaptive behavior guided by values and informed by evidence

[a]Simple and complicated problem solving are generally useful in constructing and maintaining tools, but the application of those tools in situations of real-world complexity such as patient-centered care and medical education often requires complex problem solving.

for practice, but it is a tool used to inform contextually appropriate and holistic care for patients—a conception echoed by the Bucksbaum Institute for Clinical Excellence in its mission to enhance communication and shared decision making in health care, thereby strengthening the personal and humanistic components of the doctor–patient relationship. Substantial research supports the superiority of adaptive interventions characteristic of CPS compared with pure compliance with reductionist knowledge.[8–10]

Education and learning as growth

UME has been slow to embrace CPS and remains committed to teaching SCPS. This situation exists at every level of educational practice: pedagogic methods, curriculum content, and organizational operations.[1,11,12]

A major impediment to change is outdated notions of learning. Traditionally, learning has been understood as the acquisition of facts about a predictable environment, and success is measured by compliance with those facts. Alternatively, the CPS perspective sees learning as an adaptive response to a continuously evolving and heterogeneous environment[11] such as that presented by patient-centered care. It is a socially mediated growth process representing the reconstruction of past knowledge and driven by a search to explain discrepancies between current data and past knowledge.[13]

Educational Outcomes: Growth Culture Versus Compliance Culture

Learner attitudes and learning efficacy

Substantial evidence in educational psychology shows that a growth culture better supports academic learning and achievement than a culture espousing compliance with expectations or standards.[14] Students who value academic performance underperform compared with students who value growth and learning.[15] Independent of teaching method, students who assume intelligence is fixed have been shown to underperform in the classroom compared with students who see intelligence as dynamic. Furthermore, the performance of those students with a fixed understanding of intelligence improves with instruction on flexible intelligence.[16] Thus, across an array of educational outcomes, a growth orientation has better educational outcomes than a compliance orientation.

Learning environment and learning efficacy

Other evidence suggests that a growth-oriented environment can enhance student performance as well. Teachers who view the development of knowledge as a process of conceptual change as opposed to the acquisition of facts use

more effective teaching strategies.[17] Students of science, engineering, and mathematics perform better on assessments and fail less often when the curriculum is organized around active learning compared with curricula using techniques that merely deliver information to the students.[18] Active learning has also been shown to narrow achievement gaps between underrepresented students and majority students.[19] Evidence suggests that formative feedback is essential to optimizing learning and may have a larger role in trainee development than summative feedback.[20] Whether it is teacher attitudes, curriculum design, or feedback style, our position is that environmental approaches embracing growth as the pedagogic paradigm better support student learning than the compliance paradigm.

What Does a Growth-Oriented Pedagogy Look Like?

To foster an environment reflecting the CPS paradigm and with support from the Bucksbaum Institute, several growth-oriented interventions have been initiated at the Pritzker School of Medicine since 2011. These interventions targeted particularly complex problems in UME: student well-being, the residency application process, and diversity, equity, and inclusion. They used adaptive strategies characteristic of CPS that represent a conscious shift from a compliance culture to a growth outlook.

Student well-being

Medical students matriculate to medical school with better mental health indicators than similarly aged college graduates pursuing other careers, but graduate from medical school with higher rates of burnout, depression, and suicidal ideation.[21] The structure of the medical education pathway, including evaluation systems and demanding curricula, has been shown to contribute to this disparity.[22] This problem impacts patient care as well; students with mental distress are more prone to medical errors and professional lapses.[22]

A growth mindset[14] has been shown to be beneficial to student well-being. Individuals with this mindset believe that abilities and understanding are not fixed, but can be developed with time and effort. Development of high levels of growth mindset in students predicts higher psychological well-being and school engagement.[23] Single-session "growth mindset interventions" have resulted in improvements in parent-reported student depression and anxiety and youth-reported depression. This improvement has been shown to last up to 9 months.[24] Growth mindset toward anxiety buffers the impact of stressful events, suggesting the mindset enhances resilience and coping mechanisms.[25]

Beginning in 2016, the student affairs team at Pritzker School of Medicine has used a growth mindset framework for its personal, professional, and academic development programming. Students receive information on growth mindset before matriculation. Orientation presentations explain the science behind growth mindset and contrast it with the fixed mindset characteristic of compliance culture. Growth mindset is then used to frame professional development topics ranging from career planning to performance evaluations throughout the medical school experience.

In a separate growth mindset effort, the well-being initiative directly addresses several maladaptive dimensions of compliance culture: error avoidance and perfectionism. In what is arguably the most popular event of the annual medical school calendar, "Pritzker, I screwed up!" students hear stories from deans, course directors, and clerkship directors about serious errors they have made, how they felt about those errors, and what they learned.[26] In another event required for all first-year medical students, senior students, house staff, and faculty share information about personal mental health challenges, the impact of these challenges on their personal and professional lives, and ongoing treatment.[26]

Outcomes from programming overseen by the Pritzker School of Medicine Well-Being Committee have been excellent to date. The percentage of students who report being "very satisfied" with the medical school's well-being programming on the Association of American Medical Colleges Graduation Questionnaire (GQ) has been more than 20 percentage points higher than the national average over the last 5 years. And preclinical students have consistently scored Pritzker's emotional climate more favorably than the national average on the Association of American Medical Colleges' Medical School Year Two Questionnaire. Pritzker has over 90% student participation in both surveys every year.

The residency application process

The residency application process is stressful for everyone involved: medical students, student affairs teams, and residency program directors.[27] Uncertainty in this complex and high-stakes process creates a vicious cycle of behaviors where student anxiety about getting interviews drives up the number of residency applications, further incentivizing residency programs' focus on a limited set of objective but suspect criteria for review.[28]

The prevailing response to these challenges has been to implement systematized nationwide interventions designed to command compliant behavior from stakeholders.[29] One example of this is the elimination of the United States Medical Licensing Examination Step 1 score to prevent residency program directors from using such scores to screen applications.[30] Another example is the proposal to cap the number of applications a student can submit to the residency application process.[27] Alternatively, a smaller number of voices see the uncertainty and complexity of the residency process as an opportunity to augment professional growth and to encourage the development of those adaptive behaviors characteristic of CPS.[31]

Pritzker School of Medicine has embraced the latter approach. In place of standardization and algorithms, the advising team has created a community of practice where diverse perspectives and experiences can be pooled to effectively address complex problems such as application strategy, difficulty getting interviews, or poor interview style.[32] Advising processes use key features of continuous quality improvement such as iteration and personalization. Students are encouraged to be adaptive; career planning starts with a clear delineation of student values that are regularly revisited. Application advising acknowledges uncertainty and teaches students the importance of teamwork, target program diversification, and process iteration to manage imperfect control.

Outcomes of this approach have been favorable. Over the last 10 years, Pritzker's "unmatched" rate in the National Resident Matching Program has been one-third that of the national average (2% vs 6%). Pritzker students accomplish this outcome while applying on average to 30% fewer residency programs than the national average. Responses on the GQ demonstrate that students have been "very satisfied" at a rate that is nearly 20% higher than the national average over the past 10 years.

Supporting diversity, equity, and inclusion initiatives

Increasing the racial and ethnic diversity of the health care workforce is considered essential to addressing health inequities.[33] Unfortunately, efforts to increase compositional diversity in medicine have stalled.[34] Furthermore, where compositional diversity has improved, substantial concerns remain regarding the inclusiveness of medicine and academic medicine in particular.[34]

The principles of diversity, equity, and inclusion are core to addressing social justice.[35] These principles are also an essential component of successful CPS.[36] Activities such as research, clinical care, and education, where routine or standardized actions are insufficient for success, benefit from discourse between divergent perspectives.[37] In such settings, tolerance of different views and a willingness to learn from those views predicts performance, not compliance with accepted beliefs.[35]

In response to deteriorating political discourse in the United States, Pritzker created the Identity and Inclusion Committee.[38] Composed of diverse representatives from the school's student body, staff, and faculty, the committee collaborates with every area of the school (e.g., curriculum, student affairs, student organizations) to maintain an inclusive learning environment and to prepare students to care for diverse patient populations.

The committee pursues these goals through promoting civil discourse around complex real-world problems. Students are encouraged to engage individuals with differing views as they navigate the medical school's first-year required HEAR course (**H**ealth **E**quity, **A**dvocacy, and anti-**R**acism)[39] and address complex problems within the medical school and the surrounding communities. They learn that diversity is a source of strength for teams when members see divergent perspectives as an opportunity for growth.

The impact of the Identity and Inclusion Committee on the Pritzker learning community has been positive. Students' strong agreement with GQ items related to inclusion (i.e., "Knowledge or opinion influenced by perspectives from different backgrounds," "Diversity in school enhanced training") has been 20%–40% higher than the national average over the past 5 years. In addition, a culture of inclusion has contributed to a dramatic increase in the compositional diversity of the student body, with 35% of students matriculating in 2021 identifying as Black, Hispanic, or Native American, groups traditionally underrepresented in medicine.

Supporting CPS

The Pritzker School of Medicine experiences described above illustrate that rigor in complex systems is exemplified by adaptive behavior, not compliant behavior.[40] CPS cannot succeed through centrally mandated fixed standards. Such central control impairs the capacity of frontline practitioners to respond in a contextually appropriate manner.[41] Although SPCS may be useful in constructing and maintaining tools, we believe that the application of those tools in the complexity of real-world endeavors, such as medical education and, perforce, patient-centered decision making and positive doctor–patient communication, requires CPS. We contend that adaptive behaviors such as civil discourse amongst diverse team members, the iterative processing characteristic of continuous quality improvement, and constructive attitudes toward error and uncertainty better support problem solving in real-world environments.

The Challenge of a Paradigm Shift to CPS

Epistemological obstacles

In spite of growing frustration with the ability of standardized assessment tools and teaching practices to predict and promote trainee performance, medical education's attachment to these simple problem-solving strategies is strong. Unfortunately, when faced with the uncertainty of complexity, the field's instinctive response is to intensify application of standardization.[42]

In the history of science, such flawed attachments are termed "epistemological obstacles"[43] and represent the generalization of assumptions found successful in one set of problems, to another set of problems for which they are invalid. One such obstacle in the history of medicine was the field's attachment to anatomical-pathological explanations of disease that confounded physician's understanding of diseases due to functional pathology (disease in the absence of an anatomical lesion).[44]

The "deterministic-centralized mindset"

In the case of medical education, we observe that assumptions appropriate for simple and complicated problems are being applied to complex problems. The situation is further exacerbated because a culture of compliance impairs learning CPS skills. Educators studying pedagogy in complexity have found that the epistemological mindset associated with SCPS impairs one's ability to acquire CPS skills. These educators have coined a term for this form of epistemic obstacle: the "deterministic-centralized mindset."[45] Subsequent research has shown that traditional pedagogy reinforces reductionist thinking, rewards quick answers, and promotes linear cause-and-effect thinking, all of which undermine the successful acquisition of CPS skills.[46] Consequently, optimal training for real-world practice may not be possible without robust and transparent discussions regarding the difference between SCPS and CPS.

Concerns regarding efficacy are illustrated by contemporary challenges in medical school assessment. Standards of methodologic reliability, resembling those appropriate for controlled experimentation, are regularly used to design and select clinical assessment methods. Unfortunately, these methods more often measure a trainee's ability to memorize facts and perform archetypical behaviors (SCPS) than a trainee's ability to pursue activities such as designing and executing

tailored patient care plans (CPS). As a consequence, these assessment methods have reduced construct validity for real-world competence.[47,48] Furthermore, evidence suggests these methods reinforce maladaptive behaviors amongst trainees, with significant consequences for the health care system and patients.[49–52]

Reframing Training for a Growth-Oriented Curriculum

Complex problems in health care require different management strategies than simple and complicated problems.[53] Therefore, substantial differences in medical education curricula must exist between curricular elements designed to teach SCPS and those designed to impart CPS. Several differences are described here to illustrate this point.

Educational objectives

While traditional curricula focus on well-defined problems that generally have predetermined goals and solutions, curricula in CPS focus on ill-defined and dynamic problems. As a result, "competency" in CPS is not defined by the achievement of predetermined, fixed outcomes. Instead, learners must achieve increasing levels of adaptive capacity manifest in creative behaviors such as defining problems, negotiating contextually appropriate goals, and executing novel solutions.[54] This difference has prompted debate as to whether the concept of "competency" adequately expresses the goal of medical education. Some have proposed an alternate goal: "capability," understood as the extent to which trainees can continually adapt to change, generate new knowledge, and improve their performance in contextually unique and dynamic situations.[55] This argument parallels one supporting the more responsive concept of "cultural humility" over the more static and stereotypical concept of "cultural competency" in authentic patient-centered care.[56]

The temporal relationship between learning and assessment

A focus on adaptive behavior in CPS curricula will have a significant impact on assessment. One example is the timing of assessment relative to learning activities. Because of the stability and predetermined nature of SCPS educational objectives, learning, formative assessment, and summative assessment can occur sequentially. Because CPS occurs in dynamic settings where adaptive behavior is the target of assessment, however, learning and assessment are necessarily coupled and optimally occur in parallel. Learning and validity of assessments require direct, regular, and engaged involvement of the observer at the point of care.[40,57] These dynamics highlight the importance of clinical mentorship in teaching patient-centered care.[58]

Granular, practice-based assessment

The focus of CPS on adaptive behavior has significant impact on the selection of summative assessment methods. While traditional competencies lend themselves to standardized assessment, optimal CPS assessment occurs in the context of authentic practice and expects varied outcomes according to context. This difference raises important questions about the increasing emphasis on standardized assessments such as standardized exams, traditional simulation techniques, and observed standardized clinical exercises in summative assessment. It also reinforces the importance of assessment in the context of authentic practice and encourages use of assessment methods that give mentors agency to make contextually informed judgments about student capabilities.[59]

Assessment of mental models

Summative assessment in CPS involves analysis of student mental models. Mental models are important, because complex problems are often ill defined. As such, CPS assessment must consider a student's capacity to identify and properly structure ill-defined problems in addition to problem-solving outcomes.[60] This stands in contrast to summative assessment in SCPS, which often focuses exclusively on outcomes for predetermined problems.

Concluding Observations

Over the last 60 years, a time of immense growth in medical evidence and technology, patients' confidence in health care leaders has paradoxically dropped by more than 50%.[61] Recent research has shown that more than 50% of patients attribute their mistrust of physicians to inadequate investment in them as individuals.[62] Other studies show physicians attend to explanations of evidence and logistics at the expense of patient-centered behaviors such as empathy and exploration of psychosocial factors.[63] Collectively, this evidence suggests that patient-centered care is threatened, but not by a deficit of expertise. Instead, we posit that it is threatened by a failure to apply expertise in a manner that is responsive to the contextual complexity of patient care.

As with the larger mission of the Bucksbaum Institute to strengthen the doctor–patient relationship through enhanced communication and shared decision making, training in CPS addresses this failure as well as challenges in other complex dimensions of the health care system such as health care costs, health equity, physician well-being, and career planning. Implementation of this educational paradigm is essential but will require significant UME curricular change and, importantly, a willingness to see beyond the reductionist scientific paradigm.

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