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Perspective

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Strategies for Implementing Personalized Learning While Evidence and Resources Are Underdeveloped

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Innovators are exploring new designs for the primary and secondary education system under the umbrella of *personalized learning*. The overarching set of practices being explored in the space is quite broad, but consensus is lacking on a precise definition of personalized learning or on which component practices are essential. Practitioners and policymakers seeking to implement personalized learning, lacking clearly defined evidence-based models to adopt, are creating custom designs for their specific contexts. Those who want to use rigorous research evidence to guide their designs will find many gaps and will be left with important unanswered questions about which practices or combinations of practices are effective. It will likely take many years of research to fill these gaps.

Despite the lack of evidence, there is considerable enthusiasm about personalized learning among practitioners and policymakers, and implementation is spreading. The purpose of this Perspective is to offer strategic guidance for designers of personalized learning programs to consider while the evidence base is catching up. This guidance draws on theory, basic principles of learning science, and the limited research that does exist on personalized learning and its component parts.

I begin this Perspective with a high-level definition of personalized learning and a description of the opportunities it has to address long-standing challenges in the U.S. education system. I then summarize the limited evidence on efficacy, along with some of the implementation challenges identified by the early research. I offer a set of principles that implementers might use to guide their designs in the absence of proven-effective models. Finally, I illustrate the application of these principles to mastery-based skill development, which is often present in personalized learning models.

What Is Personalized Learning?

It is increasingly common for schools serving Kindergarten through 12th grade (K–12) in the United States to experiment with innovative schoolwide strategies that are intended to provide more-

customized educational experiences for every student. The specifics of personalized learning vary from school to school, incorporating such strategies as:

- enabling students to work on content targeted to their individual levels of achievement rather than synchronized with peers at the same grade level (often referred to as a mastery-based or competency-based approach)
- finding ways to make learning activities more relevant to students and allowing them to be more involved in setting educational goals and in selecting the materials and activities to achieve those goals
- placing greater emphasis on developing social-emotional skills, which, along with academic achievement, are important for postsecondary success
- nurturing stronger relationships with students and their families and learning more about social, family, medical, or other situations that might be relevant to students' performance in school.

In sum, the goal of personalized learning is to make each student's educational experience responsive to his or her talents, interests, and needs. In this Perspective, I use *personalized learning* as a broadly inclusive term for the strategies, practices, and supporting materials—including curricula, assessments, and technological supports—being deployed in these schools. There is not widespread public agreement on this or any other definition of personalized learning; some stakeholders define it more narrowly or use different terminology, such as *student-centered learning*. In this Perspective, I use the term *model* to refer to the specific set of personalized learning strategies and materials adopted by a school or set of schools. With such a broad and inclusive definition of personalized learning, any specific model will likely include only a subset of the many available strategies.

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Opportunities Addressed by Personalized Learning

Many of the goals and strategies employed for personalized learning are not new. There is a long history of educators striving to meet students' individual needs and incorporating their interests and preferences into instruction. These efforts include developing individualized education plans for students with special needs, using data to help make instructional decisions for individual students, providing instruction to individual students or small groups of students, providing tutors or support teachers to supplement the classroom teacher's instruction, and offering diverse elective courses. Personalized learning can be viewed as a comprehensive schoolwide integration and intensification of these ideas across all grades and subject areas. It has become more feasible recently through the availability of technological supports. Specifically, technology has progressed to the point that it can help educators orchestrate the complex process of tracking individual students' learning plans and progress, and it can provide a rich variety of

instructional opportunities to students so that teachers can devote more of their time to working with individuals or small groups.

The opportunity afforded by technology is emerging in the context of widespread dissatisfaction with how the U.S. K–12 education system currently performs. The United States ranks lower than desired in such international comparisons as the Organisation for Economic Co-operation and Development's Programme for International Student Assessment.[1] U.S. proficiency rates on the National Assessment of Educational Progress are too low,[2] dropout rates are too high,[3] and growing achievement gaps between the highest-performing and lowest-performing students suggest that there are substantial inequities in educational opportunity along the lines of race or ethnicity or socioeconomic status.[4] These problems have stubbornly persisted despite extensive efforts to address them over many decades, and notwithstanding occasional minor improvements on some metrics, such as elementary school proficiency rates or high school dropout rates. It is possible that making more-substantial advancements on these problems requires major changes in how schools operate. Schoolwide personalized learning aspires to changes of this magnitude.

Personalized learning can also allow for finer granularity in topic coverage and more-flexible pathways for student success. Where a student would traditionally take a course in calculus, statistics, or accounting, a mastery-based system could allow the student to learn selected parts of each subject, tailored to the student's interests or to meet the demands of their intended career path. Such an approach can accommodate new topics that gain relevance without overloading the curriculum, helping to avoid such perverse responses as fitting in computer science by considering it a foreign language.[5] Indeed, personalized learning itself might need to leverage this kind of flexibility to accommodate its increased focus on developing social-emotional skills.

Challenges to Implementation

It is no surprise that the widespread changes aspired to in personalized learning will pose challenges. At the micro level, to continue with the earlier example, a finer granularity of course-taking departs from the whole-course criteria currently used to define the requirements of a high school diploma or college admission. Students who took parts of calculus, statistics, and accounting will have completed none of those courses. How will they document what they accomplished? This will require developing a new consensus for how students demonstrate that they have completed sufficient work, as well as how their accomplishments are communicated to parents, colleges, employers, and others.

More importantly, macro-level implementation challenges could render personalized learning ineffective for improving student outcomes. Particular risks at this early stage of development include the following:

- Curriculum materials, assessments, and technologies to support personalized learning are relatively immature, fragmented, and of uneven quality, requiring educators to spend valuable time and effort assembling the necessary supporting materials and making them work together.
- Educators, lacking models that have been proven effective, might adopt ineffective practices as they attempt to figure out what personalized learning will look like in their classrooms and schools.
- Schools—especially those that operate within traditional district structures—might struggle as their new personal-

ized instruction conflicts with long-standing district or state policies.

Some skeptics argue that these are among the reasons that personalized learning will be another in a long series of educational reforms that do not lead to meaningful improvements on the key problems faced by the U.S. education system.[6]

The major challenges that accompany the opportunities of personalized learning drive the central recommendation of this Perspective: to take a strategic approach to personalized learning implementation, focusing first on components most likely to be effective while waiting for policies, materials, and evidence to evolve in ways that support more-expansive implementation. Before elaborating on this recommendation, I briefly review the existing evidence on schoolwide personalized learning.

The Research Evidence on Personalized Learning

Thus far, the research evidence on personalized learning as an overarching schoolwide model is sparse. A team of RAND Corporation researchers conducted the largest and most-rigorous studies of student achievement effects to date.[7] We examined groups of schools implementing diverse schoolwide models of personalized learning. Most recently, we reported that 32 such schools produced average positive effects of about 3 percentile points in mathematics and reading achievement.[8] However, the quasi-experimental research design we employed leaves open the possibility that factors other than personalized learning might have caused the positive effects. Making a more conclusive determination will require follow-up studies, likely using more-rigorous methods, such as randomized controlled trials. Moreover, our studies did not have large enough samples or sufficient data to provide insights into which specific components of personalized learning might be most effective.

Despite the positive results on average, the study revealed some reasons for concern. Estimated effects for individual schools varied widely, including negative effects for some of the personalized learning schools. In mathematics, schools were estimated to produce significant effects ranging from +14 to –17 percentile points. In reading, the range was +16 to –19 percentile points. In both subjects, seven schools (nearly a quarter of the sample) had negative effects strong enough to be statistically significant.

If personalized learning were responsible for the modestly positive average effects, it is clear that it did not work equally well in every school. There are many possible explanations for this disparity, including the specific models that each school designed or implementation challenges that we identified (such as intensive demands on teachers' time, difficulties integrating data from multiple technology systems, and tensions between personalized learning practices and state or local policies). Many of the same challenges were echoed in a more recent study of personalized learning implementation conducted by the Center for Reinventing Public Education (which did not examine achievement effects).[9]

Implementation challenges and wide variations in achievement results raise key questions about the effectiveness of personalized learning for improving student outcomes. In a rigorous evaluation that enables causal attribution, would personalized learning lead to meaningfully positive student outcomes? What specific strategies or models work best? Which are not effective? What contextual factors are important to the success of personalized learning? Do the answers to these questions vary across different student populations

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or subgroups? How can we minimize the risk of negative effects? These and related questions will take many years to address.

While we await the answers to those questions, substantial enthusiasm around personalized learning persists. Educators, policymakers, and advocates are moving forward without the guidance of conclusive research evidence. How can they make wise choices to help ensure that their personalized learning models will benefit students and, importantly, not be harmful? Theory and existing evidence can guide implementers to make wise choices and help to mitigate risks.

Principles to Guide Personalized Learning Adoption

In the absence of comprehensive, rigorous evidence to help select the personalized learning components most likely to succeed, what is the path forward? I suggest a few guiding principles aimed at using existing scientific knowledge and the best available resources.

Embrace Rigorous Empirical Evidence Where It Exists

Innovations that could be suitable as components of personalized learning models, such as adaptive learning products, might already have demonstrated positive effects. Implementers can look to such clearinghouses as the Institute of Education Sciences' (IES's) *What Works Clearinghouse* or Johns Hopkins University's *Best Evidence Encyclopedia* to distinguish research that meets strong standards of rigor from less-reliable studies that some vendors or advocates might promulgate.[10]

Align with Principles of Learning Science

Where strong empirical evidence on a particular personalized learning component does not yet exist, implementers can turn to more-basic research on cognition and learning science. For example, a decade ago, IES sponsored the preparation of a practice guide based on research on learning and memory, which provides seven concrete recommendations on "Organizing Instruction to Improve Student Learning."[11] Since that time, the field has continued to advance, supported by investments of multiple funders in national centers on the science of learning.[12] Principles identified in such research can provide rich fodder for helping to determine which components of personalized learning models are most likely to prove effective, and importantly, to rule out strategies that have been proven ineffective. For example, research gives reason to be wary of some popular ideas in the personalized learning movement, such as the idea that today's learners are digital natives for whom older methods of teaching no longer work, that learning should be matched to a student's learning style, or that students should be given maximum control over what they learn and their learning trajectory.[13]

Successful personalized learning strategies or models likely will be designed to conserve teachers' time and effort for activities that are most directly helpful to students.

Focus on the Productive Use of Student Time and Attention

Student time and attention might be the most valuable resources for a student's education; learning simply cannot occur without them. If a student expends time and attention on activities that are distracting or otherwise unproductive, those resources are permanently lost. Moreover, even productive activities have an opportunity cost: What else could the student have learned while expending the same time and attention? Some personalized learning activities might lead to learning while making inefficient use of these resources. This is not to say that students cannot gain important skills through diverse activities beyond pure academics but rather that it is important to be attuned to both the benefits and the costs of all activities from which skill development is expected.

Maximize the Productive Use of Teacher Skill

Teachers are the next-most-valuable resources available to students when their skills are properly focused on providing instruction and related support to students. Successful personalized learning strategies or models likely will be designed to conserve teachers' time and effort for activities that are most directly helpful to students.

Use Rigorous Instructional Materials

Decades of work have gone into developing rigorous academic standards and aligned instructional materials, most recently through the Common Core initiative.[14] But teachers trying to personalize learning naturally seek out new materials and lessons. These materials often are not carefully evaluated for rigor and can lack coherence when cobbled together. Before shelving traditional materials, educators should consider how they might be redeployed in a personalized learning classroom, supplemented by strategies to meet such personalized learning objectives as increased motivation and agency. Where educators feel that they must step outside the traditional curriculum materials and content, they should apply a quality rubric for evaluating new material before adoption.

Monitor Implementation and Be Prepared to Adapt

Although the five principles outlined above can help identify the most-promising strategies to incorporate into a personalized learning design, success is not guaranteed. It is important to monitor whether the expected effects are emerging and ensure that there are no undesirable side effects. In addition to being useful for internal purposes of continuous improvement, such information can help the whole field of personalized learning improve.

Applying the Guiding Principles to Mastery-Based Skill Development

One of the central changes in many personalized learning models is finding ways to enable students to work on content targeted to their individual level of achievement, rather than synchronized with peers at the same grade level. Indeed, this is the first major strategy

in the definition of personalized learning put forth in this Perspective. In these mastery-based or competency-based approaches, students are assigned work for which they have satisfied prerequisites and thus have the skills needed to learn the new material, and they continue working on that material until they demonstrate that they have learned it. What do the guiding principles have to say about this approach?

Embrace Rigorous Empirical Evidence Where It Exists

Empirical evidence on the effects of one-on-one human tutoring that used mastery-based progression is supportive. An often-cited 1984 study reported large positive achievement effects compared with instruction in traditional classes.[15] Subsequent studies of both human and artificial (computer-based) tutors that used mastery-based approaches have supported this finding, although not at such a large magnitude as the 1984 study.[16] Reviewing decades of research on human and computer-based tutoring systems, one researcher hypothesized that "Tutoring does not work due to individualization alone. It works due to individualization plus nurturing and attention."[17] (This hypothesis resonates with another of the major strategies of personalized learning: nurturing relationships with students.) Taken together, these findings suggest the value of an approach where students regularly engage with educators, even if technology takes responsibility for some individualization of content and pacing.

Align with Principles of Learning Science

Mastery-based skill development is consistent with the theory that learning builds on existing knowledge in a zone of proximal development.[18] That is, students learn most effectively when working on material they are ready to learn because they have already developed prerequisite skills. Optimizing the amount of time that students are within that zone can theoretically result in greater achievement.

To illustrate, let us first consider students who enter non–mastery-based schools performing below expectations. Although extra resources could be provided to help these students catch up, until they do (and they often do not), they are probably working outside their zone of proximal development most of the time. Consequently, they might never fill in certain gaps, struggle to learn new material, and do poorly on assignments and tests. This is not a recipe for success, but one that is likely to exacerbate performance gaps. Students who endure this for their entire school career might be more likely to become discouraged and to form poor concepts of self-efficacy.[19]

In contrast, personalized learning instruction, which is designed to have students work in their zones of proximal development and master material before moving on, could lead to better learning and retention.[20] In this approach, students should experience greater success, gain confidence in their abilities, and be better prepared to continue experiencing success on the material they move to subsequently. There are also possible benefits for high achievers who might not be adequately challenged in non–mastery-based systems if they are constrained to work at the pace of their peers.

Focus on the Productive Use of Student Time and Attention

Taken together, the learning science and empirical evidence suggests that students' time is well spent when they receive individualized attention, content at an appropriate level, and pacing

based on mastery, along with quality interaction, guidance, and nurturing from educators. Having a personal teacher or tutor for every student might be one way to accomplish this, although it is impractical because of the number of skilled educators necessary and the consequent cost. How can the benefits of individualized, mastery-based tutoring be capitalized on at a large scale? Technology has been the obvious answer. Key questions include how technology can get us closer to individualized, mastery-based tutoring and whether it leads to better student outcomes than the system of mainly whole-class instruction. Some of the most-promising technology solutions do not move all instructional responsibility from teachers to technology but use the two in tandem, consistent with both learning science and evidence to date.

Maximize the Productive Use of Teacher Skill

A key aspect of this approach is that teachers can be freed from their responsibility to serve all students simultaneously, allowing them to focus their skills on individuals or small groups while other students are actively engaged with technology. Furthermore, the technology can use the information it gathers to advise teachers on how best to use their time with the students. In practice, these benefits will only be realized if the system functions well and teachers are not burdened with technical-support issues or other distractions.

Use Rigorous Instructional Materials

Implementing personalized learning is not as simple as picking some software and adding computers to the classroom. Educators, principals, and district leaders need to ask hard questions about the software they are adopting, the quality of its content, and how it will be deployed in classrooms.

Monitor Implementation and Be Prepared to Adapt

Mastery-based approaches, however promising, are not without risks. For example, it is not yet known how such approaches will play out over the long term. It seems plausible that a student who experiences the hypothesized benefits of the approach—better learning, retention, and motivation—could reach adulthood with a much higher level of achievement than they would have under the more traditional approach. Even if students benefit in a mastery-based system, will they learn faster and catch up, or will they perhaps learn more—and learn better—but never get an opportunity to learn some of the higher-level concepts that their peers are exposed to? This is known as the *coverage versus mastery* dilemma.[21] Whether a long-term mastery-based approach is better for a student's future success in life than the current system of primarily age-based progression has not yet been tested empirically.

Mastery-based approaches also raise complex questions of equity that echo concerns about tracking (i.e., grouping students into academic or vocational tracks).[22] Pending concrete evidence

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that mastery-based approaches are beneficial for adult outcomes, it seems particularly important to be sensitive to equity concerns. Careful monitoring might be necessary to ensure that students who are working on more-basic material in relation to their grade-level peers are not somehow excluded from learning higher-level material. Educators must have an unrelenting focus on advancing these students' achievement and mastery of complex concepts to the greatest extent possible. This requirement reinforces the importance of teacher involvement. It is also important to distinguish the concept of flexible pacing, which is intrinsic to the mastery-based approach, from self-pacing. Although self-pacing might help to build student agency skills, it is unlikely to be a good general strategy to ensure that students learn academic content at an appropriate breadth and depth.[23] A mastery-based system must be designed with awareness of the inclination of learners of all abilities to sometimes avoid the hard work of learning.

Finally, mastery-based approaches can conflict with standards, assessment, and accountability policies that have not yet adapted accordingly. Students in most states are still required to take assessments based on grade-level standards, and teachers and schools often are evaluated on how well students do on those assessments. In this context, teachers who are willing to experiment with mastery-based approaches early in the year might become increasingly uncomfortable with the practice as year-end assessments approach and students have not covered the material on which they will be tested. States, school districts, and school leaders who want to allow mastery-based approaches to play out over multiple years will need to rethink how systems of standards, assessments, and accountability operate. This might require a shift away from age- or grade-based targets of attainment toward systems that focus on growth in achievement.

Overall, applying these guiding principles reveals many arguments in favor of implementing mastery-based skill development approaches, along with risks that warrant diligent monitoring.

The Path Forward

In conclusion, there are aspects of personalized learning that seem to hold promise for improving the U.S. K–12 education system, based on some limited research. However, more work is necessary to establish causal evidence that the concept leads to improved outcomes for students. And because personalized learning is composed of so many interrelated strategies, considerable additional research will be needed to sort out the fine details of which strategies, and in which combinations, are most effective for which students. Presently, early implementers of personalized learning are working with imperfect evidence, underdeveloped curricular resources, and policies that might hinder their efforts. As personalized learning approaches become widespread, there are risks that these conditions could cause early implementations to fail. This could lead to the larger concept being abandoned before it can be tested under more-favorable conditions. As a protection against these risks, implementers should use some guiding principles to help discern the aspects of personalized learning that are most likely to lead to success. Following these principles could increase the chance that early efforts are productive, which will help to spur momentum for the development of the tools necessary to sustain personalized learning and put it on a path toward meeting its full potential as a major reform of the K–12 education system.

Endnotes

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About This Perspective

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