Great teachers know that learning requires practice. Ironically, when teachers learn, they listen to people talk about teaching, and sometimes they talk with others about teaching, but they very rarely do teaching. Novice teachers need many more and much better opportunities to practice their new craft, especially in short, high-frequency, low-stakes formats—similar to “drills” used in sports and music education. One of the most promising experiments that we could conduct in teacher education would be to substantially accelerate the adoption of these kinds of opportunities and to make them routine parts of pre- and in-service teacher preparation. By 2025, teacher education should ensure that 1) pre-service teachers will have opportunities for approximation and practice at least once a week in at least 50% of the approximately 2,000 teacher preparation providers in the United States, and 2) in-service teacher professional learning will include opportunities for low-stakes practice in the annual professional learning opportunities available in at least 10% of the 130,000 schools in the U.S.
talk with others about teaching, but they very rarely do teaching. If we want better teacher professional learning by 2025, then we need to provide novice teachers with many more and much better opportunities to practice their new craft.

Grossman and colleagues (2009) observed training in the helping professions—teaching, social work, and ministerial work—and characterized professional learning as including three main elements. Educators shared representations of practice such as videos, observations, documents, and artifacts. They then decomposed those elements into constituent parts and principles. A pre-service teacher might watch a representation of the first two minutes of a lesson, and then learn that those moments and activities are called a “lesson launch” with a set of theories, principles, and practices guiding more and less effective approaches to those crucial minutes. Representation and decomposition can be followed by approximation, where professional learners rehearse for their new roles in low stakes environments. Social work students regularly practiced therapeutic discussions in pairs; clergy-in-training rehearsed funeral intake interviews and orations (apparently, when you take over a new congregation, it is really best not to flub your first funeral). By contrast, pre-service teachers had far fewer opportunities for approximation. Teachers discuss ideas in seminar rooms, and then implement them for the first time in practicum classrooms, where there are 27 real students who need to learn how to factor polynomials or conjugate the Spanish verb “ir”. Teacher learning includes very few spaces and opportunities for low-stakes practice of teaching strategies. How can novice teachers learn, adopt, and implement ambitious teaching approaches—especially ones that may not be common or visible in their first placement schools—without opportunities for rehearsal and reflection?

This line of research has evolved into the work of practice-based teacher education, which seeks to substantially increase opportunities for practice in teacher professional learning. Broadly, practice-based teacher educators have asked two questions: 1) what should novices practice? and 2) how should novices practice? To answer the first question, various researchers, teams, and organizations have developed lists of “core practices” and “high leverage teaching practices” across teaching and within specific disciplines (Ball & Forzani, 2011; Dominguez, 2020; Windschitl & Barton, 2016). The second question of how teachers should practice has moved forward perhaps more slowly, but it is of urgent importance. If we want new teachers to be well-prepared for their first years of classroom work, and if we want in-service teachers to have rich opportunities to develop ambitious new teaching strategies, then we need to make approximation and practice routine elements in teacher professional learning.
At least three types of practice have emerged from this line of work: rehearsal (Lampert et al., 2013), mediated field experiences (Horn & Campbell, 2015), and simulation (Cohen et al., 2020). In typical rehearsals, one teacher-learner is assigned a role as teacher, perhaps to teach a 15-minute mini-lesson, while other teacher-learners role-play as students, perhaps guided by instructions about how they should role-play what they know or how to behave. Mediated field experiences bring teacher-learners to classrooms with actual students, but re-architect the classroom routines so that teacher-learners don’t facilitate a whole typical class period, but instead break the class up into small groups so that several teacher-learners each facilitate a short lesson with a small group, with peers and students. Simulations take many forms. Mursion, formerly TeachLive, creates a mixed reality environment with “digital puppets.” A teacher-learner stands in front of a screen and teaches a mini-lesson to five student digital avatars controlled by a remote actor (Ferguson & Sutphin, 2021). Shaughnessey and Boerst (2018) conduct standardized student simulations, where a teacher-educator role-plays a student with an interesting misconception and teacher-learners interview the “student” to better understand their thinking. Dotger (2013) at Syracuse, and Self and Stengle (2020) at Vanderbilt, have developed live-actor simulations, where actors are trained to role-play as standardized students, parents, or colleagues, and teacher-learners role-play difficult situations that emerge in the work of teaching.

I’m inspired by this body of important work, and it points the way towards theoretically-rich and practically-feasible pathways for teacher education to include many more, higher quality opportunities for practice (Reich et al., 2018). One of the most promising experiments that we could conduct in teacher education would be to substantially accelerate the adoption of these kinds of opportunities and to make them routine parts of pre- and in-service teacher preparation. By 2025, teacher education should ensure that 1) pre-service teachers will have opportunities for approximation and practice at least once a week in at least 50% of the approximately 2,000 teacher preparation providers in the United States, and 2) in-service teacher professional learning will include opportunities for low-stakes practice in the annual professional learning opportunities available in at least 10% of the 130,000 schools in the U.S.

**VISION**

An essential feature of this vision of practice is frequency. Ericsson’s model of deliberate practice (Ericsson & Harwell, 2019) suggests that nov-
ices work towards mastery when they have regular opportunities for targeted practice along with feedback from mentors that help novices see the gaps between mastery-level performance and their own emerging performance. More simply, novices need regular practice with feedback. To anyone who is a teacher educator, the problems with scaling this model are immediately apparent. What would regular improvisational practice in a methods class or a professional learning community (PLC) look like? How would teacher educators observe evidence or artifacts from practice on a weekly basis? How would they have time for generating and communicating feedback? Looking through the toolbox of typical teacher education practices, we don’t have approaches that make this feasible.

As a field, we need to invent new approaches to practice-based teacher education, and technologists will play a crucial role in developing new learning environments that allow for frequent practice that are feasible and sustainable in typical colleges of education and districts. To achieve widespread regular practice in colleges and districts by 2025, we need three interim steps: 1) to develop new pedagogical models of short, high-frequency, low-stakes practice and feedback in teacher education; 2) to build tools and routines to implement those models in sustainable and feasible ways; and 3) to build communities of teacher educators that can implement, study, refine, and disseminate these new practices.

Below, I describe the limitations of current models of practice-based teacher education and provide one example of tools and routines that could support high-frequency, low-stakes, sustainable practice. In the next section on implementation, I describe some of the community building work that would be required to meet this 2025 goal.

**Practice-Based Teacher Education: From Scrimmages to Drills**

As typically conceived, rehearsals, mediated field experiences and simulations are time-consuming and logistically complicated. Many teacher educators have their pre-service teachers conduct a 10- or 15-minute lesson towards the end of a methods class, and those who do so realize that it can take nearly a quarter of the designated class time during the semester to give everyone in a class this great opportunity. Simulation opportunities that require actors can be very powerful, but they require training and hiring actors, preparing designated spaces, coordinating actor and learner times and so on. This type of deep, rich, textured practice is quite promising and can lead to powerful learning experiences, but most institutions won’t be able to adopt logistically complicated practices into weekly routines.
This complexity connects to another common limitation of the current suite of opportunities for approximation: many of these opportunities aim to replicate the “whole” of teaching. Teaching is a fabulously complex assemblage of subordinate routines, knowledge, skills, habits, and practices. Conducting a ten-minute mini lesson in front of peers can be a powerful summative experience, but not only is it logistically difficult to organize with any regularity, there are also good reasons to raise questions about its pedagogical value, especially as a standalone opportunity for practice in a methods course.

The science of complex learning suggests that novices often struggle when asked to practice a complex whole and try to improve in its constituent parts (Van Merriënboer & Kirschner, 2017). A simple explanation of this phenomenon relates to cognitive load and working memory (Paas & Van Merriënboer, 2020); teaching is so hard that a novice can’t simultaneously facilitate a lesson and attend to specific elements for improvement. The science behind this argument is sophisticated, but the intuition will be very familiar to anyone who has ever played a sport or learned a musical instrument. Many common opportunities for approximation in teacher education look like scrimmages or recitals, where we ask novices to play out the complex whole in routines that attempt to achieve high fidelity to the actual practice. Coaches and music teachers use these strategies sometimes, but they also use drills: where educators breakdown complex assemblages into their constituent parts so that learners can develop automaticity or heuristics. Drills can be highly structured, like free-throw practice, or more fluid, like a two-on-one breakaway drill. What they share is that they abstract away the complexity of the whole in order to let learners focus on improving in discrete elements, so that those improvements can be reintegrated back into the complex assemblage. Grossman and colleagues (2009) have a worthwhile discussion of these tradeoffs.

In Figure 1 below, I offer a conceptual plot of the field of practice-based teacher education on two axes. On the x-axis, I arrange various practice opportunities based on whether they attend more to the complex assemblage of teaching or more to individual skills—whether they are drills or scrimmages. On the y-axis, I plot opportunities based on whether they are more digital or more analog (these are subjective and meant to be illustrative). Scoping out the field this way, I see opportunities for the development in the top left quadrant of practice-based teacher education routines that are digital drills focused more on individual skills.
Figure 1. Unexplored Design Opportunities for Teacher Practice Spaces.

In order to shift to a field where practice in teacher education is common, it needs to be simple. Opportunities for practice need to be short, logistically easy, asynchronous, inexpensive, repeatable, and amenable to arrangement into sequences. They should provide rich data and feedback to participants, teacher educators and researchers so that these stakeholders can see, measure, celebrate and build upon improvement from week to week. These short, regular, low-stakes opportunities for practice might then build up towards more summative rehearsals where novice teachers can weave new skills back together into the complex assemblage of teaching.

Teacher Moments as a Platform for Teaching Drills

As one effort to realize this vision, in my lab at MIT we’ve developed a freely-available, open-source platform for digital clinical simulations called Teacher Moments (Hillaire et al., 2022; Thompson et al., 2019). Teacher Moments immerses participants in vignettes of classroom life through text, images, and videos, and then calls upon participants to respond to difficult decisions in teaching through recorded audio and text. Participants (teacher-learners) experience Teacher Moments as a mobile web app. Their teacher educator sends them a link to a single scenario or sequence of scenarios which they can complete either in class on a laptop, or asynchronously from their phone or any other device. Teacher-educators have access to an author-
ing tool that lets them select existing scenarios for distribution, copy and modify existing scenarios, or create new scenarios. Certain parts of the system are technologically sophisticated—for instance there is an extensible AI coaching infrastructure that allows designers to program classifiers that “listen” to participant responses and trigger real-time feedback when appropriate. But the front-end and basic features of the system are deliberately simple—using web browsers and rich text editors that work on basic mobile devices and are familiar to nearly any internet user.

Figure 2. Schematic of Teacher Moments, A Platform for Teaching Drills.

One example scenario in Teacher Moments is Jeremy’s Journal, in which teacher-learners follow the life of one student in their class over the course of a week (Borneman et al., 2020; Buttimer et al., 2022; Littenberg-Tobias et al., 2021). The narrative in Teacher Moments focuses on Jeremy’s participation in class along with images of his daily notes from class. The topic of the week in this English Language Arts class is hyperbole, and Jeremy misses one day in the middle of the week due to illness. On the last day of the week, he comes to class late and says that he can’t take the weekly quiz because he’s going to fail and “my mom will LITERALLY kill me. KILL me. Like, actual DEATH” (Many participants pick up on the fact that Jeremy may actually have done some good learning over the week about hyperbole). Participants need to decide if Jeremy will take the quiz, and perhaps most importantly, record what they would actually say to Jeremy in this moment.
We embedded Jeremy’s Journal in a longer online course for teachers about anti-racist teaching practices called *Becoming a More Equitable Educator*. In our view, a key element of anti-racist teaching is seeing students as individuals, charting their lives, backgrounds, needs, and ambitions. To allow students to practice this way of seeing, the Jeremy’s Journal scenario abstracts away much of the complexity of teaching—the scenario doesn’t require planning or facilitating lessons, or even attending much to the other 20 students in class. Instead, we collapse a week of class into a 30-minute digital clinical simulation and ask participants to primarily practice and focus on attending to one particular student having a tough week. In *Becoming a More Equitable Educator*, we build from this individual focus outwards towards addressing issues of equity in classrooms, curriculum, and community, all while continuing to center the needs and aspirations of individual students.

I share Teacher Moments not as the final answer to how we might rapidly scale practice-based teacher education, but as one possible example for reflection. Teacher Moments is an attempt to meet the requirements that I outlined earlier for systems that could support large-scale, routine use of approximations in typically teacher education settings: inexpensive, simple to operate, requiring minimal technological specifications, suitable for both in-class and asynchronous use, and focused more on individual skills than on the complex assemblage of teaching. Teacher Moments is a system for teaching drills which could shift a typical methods class so that “improvisational practice” could be added to the weekly routines of reading, discussing, designing, and reflecting.

**IMPLEMENTING TEACHING DRILLS AND OTHER NEW FORMS OF TECHNOLOGY-ENABLED TEACHER EDUCATION**

As advocates of practice-based teacher education build new systems and approaches for making practice more routine, we also need to be attentive to issues of teacher education adoption. Many of the teacher educators (like myself) with the opportunity and privilege to build new systems work in well-supported, research-focused institutions with modest teaching loads. But the teacher educators doing the yeoman’s work of actually training the nation’s teaching corps often work in less well-funded institutions with much higher teaching requirements. Achieving scale means that typical teacher educators with complex lives, busy teaching loads, and some research requirements need to find the opportunities to adopt practice-based approaches intuitive, straightforward, and enjoyable.
One point of consensus in the research on teacher adoption of technology is that adoption is a developmental process. In this I believe that teacher educators are no different than other educators. Since the 1980s and the Apple Classroom of Tomorrow project (Sandholtz et al., 1997), we’ve known that most teachers adopt new technology in simple ways that align with existing routines. Only with extensive time, support, coaching, and experimentation do teachers move on to making substantial changes to their goals, curriculum, and routines to allow new technologies to be used in innovative ways. Put another way, to achieve a goal whereby in 2025 there are many teacher educators who are using practice-based approaches once a week, then as soon as possible we need to make it easy, intuitive, compelling, and rewarding for teacher educators to use practice-based approaches just once. Then, we need to provide those teacher educators with supports to help them expand that initial experiment into curriculum-wide innovation and improvement. I have four design hypotheses about key features that will allow practice-based approaches to teacher education to scale.

First, there need to be shovel-ready entry points. If starting a new practice-based approach requires designing new programs or curriculum from first principles, or adopting logistically complex practices, then most teacher educators won’t do it. With Teacher Moments, the simplest entry point is that we can guide teacher educators to some of our best scenarios, give them a link to share with their teacher-learners, and they can get started with almost no training or support. For four of our scenarios, we have facilitator guides with some detailed ideas about how they might be used. Again, these approaches are not the “right” answers, but they are illustrative efforts to make new approaches as easy as possible to try out.

After teacher educators have some positive results with trying out a practice-based approach, then they are ready to make more investments in curriculum and program change. As Seymour Papert (1993) argued many decades ago, good learning technologies have low floors and high ceilings. Effective systems for supporting practice-based approaches need to be able to be adapted and localized to the vastly different contexts and circumstances of teacher educators in big programs and small, in urban and rural places, and across all of the grade levels, subject areas, and other divisions of teacher education.

My third design hypothesis is that those complex changes often benefit from the support of a community of practice. We have used two models for offer this support. With philanthropic funding, we’ve developed fellowship programs where teacher educators (often from shared backgrounds like Computer Science Education), come together to design new teaching drills,
implement them with colleagues, and develop plans for research or curriculum change. We also host monthly drop-in community of practice meetings where anyone can come to meet other users and get support from our team. Scaling practice-based teacher education will require scaling communities as much as spreading new technologies (Reich, 2020).

Finally, even in teaching-focused institutions, many teacher educators have research goals and promotion requirements. Advocates for practice-based teacher education should think not only about how teacher educators implement new approaches, but how they can get support to study and publish about those innovations to advance their careers.

Combined, these principles about practice-based technology and adoption suggest key pathways towards the goals of making teacher practice a weekly routine in half of all teacher prep programs by 2025 and in 10% of all in-service teacher professional development programs by the same year. There is room for many different kinds of teacher education to practice-based approaches, and early efforts in the field offer educators a suite of very rich opportunities for comprehensive practice. To make practice more routine, the field needs to generate new kinds of opportunities for practice that are simple, inexpensive, logistically easy, low-stakes, repeatable, and asynchronous. There may be certain kinds of in-person, analog routines that fit these descriptions, but developing a weekly cadence of practice in teacher prep programs will almost certainly require digital tools. Adopting new tools and approaches into programs will be a developmental process, and so teacher educators will need opportunities to join communities of practice and find fellow travelers within their institutions, their areas of specialty, and across the field to work with in developing these new approaches.

Preparing students for a complex future requires training teachers to be ready to implement ambitious teaching strategies from the earliest days of their career. To achieve this ambition, teachers need more access to a very basic resource for learning: opportunities for practice. Creating these opportunities at scale represents one of the most promising ways to improve teacher education and the work of teachers of all kinds in all schools.

Acknowledgements

This material is based upon work supported by the National Science Foundation under Grant 1917668.
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