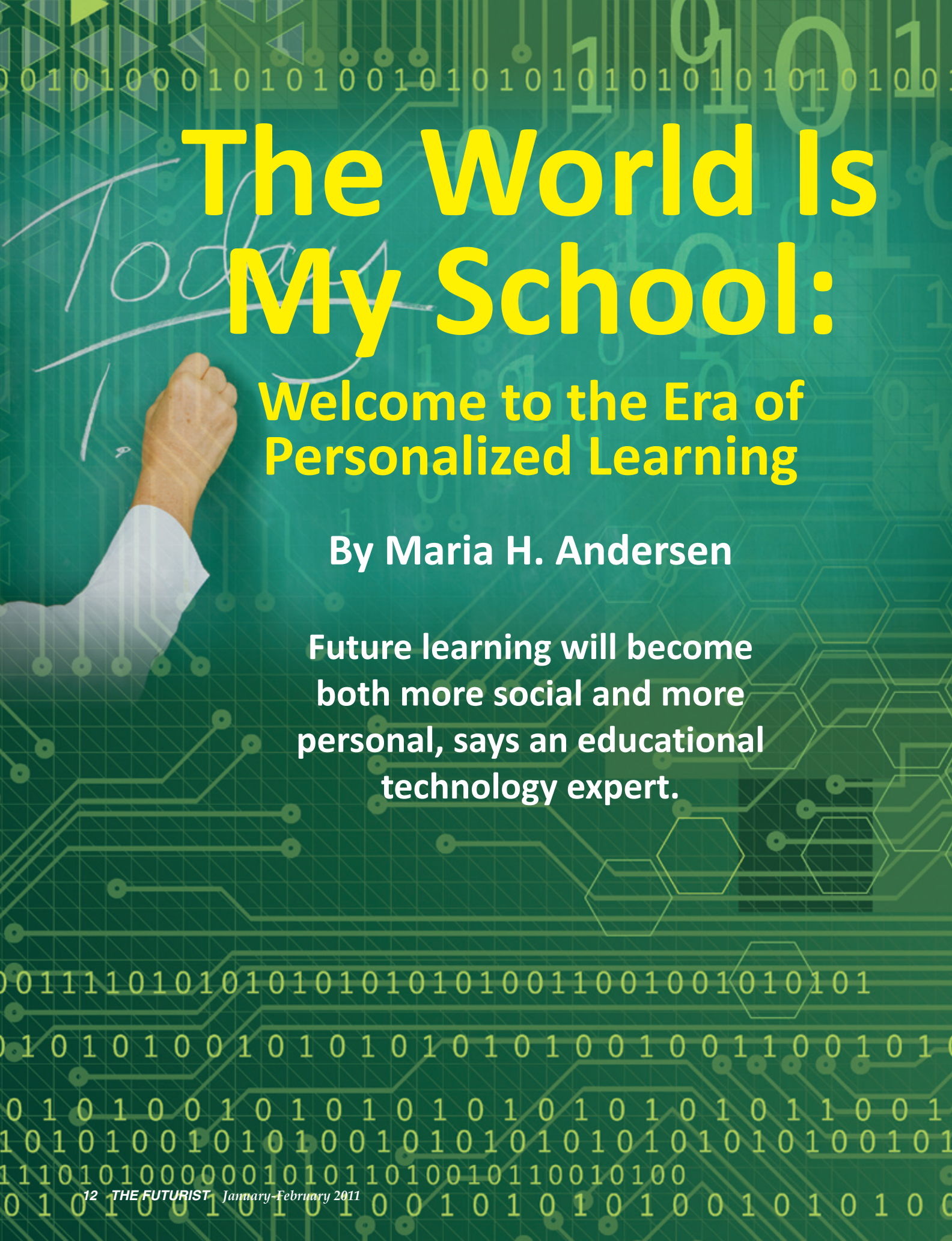

The World Is My School:

Welcome to the Era of Personalized Learning

By Maria H. Andersen

Future learning will become both more social and more personal, says an educational technology expert.

Humans have always been learning, but how we learn has changed over time. The earliest means of education were highly personal: Oral histories passed from adults to children, informal or formal apprenticeships, and one-on-one tutoring have all been used in the early history of most cultures. It's only been in the last two centuries that we've used formalized systems of mass public education (aka industrialized education).

Certainly, personalized learning is the more effective method. In 1984, educational researcher Benjamin Bloom found that average students who were tutored one-on-one outperformed 98% of students who were learning via conventional methods (this is referred to as Bloom's two-sigma problem). However, personal learning is not cost-effective, and so we currently educate students in batches of 20, 30, or even 200 students at a time. This is likely to get worse before it gets better, with prominent philanthropists like Bill Gates declaring that "the best lectures in the world" will be online within the next five years. Certainly we can use technology to deliver those lectures to thousands, or even millions, of students at a time, but a lecture does not automatically produce learning any more than attending a class does.

Mass education is adequate, as long as students are highly motivated to learn and get ahead of their peers. In developing countries, a student who is successful in education will be able to climb the ladder of personal economic prosperity faster than those who are not successful. But in industrialized countries, where prosperity is the norm, an education does not necessarily translate into a significantly higher standard of living. In these countries, there is no longer a large economic incentive to learn, so the motivation to learn must become intrinsic. As we redesign en masse education, we must address learners' intrinsic motivations, which means that education must circle back to being personal again.

The vision of a modern education built around personalized learning is not new, but it is definitely tantalizing. Neal Stephenson's novel *The Diamond Age* (Spectra, 1995) shares a vision of personalized learning in the future via an interactive book that possesses a conversational interface (CI) and "pseudo-intelligence," a kind of artificial intelligence (AI) that is inferior to human intelligence. It's likely that we'll see decent conversational interfaces within the next decade, and certainly applications like Google Voice are moving us much closer to this reality. AI that is capable of directing the learning needs of a human will take much longer, developing in the next 20–50 years, but we can't wait that long for the technology to catch up with education. The need for personalized learning exists in the here and now. So how does one bridge this vision of the future with the realities of the present?

Learning Technologies Today

Let's start by taking stock of the personalized technologies for information that we already have. We have software that stores the content we like (e.g., Evernote, Posterous) and software that merely stores the location of that content (e.g., Diigo or Delicious). Even traditional media, like books, now have parallel digital systems that allow for note taking, highlighting, and bookmarking (e.g., Kindle, Nook, or iPad). While it's useful to store and search information, I would venture that we rarely go back to look at the information we mark for storage.

This is a problem; for deep learning to occur, we need to have repeated exposure to the information, along with some time in between for reflection. We need to give our brains a repeated opportunity to process the information we take in so that it becomes knowledge, understanding, and wisdom. This means we're going to have to find time in our busy lives to reflect on the information that flows past us on a daily basis, and we're going to need some kind of technology that keeps us on track with our learning goals.

While it seems outrageous that we could find any more time in our busy lives, consider some of the disruptive changes we've seen quite recently that affect how we spend our free time. Facebook, now with 500 million users, has disrupted normal social interactions in a little over six years. Micro-blogging exploded when a Web site simply invited us to answer the question: What's on your mind? Twitter users now send more than 50 million tweets per day, and big news stories break first on Twitter—in real time and with eyewitness accounts. As big as Twitter is, there were more people playing Farmville (a social media game on Facebook) at its peak than there were active Twitter users—a fact that has not gone unnoticed by game designers and educators. These Farmville players are choosing to spend their free time for collaborative activities (their "cognitive surplus," as media scholar Clay Shirky puts it) plowing virtual soil and planting virtual crops.

These innovative social disruptions have happened quickly, but not from within the existing organizational structures. For example, Facebook did not disrupt phone communication by changing the nature of phone calls or phones. Facebook built an entirely new system that eventually circled back around to phones by the way of phone apps. In the same way, the trick to developing a personal learning system is to abandon thinking about how to build it from within the existing edu-

"For deep learning to occur, we need repeated exposure to information plus time for reflection."

ILLUSTRATIONS: SCOTT SPENCER, DIANE LABOMBARBE, MARTIN MALCHEN / ISTOCKPHOTO

cational system and to begin pondering how such a system could be developed outside of education. Educational institutions form a vast interconnected network, and while small changes can occur within the system, individual parts only have the ability to flex within their existing boundaries. For a personalized learning system to take hold inside education, it will have to be built on the outside.

A Simple Idea: Learn This

Let me propose a realistic scenario of what a true personalized learning system might look like and how it would function. We first have to create (1) a new layer of learning media in the background of the existing Internet and (2) an ecosystem of software to easily manage the learning media we engage with. In the same way we've integrated buttons like Twitter's "Tweet this" and Facebook's "Like" at the end of videos, articles, and other media, imagine we now add a button for "Learn This." Clicking this button (anywhere you find it) would bring you into an interface to help you learn the content.

We don't need a humanlike artificial intelligence to begin this journey. The technology for such a journey already exists and is simple enough to use with traditional learning methods. In the first version, learning should simply be by way of Socratic questioning, where questions are used to analyze concepts, to prod at the depth of knowledge, and to focus on principles, issues, or problems. Socratic questions are elegant because, unlike with other formats (e.g., multiple choice), learners must self-generate the answers rather than rely heavily on the ability to recognize a correct answer when they see it. The personal learning system would use a spaced repetition algorithm (SRA) to reintroduce the Socratic questions over time so that biological memory is more likely to grasp onto the ideas and information. For now, let's call this system SOCRAIT (a play on "Socratic" that includes SOC for *social*, AI for *artificial intelligence*, and IT for *information technology* within its name).

For example, suppose I read an article about digital copyright in educational settings, and I decide that it's important for me to remember some of the details of this article. At the end of this article, I choose "Learn This" to add a question to my SOCRAIT question bank. Two options would appear: (1) write your own question or (2) choose from a list of questions written by others. If I choose the first option, I might write a simple question and answer for myself: "What are the allowable uses for copyrighted video in an educational setting?" Following this, I'd write a short summary or clip a few sentences of content from the article to summarize the answer to the question. Along with the question and answer, SOCRAIT would save the source URL (link to the content), and I could tag the question with metadata tags I indicate (e.g., *copyright, digital copyright,* and *education*).

Later in the day or the week, when I have some down time, I could reengage with SOCRAIT. Here's how it would work: I read or listen to a question, answer it in my head or out loud, view or listen to the answer, rate my understanding, and go to the next question. Since the learning is tailored to intrinsic motivations, learners could rate their own ability to answer a question (e.g., 1 = I have no clue, 2 = I knew some of it, and 3 = I nailed it!), and SOCRAIT could make decisions based on these ratings. If your rating of understanding is low or spotty, the system would offer to send you back to the source for another look. Notice that there is no need to develop software to verify the answers to questions—if you aren't good at rating your own understanding (we call this metacognition), this will come out later in the process, and you'll have to learn to get better at it.

With a rudimentary computer interface, like the one imple-

Author Maria H. Andersen offers the following questions as sample Socratic-learning prompts for readers of this article.

- What technologies are we likely to see in personalized learning systems on the 20–50 year horizon?
- What arguments are made for the likelihood that we can "find" the free time to engage in a personal learning system?
- Why are Socratic questions and spaced repetition algorithms (SRA) an elegant solution to the personalized learning problem?
- How are responses evaluated in the proposed SOCRAIT system?
- What evidence do we have that people will be willing to put in the cognitive energy to create a learning layer on the Web?
- How could SOCRAIT be used by journalism to improve the revenue stream?
- How would the SOCRAIT model change the way we consume media?
- What are Socratic scholars and what function do they serve?
- If SOCRAIT were implemented, how would the role of educators shift?
- What is the "game layer for learning" and why is it necessary for something like SOCRAIT to work?
- What is needed to build a system like SOCRAIT?

mented in Google Voice, there's no reason why SOCRAIT couldn't be voice-based and available anywhere we interact with computers (e.g., cell phones, tablets, auto navigation systems). This would allow us to improve our learning while performing other tasks: commuting to work, making dinner, or walking the dogs.

Initially, the so-called "Pareto's Vital Few" (the 20% of people who get 80% of the work done) would be the ones who would be most interested in creating and engaging with questions. But as the connectedness of the system matures, the need to write your own Socratic questions would lessen. Authors and media creators would write their own questions, targeting comprehension of important ideas and facts. Media consumers would be able to choose from a list of questions, perhaps seeing a sorted list based on their indicated learning priorities. Two readers of the same article would see different questions at the top of their "suggested questions" based on tags of the content. In some cases, the user might choose to pay for curated or reputable content so that their learning can later be certified by an employer, educational body, or organization.

Personal Learning's Implications For Education

Now let's take a step back and look at the big picture. Any content that exists on the Internet (or is connected to the Internet) would be tagged with Socratic learning questions and metadata for subjects. Learners would have their own bank of questions, personalized to their own learning interests. As a result, instead of learning that is designed around a physical place (e.g., schools), an educational space (e.g., learning management systems), or a person of authority (e.g., instructor), this system is designed around the learner.

It goes without saying that the implications for education are huge. In the space of a few years, we could develop a completely separate content learning system that's incredibly flexible and personalized to the interests of the learner. The architecture needs to develop organically around Web-based content and grow tendrils into everything we produce in the future. It will take some time to go back and create a learning layer to integrate with all the content that we already have, but as we've seen from projects like Wikipedia, there are people willing to contribute their time and energy to these kinds of tasks. Wikipedia became the largest encyclopedia ever assembled within a mere six years after its creation, and was built using less than 1% of the time that Americans spend watching TV every year (as calculated by Clay Shirky).

A system like SOCRAIT has the potential to benefit other industries outside of education. For example, modern journalism has been struggling with a problem of income stream. While revenue has shifted to online advertising, it is not enough to shore up the industry. At present, the vast majority of Internet content is free and, as Chris Anderson argues in his book *Free* (Hyperion, 2009), it's not likely to change. How do you get readers (or viewers) to pay for something that they already get for free? The answer: Add something to the content that's not already there. If readers or viewers had the ability to quickly add reputable questions to their learning bank, this would be a value-added service. Cleverly, the media content would remain free, but access to the question bank would require a one-time payment or ongoing subscription by the consumer. This would certainly help modern journalism (or the textbook industry) to shore up their revenue stream.

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"To learn, to analyze, to innovate, and to think creatively, we must internalize some of the information we process."

A New Learning Ecosystem

Books like Nicholas Carr's *The Shallows* (W.W. Norton, 2010) cause us to question whether we might be trapped on the information superhighway—stuck on the line between data lanes and unable to scoot forward or backward. Twitter users regularly use the phrase "drink from the fire hose" when referring to their experience of dipping into the live data stream. Information, whether it be from radio, television, print, Web media, or social networks, is coming at us too quickly; all that most of us can do is surface-skim, rarely pausing to reflect or think deeply. To learn, to analyze, to innovate, and to think creatively, we must internalize some of the information we process.

An entirely new ecosystem could grow up around this Socratic learning system. Certainly a ratings system for questions could be built using the technology developed by companies like Netflix. For example,

"Your friends John and Iveta chose this question. Would you like to see other questions/media they chose for this topic?" If you choose to do so, the questions you see when you add content to your question bank could be filtered by your existing social networks. Rather than showing all the possible questions in existence for that media (which could become a fairly lengthy list), you could choose to see only the ones people in your social network have also used.

So far, I've discussed how the system would work if you engaged in reading and watching media as you do today. However, such a system could also shift how and when we seek out content. After all, a lot of time is wasted in modern education by re-teaching content that some of the learners already know. There is no incentive for students to get ahead when the reward is sitting through a lecture on something they've already learned.

Imagine: When you need to learn something new, you could subscribe to a curated collection of questions on that topic. For example, "Digital Copyright 101" might be a collection of questions developed by somebody who teaches digital copyright policy to beginners. The truly fascinating shift is that you wouldn't necessarily start by consuming the media that goes with the questions. Instead, you would simply start answering the questions in your bank. As you encounter learning questions that you can't answer, you could dive into the content at those points in time—this is the exact point between boredom (with things you already know) and frustration (with things you don't know), the point to engage in learning.

Testing Knowledge Acquisition

Almost immediately after the personalized learning architecture is in place, we will need a new educational industry tasked with certifying knowledge and understanding. For lack of a better name, let's call these folks "Socratic scholars." Their job will be to rate how well you know what you claim to have learned. For example, let's say I've engaged with and theoretically learned 500 tagged questions on biochemistry to prepare for teaching a new class. In order for this to count toward my professional development hours, my college asks me to certify the learning. I pay for a Socratic scholar who specializes in chemistry to rate my knowledge. We meet either in person or via the Web (more likely) and have a discussion about the questions in my learning bank on biochemistry.

"When you need to learn something new, you could subscribe to a curated collection of questions on that topic."

The scholar has access to the 500 questions I say I've mastered and asks me to answer a random selection. Of course, this is where it would be valuable to have reputable questions in my learning bank (from authors, researchers, scientists, and leaders in the field). Since the scholar can see both my questions and the answers (linked back to original content), it should not be difficult to ascertain whether I have, in fact, mastered the knowledge and concepts as I have claimed. Because the certification is human-to-human, and not human-to-machine, the nuances of human language would be understood. So if the language of the verbal answer and the language of the written answer don't match up exactly, that wouldn't be a problem. At the end of the session, the scholar would "grade" my understanding of the 500 questions on biochemistry, and I could provide this certification to the human resources department.

In many respects, this is a much better system than what we have today. For most certification of learning, we simply look at a transcript. If the class is listed, we assume the learner has that knowledge. Of course, knowledge ages—sometimes it evolves into understanding or wisdom, and sometimes it fades out of existence. The fact that I earned a chemistry degree in 1996 does not mean you would want to hire me as a chemist today. Ideally, you'd want me to recertify before I entered the "chemist" job pool. Biological memory is not reflected in the metrics of transcripts or grade point averages.

I am not saying that this "certified" content knowledge equals the ability to function as a practitioner in the discipline. Even a diploma only indicates that the educational system has walked you through some series of appropriate paces for the discipline. Skills like critical thinking and creativity are often lost in education (especially in science and technology) because there is such an incredible amount of content to cover. However, if the content knowledge moved outside the educational system, then educators could focus on the learning that surrounds technical knowledge instead (e.g., problem solving, analysis, creativity, applications).

Let's imagine what would happen if a robust Socratic learning system was at the heart of the educational system. A learning coach (a more appropriate term for the teacher or instructor in this learner-centered environment) will designate some core material that he or she wants you to learn. For example, in calculus, I might use a set of 500 curated concept-oriented questions from a well-known calculus textbook author, with each question linking to supporting media. Every student would be working on those questions, and so, as a learning community, we'd all work on that together. I would hope that this doesn't sound like too radical a departure from normal.

This is where it changes: Because every student has different interests and career ambitions, I would also require that each student find an additional 100 questions tagged with both *calculus* and tags that are of interest to that student. For a student studying to be a doctor, questions

tagged with *medicine* or *epidemiology* might be appropriate. For a student going into business, questions tagged with *marketing* or *management* might be more appropriate.

As the learning coach, my job is no longer to "deliver content" to the students. SOCRAIT does that. Now I can use my time to help students search for good questions, help them to understand the content they are learning, provide activities to help them work with the concepts or connect the material in an applied way, and foster discussion with other students on these topics.

When it comes time to certify the learning for each student, it is done by an oral interview in which I have access to the common questions and the personalized questions for each student. Even if I'm not an expert on all the personalized questions, the answers are provided and the content is related to a subject of my expertise. Again, I only have to ask about a random selection of questions to be able to assess understanding. At the end of the semester, all students have learned their own personal versions of calculus, while still learning a core of common material.

Such a system has implications for lifelong learning "on the job," too. Instead of holding mandatory training, a human resources department could push out a bank of Socratic questions to all their employees about safety, new initiatives, mission statements, etc. For example, to train employees on Occupational Safety and Health Administration (OSHA) compliance, the employees would be invited to add a curated list of 40 questions about OSHA policies. Each question would lead back to a source that provides the necessary content to answer the question. After two weeks, someone in HR can act as the Socratic scholar and spend five minutes with each employee to test his or her knowledge of the policies, using a random selection of questions.

A Game Layer for Learning

Futurist John Smart writes about a coming "valuecosm" within 10 to 20 years, when we'll be able to program our apps or avatars to make decisions for us based on what we say is our set of values. The real question is whether learning can become one of our new values, especially in the United States. In 2009, The U.S. Bureau of Labor Statistics estimated that the average American adult spent more than five hours per day on leisure activities (close to three of those leisure hours watching television) and about 30 minutes per day on educational activities. Given the 10:1 ratio of leisure to educational activities, is American culture likely to embrace learning as a choice? Initially my answer was no, but then I began to think about video-game design.

Entrepreneur Seth Priebatsch spoke at TEDxBoston (2010) about building a "game layer on top of the world." What if one of the game layers we create surrounds learning? The same game dynamics used to build successful video games (e.g., appointment dynamics, influence and status dynamics, and progression dynamics) could be deployed to make learning the game itself. While this might still be a hard sell for the average adult, there will be subpopulations, such as early technology adapters, who will see the immediate value in cultivating and learning from their own question banks. Children who grow up learning with a Socratic question system might gain learning values naturally and carry these to their adult lives.

A successful Spaced Repetition Socratic Learning System (SRSLS) would have to entice you to keep to specific goals, like answering 50 questions per week or answering 100 questions with a certain tag in the next month. Any of these goals could be incentivized with points (1 question answered correctly = 1 point), incentive rewards for meeting certain goals ("you've earned your Silver Calculus badge for 100 questions learned"), and social status levels ("Maria has just become a Calculus Master—can you do it too?").

Those engaged in formal education would participate with a far greater intensity of daily questions than those who are in the workforce. However, the wise worker would continue to learn, albeit at a slower pace. Résumés would boast levels of knowledge on particular topics and stats on the intensity at which you participate in learning.

Let's Build It

A diploma has become a social signal to stop learning. In today's world, where technical knowledge doubles every two years, this is absolutely the wrong thing to do. Careers shift overnight, and industries collapse rapidly. We have to learn, and learn faster than we ever have before, in order to stay ahead of the problems we are now creating.

The content for a system like SOCRAIT already exists; it is the architecture and interface we are missing. This new learning medium needs to be an interconnected network of user-generated, or author-generated, Socratic questions with a seamless question-management interface. The architecture needs to remain open so that anyone can create questions on any content, and any developer can build applications for the computing device of his or her choice.

A system for personalized learning will not grow from inside formal education. Education is like a field that's been overplanted with only small patches of fertile soil. Too many stakeholders (parents, unions, administration, faculty, etc.) compete to promote various ideas about how to change, acting like weeds or plagues that choke off plant growth. The fresh and fertile soil of the open Web can foster the quick growth of a personalized learning system. Then, like a good fertilizer, it can be used to replenish the soil of formal education and help us to reach that "Holy Grail" of education: personalized learning for all. ❑

About the Author
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