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Can You Learn How to Learn for Life? Components from Expert Learning Research

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Given the increasing skill complexity required to succeed in a changing global economy, the objective of this paper is to describe three components, distilled from the research literature on expert learners, for promoting the goal of lifelong learning: deliberate practice, mentorship, and the personal dispositions of reflecting, leveraging, and framing. These three components reflect the *meta-skills* required for individuals to learn across the lifespan irrespective of domain. The paper concludes with a recommendation that these components be modeled and measured with cognitive diagnostic assessments at the classroom level, when students are potentially undergoing a sensitive period to learn these life skills.

INTRODUCTION

The theme of this paper is that research into how experts become efficient and prolific learners can be useful in helping us understand the challenges associated with the goals of lifelong learning. Expert learners, such as accomplished musicians, researchers, professional writers, and leaders in medicine and law are individuals who by definition have invested a significant amount of time learning and receiving formal instruction in their respective domains of expertise and, most significantly, who continue to pursue learning as part of their everyday activities. By examining commonalities across expert learners, we may be able to shed light on the factors and conditions that can help set up solid foundations for lifelong learning. There is in fact good reason to believe that understanding these factors and conditions could significantly help shape the way we teach children in order to ensure that they develop the meta-skills and habits we have come to associate with experts, many of whom happen to be successful lifelong learners. One of the challenges associated with this is of course that this would entail cultivating habits and skills that, although supported by research evidence, might only yield their most significant benefits years after the fact. Yet, this is a challenge we must face given that a commonly accepted goal of teaching children is to develop in them the skills and habits that will help prepare them for a future in which they will be expected to continue learning throughout the course of their lives.

The practices and skills cultivated by expert learners may fortify the process of learning and promote the transfer of learning across myriad contexts. In the next section, I describe three basic components associated with expert learning—deliberate practice, mentorship, and personal dispositions—that, I think, could act as the cornerstones of a true culture of lifelong learning. These three components could also be labeled meta-skills because they represent skills required to learn new skills. The components of deliberate practice, (seeking and securing) mentorship, and developing specific personal dispositions in relation to learning represent general skills for acquiring more specific learning skills. These three components have been distilled from decades of educational and psychological research on how highly skilled individuals—both children and adults—learn and what keeps them learning (e.g., Ferrari, 2002).

THREE COMPONENTS OF EXPERT LEARNING

Deliberate Practice

According to Ericsson and Charness (1994; see also Ericsson, 2002), deliberate practice is "an effortful activity motivated by the goal of improving performance. Unlike play, deliberate practice is not inherently motivating; and unlike work, it does not lead to immediate social and monetary rewards" (p. 738). Two points should be made about this definition: first deliberate practice is fundamentally about effort; and second, the practice is specifically directed at improving performance. These aspects of deliberate practice are described next.

Time spent on domain-specific experiences. The successful acquisition of complex skills requires participation in specific, domain-related activities (Ericsson, 1994; Ericsson & Lehmann, 1999). For example, a student who wants to improve her ability to reason mathematically needs to learn the conceptual and procedural knowledge underlying the mathematics of interest (e.g., how and why fractions are solved in specific ways). She must also practice this newly acquired knowledge by spending many hours solving mathematical problems. Studies, in fact, have found a consistent relationship between amount of practice and performance level in the domains of medicine, software design, bridge playing, snooker, typing, and exceptional memory performance (Ericsson & Lehmann, 1996); chess (Charness, Krampe, & Mayr, 1996); sports (Helsen, Starkes, & Hodges, 1998); and music (Sloboda, 1996). Without long hours of practice in a given domain, a learner's basic skills generally do not have the opportunity to become automated (Ericsson, 2002). And developing automaticity of basic skills is a necessary step in acquiring complex skills (Ericsson, 2006; Mayer, 2008), which in turn paves the way for expert learning. Automaticity in this context refers to the ability to complete a cognitive task without devoting much conscious attention to it. When, for example, a student has practiced the skill of solving fractions so much that she can do it without checking her textbook for all the steps, the skill has become automated and her attention can now be directed to other aspects of mathematical problem solving. Her attention can then be directed to solving complex mixed fractions or discovering short-cuts for solving fractions more efficiently. However, although automaticity of basic skills is desirable, it can also work against the development of expert learning. Ericsson (2002) warns against arrested development, especially when learning complex skills.[1]

It is also important to note that deliberate practice is not simply "drill and kill." In the mathematics example presented earlier, deliberate practice in solving fractions in the absence of an understanding of numbers, number line, and part-whole relationships is ineffective. An important aspect of supporting expert learning is to remember that practice, in the absence of understanding, will not be expected to improve long-term performance because the repetition will not be tied to conceptual knowledge and therefore will not be expected to lay the foundation for increasingly complex learning in the domain. In other words, the deliberate practice of skills will only yield positive results if it is accompanied by the opportunity to refine and "tweak" the skills that are being practiced as learners' conceptual understanding grows. This further suggests that deliberate practice should take place over a long period of time. In fact, even for those individuals considered talented and prodigious in domains such a music, athletics, mathematics, and science, at least 10 years of intense deliberate practice appear to be required before reaching an international level of recognition. Although minimum competency may be achieved in fewer years, the 10-year-rule underscores the minimum of time and effort required to see true expertise of complex skills across the lifespan.

Activities that mediate improvements in performance. Although time-on-task or amount of domain-specific experience is necessary for deriving positive outcomes from deliberate practice, it is not sufficient. The second component of deliberate practice is the quality of domain–specific experiences, which involves carefully choosing activities that will most effectively improve performance. For example, in the mathematics example presented earlier, the student could choose to practice her newly acquired knowledge of fractions by completing worksheets. Although completing worksheet after worksheet of fractions could ultimately automate her skills in executing the solutions, it would likely not challenge her conceptual understanding of how to solve word problems about fractions. Alternatively, the student could seek out interactive computer environments (e.g., see Bransford et al., 1996; Lajoie, 2007) that would require the translation and integration of what she has learned from completing the worksheets in order to solve fractions in novel settings. Not surprisingly, research shows that activities that combine the opportunity for the individual to apply newly acquired skills in novel environments with that of obtaining high-quality feedback provide more effective training grounds for skill refinement (see Bloom, 1985; Ericsson, Krampe, & Tesch-Romer, 1993).

When choosing activities that mediate improvements in performance, obtaining high quality feedback therefore appears to be instrumental. Horn and Masunaga (2006, p. 601) explain its importance well:

> [F]eedback can be obtained from objective observers—human teachers and coaches—or it can be self-generated by comparing one's own performance with examples of more-advanced expert performance. Such objective feedback helps the learner to become aware of the standards of expertise, to internalize how to identify and correct errors, to set new goals, to focus on overcoming weaknesses, and to monitor progress.

The feedback provided by a human teacher, coach, parent, or computer tutor should therefore (a) identify where learners need to focus effort; (b) guide learners' attention to appropriate activities designed to improve performance; and (c) help eliminate mistakes (see Anderson, 1993; Mayer, 2008). In other words, the provider of feedback would need to be sufficiently knowledgeable to identify, guide, and help learners improve their skills. Moreover, the teacher, parent, coach or computer tutor would need to have the capacity to carefully observe learners' demonstrated levels of performance, in order not to push them to perform at a level that is beyond their capacity, while at the same time challenging them to sharpen their skills and improve current performance levels. This idea is similar to Vygotsky's (1978) zone of proximal development, which refers to the difference between a learner's current level of performance and the desired level of performance that can be obtained with expert guidance. There is, moreover, substantial evidence for the necessity of specific, objective feedback in the acquisition of complex skills and development of expertise (Ericsson et al., 1993; Mayer, 2008). Who delivers this feedback is discussed in the next section.

Mentorship

Avenues for providing feedback. Teachers, parents, coaches, and/or computer tutors who are highly knowledgeable about a domain can provide feedback to learners and help them acquire skills of interest. The feedback provided by mentors does not simply reinforce a correct type of response in students; students must interpret the feedback and view it as informative for modifying their behavior. In other words, mentors have to be sufficiently specialized to provide high-quality feedback and learners have to accept the mentor as a source of first-rate feedback and be motivated to use this feedback to alter their performance (Mayer, 2008). In an analysis of retrospective interviews with international-level performers in a variety of disciplines, Bloom (1985) found that parents of future elite performers spent a lot of money and time trying to access the best teachers and training environments. This focus on obtaining the best, most knowledgeable mentors had sometimes even meant relocating the family to a new city where the mentor lived and worked.

The involvement of top-level mentors who provide high-quality feedback to students is exemplified in cognitive apprenticeships. The goal of cognitive apprenticeships is to assist students, via guided experience, to acquire the cognitive "processes that experts use to handle complex tasks" (Collins, Brown, and Newman, 1989, p. 457). Three methods used in cognitive apprenticeships include modeling, coaching, and scaffolding. Modeling occurs when a mentor describes his or her thinking aloud to students when carrying out a complex task. For example, a science teacher might orally outline his or her thinking for differentiating models (single-loop versus double-loop) of the circulatory system. Coaching occurs when a mentor offers hints, comments, or critiques to learners as they solve complex tasks. For example, a math teacher might watch a student struggle to begin to solve a statistics word problem. To help the student begin, the teacher may offer a hint by pointing out the nature of the dependent measure and its status as categorical or continuous. Scaffolding occurs when a teacher helps a student solve a task whose subcomponents require skills the student has not yet mastered. Recognizing this discrepancy, a teacher will assist in solving the subcomponents. For example, in learning to drive a student may be overly focused on the road and forget to look at his or her mirrors. To improve the student's driving, the instructor will take on the duty of checking the mirrors so that the student can focus on the road signs and avoid collision. With modeling, coaching, and scaffolding, the mentor must be adequately skilled to diagnose the type of assistance the student needs and to know when it is no longer necessary.

Inspiring and creating opportunities. By means of feedback, mentors can help learners modify and ultimately acquire the skills they seek. However, they also do something else: they inspire and pave the road for learners to accomplish their goals (Gardner, 2002; Kram, 1985). Gardner (2002, p. 17) states "[c]hildren can be inspired by examples from literature, history, or the media. But it is much more vivid to encounter individuals first hand. Therefore it is important, whenever possible, to create situations where children have the opportunity to meet and interact directly with individuals who have accomplished something." There is, unfortunately, limited empirical evidence that can help explain how mentors inspire and open doors for their apprentices, in part because of the difficulty associated with operationalizing constructs such as inspiring and creating opportunities (see Raggins & Cotton, 1999). However, good mentoring is widely recognized as an undeniable factor in the success of learners in complex skill domains. For example, to recognize the important role mentors play in cultivating complex skills, the international journal, Nature, which publishes first-rate, peer-reviewed research in the fields of science and technology and boasts one of the highest impact factors among all of science journals, published a guide for mentors in response to the Nature Mentorship Awards. In the June 2007 issue (p. 791), Lee, Dennis, and Campbell stated, "[t]he Nature awards for creative mentoring in science were created on the premise that the mentorship of young researchers—although fully deserving of recognition—is perhaps the least remarked on of all activities that take place in the lab. Indeed, there is no established definition of what constitutes good scientific mentoring."

Lee and his colleagues described several characteristics of excellent mentors. First, they argued, mentors help build the mentee's career and remain close to the mentee for life. A quote from one of the applications to the Nature mentorship awards captures this dimension: "there is a difference between a supervisor and a mentor. With the latter you find that you are not simply a student with a research project, but a student with a career in front that the mentor helps you start" (Lee et al., 2007, p. 791). Second, they noted that successful mentors pass on attributes that help their mentees build the requisite personal dispositions to become confident and successful in the field. These mentors show enthusiasm for their students' learning projects, sensitivity to students' professional and personal lives, appreciation of individual differences by tailoring development activities to students' strengths and weaknesses, respect for student ideas, and unselfishness in seeing protégés run with ideas without needing to take the credit. Third, successful mentors teach and communicate effectively. "Many of the mentees who themselves have gone on to very successful careers" observed Lee and colleagues. "and have international reputations in science would not have gone down that pathway if they had not been exposed to their future mentor as a teacher" (2007, p. 792).

Given the importance of mentorship for providing feedback, inspiring, and creating opportunities for learners, Lee and colleagues. (2007) made the following 10 recommendations based on a review of students' reports and mentors' reflections:

1. Be available—specific feedback and advice has to be delivered through an open door policy where the learner can constantly "check in."
2. Be goal-directed and optimistic—give learners the big picture of what they are trying to accomplish and teach them that unexpected results are opportunities for growth.
3. Balance direction and self-direction—allow learners the freedom to pursue ideas but gently rein them in when they get off track.
4. Listen and ask questions—listen to learners' questions and help them seek answers instead of simply providing a response.
5. Be open to ideas and solutions from other disciplines—acknowledge new directions offered by a learner and how it has or can move your thinking forward.
6. Be prepared to help a learner get started on an initial project—new apprentices are often grateful to be given a task where they can "get their feet wet."
7. Celebrate novel ideas from learners—rewarding thinking and effort in thinking can be highly motivating for learners who are eager to know whether they are on the right track.
8. Build a community of learners—help students appreciate the environment of learning where every member helps the other flourish. This could include holding formal meetings where projects are planned or activities are discussed, and informal gatherings where people get to know each other.
9. Teach learners specific tacit skills that are essential to the profession—in the domain of science, examples might include providing and accepting good constructive criticism, the art of writing well and the importance of valuing good writing, and techniques for communicating their knowledge orally.
10. Share your network of colleagues and associates with your apprentices—use your contacts to promote learners, send learners overseas for better opportunities, and be ready to provide advice on career decisions.

These 10 recommendations could be applied in many domains. The common threads running through these involve providing learners with feedback about their learning processes and inspiring learners to acquire the dispositions of active learners (being open, asking questions, listening, collaborating).

In the next section, I examine more closely the specific personal dispositions of individuals who have been found to be successful learners.

Personal Dispositions

In order to sustain the kind of deliberate practice that will lead to acquiring complex skills and incorporating feedback from mentors, learners require specific personal dispositions such as interest, motivation, and perseverance, all of which entail some level of self-regulation (Bandura, 1986; Zimmerman, 2006). According to Bandura (1986), self-regulatory competence involves monitoring cognitive and affective states, behaviour, and the environment. For example, when a track-and-field athlete realizes she is being negatively affected by the pressure to win a race and consciously attempts to calm down by imagining herself on a secluded island lying on a beach, she is monitoring her cognitive and affective states. Likewise, when the athlete recognizes she is going too slow to overtake her opponent and adjusts her speed based on her coach's suggestions, she is monitoring her behavioral performance. Furthermore, when the athlete discovers that the day-time temperature for an upcoming race will be unusually warm and so decides to warm-up in an air-conditioned gymnasium, she is monitoring her environmental setting. According to Zimmerman (2006, p. 706) "successful learners monitor and regulate these triadic elements in a strategically coordinated and adaptive manner."

Addressing specifically how successful learners monitor cognitive and affective states, Gardner (1997, 2002) has found that they engage in three related self-regulatory practices that allow them to connect in meaningful ways with their domain of interest. First, expert learners spend much of their time reflecting; that is, they are constantly thinking about what they want to achieve, the methods they have chosen to meet their goals, and how to expend even more effort attaining their chosen objectives, including assessing when they should change course and alter a chosen pathway. Toward this end, many learners keep diaries or records of their efforts, successes, and failures. Second, expert learners are constantly leveraging their skills. What this means is that these learners identify their cognitive strengths and weaknesses. They make the most of their strengths in intelligence, personality, temperament, and/or resources with the aim of finding an opening where these perceived strengths can help them achieve their goals. They do not allow weaknesses to stop them from attempting to meet objectives; instead, they seek the help of others who can assist them in those areas in which they are not as proficient. Albert Einstein provides an excellent example of leveraging. According to Einstein biographer Walter Isaacson (2007), an underappreciated aspect of Einstein's genius was his ability to correctly recognize when he needed assistance and who could provide it. In particular, Einstein sought out the help of his mathematician friends Marcel Grossmann and Hermann Minkowski to formalize his emerging theory of relativity:

> "Grossman, you've got to help me or I will go crazy," Einstein said. He explained that he needed a mathematical system that would express—and perhaps even help him discover—the laws that governed the gravitational field…

> Until then, Einstein's scientific success had been based on his special talent for sniffing out the underlying physical principles of nature. He had left to others the task, which to him seemed less exalted, of finding the best mathematical expressions of those principles, as his Zurich colleague Minkowski had done for special relativity.
>
> But by 1912, Einstein had come to appreciate that math could be a tool for discovering—and not merely describing—nature's laws. (p. 193)

Third, expert learners are able to frame their positive and negative experiences. Individuals who are ambitiously committed to learning fail often because they are continuously attempting to understand, master, and apply their newfound knowledge in a variety of situations. However, expert learners reflect on the reasons for their failure and instead of abandoning the pursuit, attempt to learn from the defeating episode (Gardner, 2002).

The idea that expert learners are in part successful because they frame their experiences in constructive ways, allowing them to persevere on task, is supported by research on attribution motivation. Specifically, attribution theorists (see Weiner, 1992; Pintrich, 2003) predict that individuals who explain or attribute their successes and failures to fixed, innate ability will not persevere on future tasks. In contrast, individuals who attribute their successes or failures to effort will persevere on learning tasks. Martin, Marsh, and Debus (2000) found that learners who tended to attribute their poor grades to bad luck or uncontrollable factors also tended to self-handicap—for example, these learners claimed that they could not attend their classes consistently and so had an excuse for not doing as well as they had hoped. In his summary of the research literature on attributions, Pintrich (2003) observed that learners who felt a lack of control over their learning because they attributed learning outcomes to external, non-controllable factors such as fixed, innate ability or luck were less likely to be successful achievers than those learners who felt in control of their learning.

Learners' ability to reflect on, leverage, and frame their learning and performance in constructive ways can bolster their deliberate practice and maximize the positive feedback from mentors. A learner who does not reflect on his or her performance is unlikely to identify those aspects that need to be improved or effectively incorporate information from coaches, parents, or teachers. A learner who does not leverage his or her skills is unlikely to seek out new learning opportunities because these new avenues may often appear to contain insurmountable challenges. Finally, a learner who does not attribute his or her successes and failures to controllable factors such as effort is unlikely to persevere in the face of difficult learning goals because success is viewed as elusive and subject to arbitrary conditions such as luck. How can we improve the odds that learners will develop a love of learning and avoid learned helplessness? In the next section, I offer one way to begin to cultivate these principles of lifelong learning—deliberate practice, mentorship, and personal dispositions—at an early age.

USING ASSESSMENTS FOR AND OF LEARNING TO CULTIVATE LIFELONG LEARNING

To assure that all learners are exposed to the three components of lifelong learning discussed in this paper, these need to be fully integrated into the fabric of the classroom, children's most common formal learning environments. Educators often observe that what is valued is tested. One way to ensure that these components are cultivated and developed would therefore be to integrate them into assessments of and for learning. These assessments, called cognitive diagnostic assessments or CDAs (Leighton & Gierl, 2007) are in their infancy, to be sure, but they represent a fundamental shift in the way assessments are envisioned. CDAs are designed:

- from evidence-based models of student learning, which emphasize deliberate practice of complex skills, including common misconceptions that hamper students from progressing into more complex levels of learning;
- to measure increasingly complex skills with gradually more difficult test questions that isolate constellations of skills; in this way, the questions a student answers correctly or incorrectly help identify the specific skills the student has mastered and those which require extra practice and mentoring; and
- to reward meaningful learning and to be a source of dialogue between the student, teacher, and parent about the students' learning goals (reflection), cognitive strengths and weaknesses (leveraging), and attributions of past and future performance (framing).

Why communicate the principles of lifelong learning through assessment and not curriculum? Although the curriculum could easily incorporate these principles, we know that assessments are a constant and integral part of what teachers do in their classrooms irrespective of the specific curriculum covered. In fact, research suggests that high school teachers spend 20% of their classroom time planning learner assessments and another 20% administering assessments (Stiggins & Conklin, 1992). More importantly, however, we know that assessments can have an indelible influence over learners. Many are anxious about taking tests and harbor a distrust of assessments as mysterious, tricky, and designed to evaluate their intelligence rather than their achievement. But what if cultivating a love of learning could be done through the very vehicle that most learners have traditionally found to be objectionable? What kind of message would this type of assessment send to learners? Learners might infer from this type of assessment that effort mattered and that a good way to see successful test results is to engage in meaningful learning. This might especially be the case if the learners who scored well were those engaged in the deliberate practice of skills, incorporated feedback, and reflected, leveraged, and framed their learning. However, even if some learners did not score well on the assessment as a whole, the test results could still be used to provide feedback on the skills mastered and those in need of remediation. In this way the assessment would function as a source of feedback that a teacher (or other mentor) could use to help learners reflect on what they hoped to accomplish and on the means for doing so; to leverage their skills by recognizing strengths and weaknesses; and to frame their performance as new opportunities for taking control of their learning through deliberate practice. CDAs are, at their core, not only vehicles to convey information about learning but also a means to help circumvent children's detachment from the learning process during a potentially sensitive period when they are learning what it means to learn. Assessments could then become a powerful and positive means of shaping learning. Designing assessments that incorporate deliberate practice, encourage mentorship, and foster personal dispositions to learn could then help young learners not just learn one skill at one time but embrace the process of learning for a lifetime.

CONCLUSION

The statement "becoming or being a lifelong learner" might be dangerously close to a truism. If we are not careful to draw lines around its meaning and say something about how it can be fundamentally cultivated, anything could fall under its attractive umbrella. Is not everyone a lifelong learner in principle? Could there be people who do not learn? It is of course possible that some might not be recognized as lifelong learners, especially if what we mean by lifelong learning is whether someone learns a specific behavior at a specific time rather than whether someone embraces the process of learning. However, for our purposes, we can think of lifelong learning as a process of continually changing, shaping, and improving thoughts, ideas, and performance so that new avenues of experience open and lead to more productive, rewarding, and interesting lives. This allows us to think of lifelong learning not as measured simply or even most accurately by the products of learning (the number of books read, courses completed, or new skills learned), but rather by the processes and outcomes of successful learning and the conditions that support this. One way to begin to understand the processes that underpin successful lifelong learning is, as discussed in this paper, to examine how expert learners go about maximizing how and why they learn.

Lifelong Learning Implications

Lifelong learning matters not only for academic reasons but also for practical, policy-related reasons. For example, deficits in adult literacy have sparked acute interest in governments to address the challenges faced by many adults who are barely coping in an increasingly technical and knowledge-intensive post-industrial society. Synthesizing results from the International Adult Literacy Survey (IALS, 1994-1998) and reports from Statistics Canada and the Organization for Economic Cooperation and Development (OECD), a recent report by the Canadian Council on Learning (2007) indicated that 25 to 40% of adults in top performing countries such as Sweden, Norway, and Canada do not have the prose, document, and numeracy skills to function effectively in modern society. This means that in the best case scenario 1 in 4 adults is having difficulty processing information in everyday life (including work) to meet basic, everyday needs. The US adult population fares less well with at least 55% of respondents not having the basic skills deemed necessary to function effectively in life and work. These deficits are alarming because it is well known that a critical driver of economic growth, technological innovation, and successful participation in globalization involves a literate population that has the capacity to acquire knowledge to solve new challenges (Myers & de Broucker, 2006).

How do we begin to address these literacy deficits and cultivate learners able and willing to learn for life? One way is to generate government policies and programs to help at-risk adolescents and adults acquire needed skills or provide incentives for these individuals to seek out opportunities for retraining or relearning—certification, accreditation, diplomas, and degrees. One challenge with this approach, however, is that at-risk learners often do not take advantage of these policies and programs. In fact, often it is those individuals with high levels of literacy skills who benefit from government programs. For example, data from Statistics Canada (2005) and the OECD (2006) indicate that learners who are relatively youthful, already employed, working in larger firms, and already have higher levels of educational attainment participate more frequently in ongoing learning opportunities. For those who are older, unemployed, working in smaller firms, and have lower levels of education, the biggest obstacle to taking advantage of learning opportunities is time. However, a report by the Canadian Council on Learning (2007) indicates that another obstacle is the perceived irrelevance and lack of motivation associated with new learning opportunities:

> Inappropriate pedagogy is frequently mentioned as a factor in non-participation: many adults do not like the institutionalized (school-like) instruction and respond negatively to such learning settings. Poor motivation may also come from the lack of relevance of the available learning opportunities to the needs of the adults. (p. 12)

Not being motivated to learn because learning is viewed as irrelevant and, consequently, shying away from formal instruction therefore appears to be an especially important obstacle to overcome. As previously discussed, personal dispositions to learn are an essential component of acquiring expertise and becoming an expert learner.

A second way to tackle the problem of low literacy is to cultivate a love of learning while the individual is still youthful. The idea that some skills need to be learned within a specific developmental window—a sensitive period—because the young brain is primed to establish the necessary neuronal connections has been shown to be true for language skills (Lenneberg, 1967). There is increasing evidence that intellectual abilities may also develop within a sensitive period (Bransford et al., 2000; Garlick, 2002). Could such a window of opportunity also exists for meta-skills such as learning to learn? Sensitive periods are important to identify because once the window closes, the skills of interest may not be learned later or at least not as well. Although cultivating the skill of learning to learn in children would not fix the existing problem of low literacy among adults, it could begin to provide a more principled, longer-term solution to low literacy than any policy or government program to date. A pedagogy focused on teaching children the skills associated with lifelong learning would entail cultivating the essential practices, social interactions, and thoughts that exemplify the process of expert learning for a lifetime.

Author's note

1 When a complex skill is being learned one must avoid premature automaticity since this will interfere with attempts to refi ne subtle aspects of the skill.

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