Developing Adaptive Expertise for Navigating New Terrain:

An Essential Element of Success in Learning and the Workplace

Applying Learning Sciences Research to Learning and Workforce Development for Next Level Learning Brief Series

Tina Grotzer, Tessa Forshaw, and Emily Gonzalez

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"Our Age of Anxiety is, in great part, the result of trying to do today's jobs with yesterday's tools."
–Marshall McLuhan

"Narrowly focused specialists may be good at incremental innovation. But breakthrough innovation is often the product of temporary teams whose members cross disciplinary boundaries—at a time when breakthroughs in every field are, in fact, blurring those very boundaries." – Alvin Toffler

"An adaptive mind has better learning capability." – Pearl Zhu

Executive Summary

This third brief in the series invites us to consider the nature of expertise in the context of supporting marginalized and vulnerable workers to thrive in our rapidly changing landscape of work. In the context of such change, information that is relevant to a given problem space within a certain time horizon is dynamic. To thrive at this pace of change, humans must know how to obtain and restructure information, to let go of information that is no longer useful, and to repurpose information between contexts. Deep knowledge of specific domains is important for grasping nuance and complexity, yet it is also important to know how to learn about new domains and to apply knowledge flexibly across domains.

This brief introduces the concept of *adaptive expertise*—an ability to think flexibly, adapt to varied contexts, and to gain new understandings. *Like a spider weaving a web, adaptive expertise allows one to build from what is in one's grasp to cast out into new terrain and to new make connections.* It contrasts with classical expertise, which involves deep knowing within a subject matter area. *While classical expertise is important, it can be siloed; we argue that adaptive expertise is a critical component of high-level performance in a changing world.* Based upon research in cognitive, neuro-, and the learning sciences and building upon the agentive and dispositional vision of the learner in the first and second briefs, this third brief argues that Next Level Learners engage in *six tendencies* related to Adaptive Expertise. These enable thinking flexibly, orienting to new areas of knowledge, gaining new understanding effectively and efficiently, and being aware of contexts and cultures of knowledge. Adaptive expertise supports our asset-based focus on leveraging prior knowledge and skills in workforce development, rather than one of "starting over" as communicated by the term "reskilling," and can play an essential role as people increasingly need to orient to new bodies of knowledge and competencies.

Framing Questions

- What is the nature of deep knowledge?
- What does the research tell us about *how* classical experts think and reason with deep knowledge?
- What is adaptive expertise and why is it important for the workforce in a changing world?
- What are the tendencies of adaptive expertise?
- What does the research suggest about whether learners can become adaptive experts?
- How might we realize the promise of developing adaptive expertise in workforce development?

Introduction

Malik has worked for ten years in manufacturing. He works in a high production facility developing die cast machine parts and knows his job well, having reached a point where he is considered an expert in his niche. The main steps of the process are straightforward, but over time, he has learned the finer details necessary to develop casts with very consistent dimensions and smooth surface finish. These are important characteristics for machine parts which often must work within very tight parameters.

Malik holds what would be considered classical expertise in a particular domain. Over the years, he has honed his skills and taken on increasingly complex design challenges. He knows how different materials respond to heat, what the best compound of metals are for specific purposes, and how to get the maximal integrity out of his pieces. Unfortunately, as changes in the industry and modes of manufacturing have reduced demand, Malik and many of his contemporaries have been laid off.

Malik subsequently received a job offer from a company that also designs machine parts. However, this company doesn't cast the parts, they use a CNC (Computer-Numerically Controlled) process. Malik needs the job and sees their approach as representative of future directions. He needs to figure out how to quickly orient to their manufacturing process and how to translate his transferrable expertise to the new process. At the same time, he needs to manage his own thinking so that he lets go of or "unlearns" that which is no longer relevant from his time using the die casting methods. It is not just the process that is different, the new organization also has a different culture. While his old company was very hierarchical in structure, this one is flatter; it seems more like a bunch of people on a joint mission. Finally, he must figure all of this out as quickly as possible because they are on tight production deadlines. *To maintain economic inclusion in a constantly changing world, Malik needs adaptive expertise in addition to his deep manufacturing knowledge. Like a spider, he must draw from* what is within to make new connections and discard those that no longer serve the purpose.

Below, we introduce what is known about classical and adaptive expertise, starting with classical expertise because that is what people are most familiar with, and consider the implications for workforce development programs as well as work-based learning programs.[1] People often connect the word "expertise" with being an "expert"; this implies that one either does or doesn't possess expertise. We use the term expertise more broadly—as a continuum towards greater capacity, as learnable, and as a journey on which everyone can embark and deserves support for doing so.

What Is the Nature of Deep Knowledge?

Typically, expertise is viewed as deep knowledge that is built up over a long period of time, typically over ten years or more, as in the case of Malik. Known as classical expertise, such deep understanding has certain characteristics and features.[2]

1. **Knowledge is connected within the domain.** Concept are viewed within a complex web of related concepts. One knows how the concepts fit within the broader landscape of knowledge and has multiple paths to the knowledge. If some neural pathways decay, others can lead back to it (for instance, if an algorithm is forgotten, one can derive it conceptually). *For example, Malik understands that slight changes in the alloy composition of the metals impact how the metals behave under various conditions in the field.*

2. **The structure of the domain knowledge is understood.** One can discern and consider the deep structure of the domain concepts, the principles (or bones) of the concept, and its exceptions (even in the presence of significant noise/distraction).[3] Grasping the deep structure makes it easier to understand related concepts and procedures. *For example, Malik knows that the behavior of metal is connected to its atomic and molecular structure and that knowing the molecular structure makes it possible to understand the behavior of the metal and to predict procedures for the best ways to cast it.*

3. **Representative cases and edge cases of the domain knowledge are understood.** One can detect typical cases of a concept and where the edges/boundaries are. One knows the "essence" of the concept and how far it can be stretched. *For example, Malik knows that pure cases of a given metal will behave in certain ways and will work, even with a certain amount of impurity, but that at some point, the impurities impact the structural integrity, and the metal can fail.*

4. **The disciplinary origins of the domain knowledge are understood.** One understands how the knowledge was generated and with what disciplinary assumptions and lenses. This can impact whether one believes certain interpretations to be valid, findings to be reliable, and when uncertainty or faith are inherent to, or part of, the conceptual origins. *For example, in the case of Malik, he is basing his understanding on materials science, which is grounded in the disciplinary knowledge of the sciences, including testing and experimentation.*

5. **In the case of designed knowledge in the domain, the motivations and design principles are understood.** One understands the design of constructs or concepts and the design principles that give rise to the circumstances surrounding it. Some types of knowledge are designed to meet certain needs, for instance, numbers and maps. Frameworks (thinking, problem-solving) are also like this. Deep understanding entails knowing why it is a certain way, what purposes it serves, and what trade-offs were made in its design. *For example, Malik understands the process for the die cast parts. He understands the purpose for each design and why it has the features that it does. This allows him to quickly realize when minor defects with a cast part would result in points of product failure.*

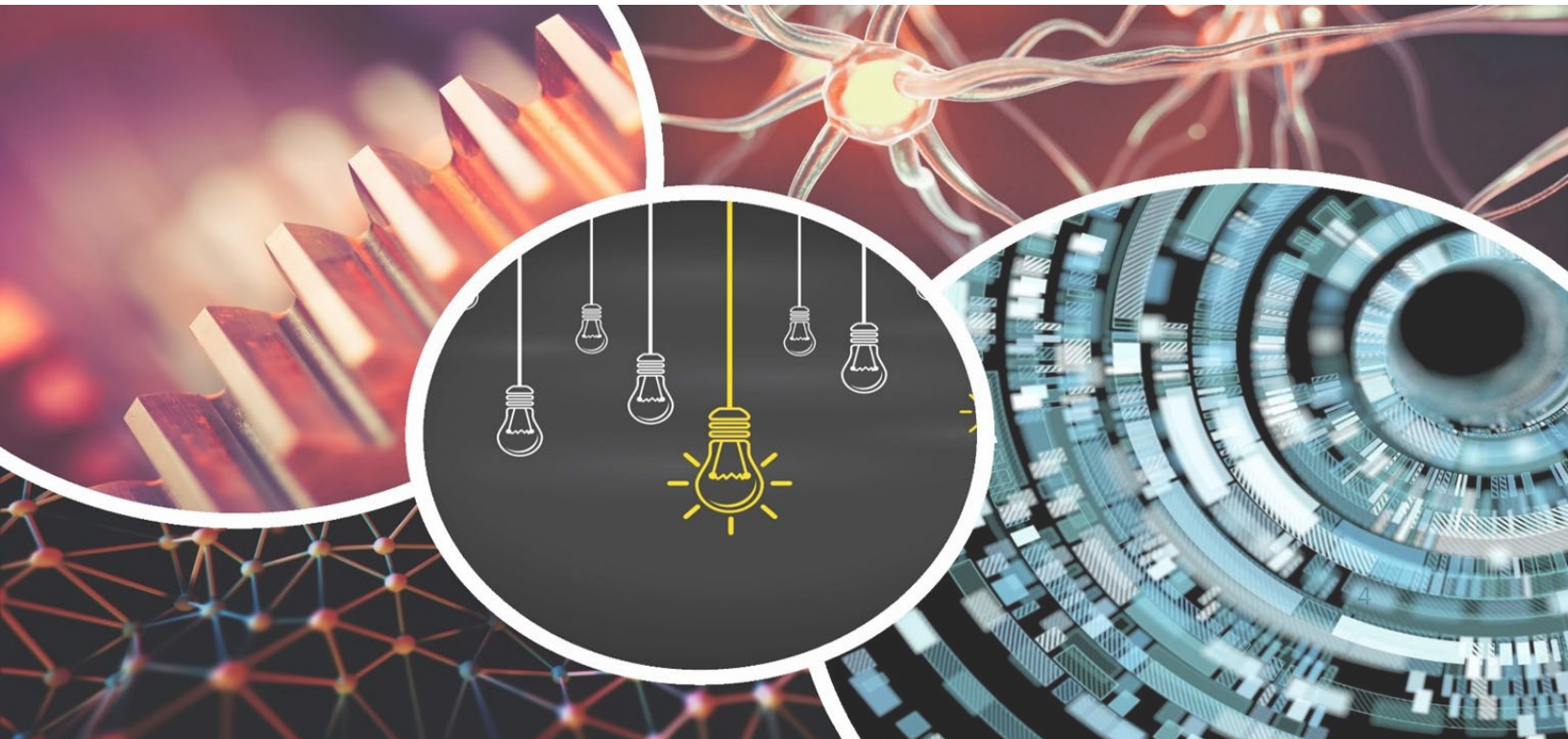
6. **The knowledge can be distinguished from closely related concepts.** One realizes how concepts in the domain are similar and different. When gaining understanding, it is common to see similarities between closely related concepts but still be unclear about the boundaries and distinctions. Deepening understanding includes clarifying these. *For example, as Malik was learning the design of various die cast parts, he began to realize that some of them had similarities. As he came to understand more about each piece, he began to pay greater attention to what distinguished them, such as the resistance of the specific metal alloy to corrosion or different points of relative weakness in each shape.*

Notice that each characteristic of deep understanding is related to knowledge *within* a domain. This depth can be empowering, but that very depth can also make the knowledge siloed if there is not explicit focus on connecting it to knowledge across domains, as discussed below and in the fourth brief on Transfer.

What Does Research Say About *How* Classical Experts Think and Reason?

Deep understanding, such as Malik's understanding of die cast processing, can be a powerful component of high-level performance, and much of the research on expertise has considered classical expertise—deep understanding within content domains. This research shows that classical experts reveal certain behavior patterns in their thinking and learning (Table 1).[4] Note that these forms of thinking are particular to their area of expertise. Here we use the terms "domain", "topic", "knowledge", "content", and "subject" interchangeably as we speak about areas of expertise. We also view the boundaries of expertise flexibly in recognition that these vary for different people; it may be defined by a job role in one person's case or by disciplinary boundaries for someone else.

As a classical expert, Malik *notices meaningful patterns* that have implications for the integrity of the resulting product. In the course of his work, he is able *to develop efficient routines and procedures* that are based on *deep knowledge of the domain.* He knows when there is a problem in the process because he knows its *rules, exceptions, and nuances.*[5] He has *better recall* because the information is more connected in his mind, so it is easier to hold onto.[6] Malik also *uses informal background knowledge* of the domain—things that he has learned or noticed "just from being on the floor." This works to ground his knowledge in ways that classroom instruction can seldom match. It also gives him the opportunity to develop *important self-regulatory knowledge*—such as "never operate that machine when you are not fully attentive or are light-headed because it is 3 pm and you haven't had your lunch yet."[7] He *can use a variety of models* to think about tasks and *switches between them easily*.[8] Sometimes, the models convince him that things work differently than he thought, but nearly as often, he finds the need *to make modifications to the models* based on what happens on the manufacturing floor.[9] He continually wants to learn more, particularly when he is puzzled by how something works. This *process of finding and pursuing problems* that challenge him leads to increasing expertise in his domain.[10]



Much of what Malik is able to do appears to be automatic and based upon insight because so *much of this knowledge is implicit* to what he does every day.[11] He is not necessarily able to articulate it. In part, he has *automatized the information* in ways that lead him to take it for granted. To others, these *leaps of insight* seem a bit magical—Malik just knows what to do—but if a colleague or mentee asked him to unpack the knowledge through their questions, he would need to reflect deeply to be able to offer insights into it.

Classical expertise can be quite powerful. It can be thought of as the launching pad for meaningful innovation. Without deep understanding of a problem space, we are not positioned to re-envision its edges and its possibilities. For instance, when COVID-19 emerged, those with deep understanding of coronaviruses recognized its characteristics and offered essential information about how the virus was likely to behave and what some of its key features might be.

Table 1: The Thinking and Learning Tendencies Related to Deep Knowledge/ Classical Expertise

As a result of their deep knowledge, classical experts…

- notice and attach importance to deeper, more meaningful patterns in their area of expertise.
- are faster at solving problems *within their area of expertise* because they routinize the process somewhat.
- often make "leaps of insight" within their area of expertise because they know its rules, exceptions, and nuances.
- tend to show superior memory performance for typical information within their subject area.
- often hold tacit knowledge about the domain that is hard for them to articulate.
- use models and other tools relevant to their area of expertise to clarify conceptualization of system structures, relationships between and among components to make predictions, and to support problem-solving.
- easily switch between multiple representations: models, data, and experiences to ground truth or iteratively check models and revise their understanding.
- tend to work at the edge of their competence within their area of expertise to push their understanding deeper, engaging in "progressive problem-solving"— finding and pursuing problems that challenge them in their domain.

As in the example of Malik above, mentally routinizing and automatizing aspects of a problem space lets the person hold more information in mind and to manipulate that information in dynamic ways. This enables them to handle more information in their working memory, which in turn makes it possible to handle greater complexity. *However, this efficiency inherent to classical expertise[12] can also be a double-edged sword. It can lead to routinization that introduces rigidity into one's thinking, thus pulling against creativity.[13] This rigidity can also pull against opportunities for transfer because thinkers hold their understanding as context embedded and dependent. This can lead to functional fixedness of the skills.[14]*

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What Is Adaptive Expertise and Why Is it Important for the Workforce in a Changing World?

While classical expertise enables one to go deep into a domain, adaptive expertise is *critical to working across domains, learning new domains, and maintaining flexibility* when automatization can lead to rigidity. Visualize a spider drawing from the silk within to cast connections into new and often changing terrain. It navigates new edges and geometry, the dynamic challenges of wind and rain, and makes connections to both solid and tentative or uncertain contexts. While classical expertise goes deep and builds iteratively within known framing, adaptive expertise ventures across and seeks applications in the unknown to the learner and, sometimes, to the field.

While classical expertise is important, it can be siloed.
Adaptive expertise is a critical component of high-level performance in a changing world.

Adaptive expertise has been defined in different ways in the research literature. In this section, we consider a variety of definitions of adaptive expertise and sum across them to explicate its key features and why they are important.

Early research on adaptive expertise positioned it as referring to experts' knowledge of why established disciplinary procedures work and their ability to modify them flexibly as needed, or invent new ones when necessary.[15] Research found that when reasoning in the lab, expert scientists were more flexible in how they revised theories in response to data.[16] Interestingly, not all experts revealed this flexibility in their thinking .[17] Furthermore, some novices demonstrated flexibility even without deeply grounded knowledge of a domain.[18] David Perkins has called this lateral, flexible knowledge "flexpertise." [19]

Later definitions argued that adaptive expertise could be shown within domain expertise but that it also involved *additional cognitive and metacognitive skills that made it possible to go beyond, to create new knowledge from one's more routine knowledge.*[20] For instance, to step back and ask whether there were other patterns that were not being noticed because of the patterns that the person expected to see.[21]

Other research argued that adaptive expertise is particularly helpful in dealing with complexity—specifically in cases where the outcomes arise from the inputs in unanticipated ways.[22]

Moving beyond the definitions above, others have extended conceptions of Adaptive Expertise *to include understandings related to knowing how to map and gain knowledge of a domain.*[23] Teaching to these conceptions of adaptive expertise entails helping learners understand how to chart journeys towards understanding, to benefit from feedback, and to assess the state of their understanding. It also entails helping them to navigate stumbling blocks, be alert to typical misconceptions, and to hold a mastery-oriented mindset. It encourages a dual focus in learning—one on content and the other on becoming a more expert learner.

Adaptive experts know how to develop deep understanding of new domains. They work at the edge of their competence; engage in progressive problem-solving; and view failure or errors as steps in a process towards success. They focus on techniques for upping their game/ process and they set evolving and revisable paths for learning.

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According to Grotzer and colleagues, classical expertise refers to knowing a domain and its inherent content very deeply. In contrast, adaptive expertise focuses on being able to gain expertise. Adaptive experts know how to effectively develop understanding. Like classical experts, they tend to work at the edge of their competence; engage in progressive problem-solving; and view failure or errors as steps in a process towards success. However, they focus these processes across domains and in novel domains. Adaptive experts tend to focus on techniques for improving and set evolving and revisable learning paths." [24] These tendencies fit well with the notion of an agentive, self-authoring learner as in the first brief and supported by research on mindset,[25] mastery-orientation.[26] Adaptive expertise in learning and in understanding how the human mind engages in learning will continue to pay dividends, even as deep domain knowledge may become outdated by innovation in a changing workforce, as happened in Malik's case.

Nasir and colleagues[27] write about adaptive expertise as "the development of flexible knowledge and dispositions that facilitate effective navigation across a variety of settings and tasks." (p. 490). They argue that learning and teaching are essentially cultural processes and that it is important that learning opportunities engage in meaningful and mutual approaches to revealing cultural principles, perspectives, and practices. Given the general lack of reflectiveness about cultural influences in education, they suggest that adaptive expertise may be especially important for learners from minority groups, given the societal challenges that they face. We interpret this to mean that gaining adaptive expertise is important for those charged with supporting learners and for the learners themselves. Extending this to the workplace, adaptive expertise is an important component of being able to navigate varied cultures and subcultures. For instance, Malik found himself navigating a work environment with managerial structures that were very different from his prior context. Adaptive expertise combined with a reflective organizational stance on culture would support his learning and best work.

What Are the Tendencies of Adaptive Expertise?

Here we set forth a framing of Adaptive Expertise that has *six key tendencies*, each with cognitive, emotional, and social components:

Cognitive Flexibility refers to using one's skills adaptively and seeing beyond ritualized applications of knowledge. It involves dis-embedding skills and concepts from the contexts where they are routinely experienced towards new uses. Visualize preschoolers using an object to pull things towards them after seeing someone use a rake. Or picture David Perkins' example of using a credit card to slice a wedge of cheese.[28] However, cognitive flexibility extends beyond functional similarities. It involves rethinking spatial relationships, turning problems inside out, and using analogies from one domain to solve a problem in another. While cognitive flexibility specifically uses the word "cognitive," it also requires "affective" flexibility. If one is intimidated by doing things differently or by taking a risk, they will not show a tendency towards flexibility.

Metacognitive Self-Regulation involves reflecting upon and regulating one's thinking and learning skills. Metacognition can occur at different levels. It includes awareness of the content and processes of thinking, evaluating thinking, planning thinking, and monitoring thinking.[29] For example, you might realize that your mind has been wandering and re-center with a set of focusing techniques. Metacognitive regulation also includes monitoring and managing emotions that influence our thinking and learning such as realizing when we are avoiding a task that seems stressful to us or when we are letting past feelings of inferiority diminish our engagement. Self-regulating learners metacognitively manage their learning processes and strategies.

Seeking Future-Oriented Feedback refers to a tendency to seek out what has been called "feedforward"[30] (progressive feedback that supports learning) and what can be done to improve performance. It focuses on the most effective forms of feedback[31] – those related to task completion, the processes that we use in learning with support from a more accomplished mentor, and self-reflective feedback, as elaborated in the example below. To be effective in seeking and receiving feedback, one needs to manage the emotions involved, especially in instances when the feedback may be useful but not thoughtfully conveyed.

Building Progressive Learning Paths involves leveraging forward task and process feedback towards developing learning paths to achieve improved outcomes and managing the affective dimensions involved. It often uses instances of failure as forms of opportunity. Some tasks more easily invite the building of progressive learning paths, for instance, games with levels where skills are learned and used in

more difficult tasks. It can be harder to build paths when the terrain is entirely uncharted as in new domains or at the highest levels of expertise,[32] for instance, innovation towards more agile and extreme moves such as in figure skating. Building learning paths from the stance of a relative novice is a different process from that of how educators design learning paths based upon a deep knowledge base, and so it requires greater flexibility, motivation, and reflection.[33] Having a growth mindset[34] can be viewed as prerequisite for holding the tendency to build progressive learning paths in that it encompasses the belief that one can become more capable and knowledgeable with strategies, dedication, and hard work. It also requires being an agentive learner who is actively seeking to increase one's capacity, as discussed in the related brief.

Developing a User's Manual to One's Mind relates to gathering information about how human minds, in general, and specifically our own minds, work. Current research in neuroscience, cognitive science, and the learning sciences inform our knowledge of the nature of learning, the kinds of strategies that are likely to be effective, and the kinds of challenges that we are likely to face. It informs how our human cognitive, emotional, social, and physical architecture works. Research also helps us to understand neurodiversity and how our minds might differ from those of others. A tendency to actively seek information about how to use one's mind well supports the pursuit of expertise across domains. It also supports the other tendencies—how to maintain cognitive flexibility, what strategies work best for engaging in metacognition, and so forth.

Capacity for Navigating Cultures represents an awareness of the cultural processes in places of learning and work and the tendency to seek out information relevant to navigating them. This can include one's own cultural assumptions, the variety of assumptions within the learning environment or workplace, cultural differentials, and even how supportive these environments are to mutual navigation of these cultural aspects. As work development counselor Monica Zeno-Martin expressed, these factors influence everyday work experiences[35] making it important to be able to hold and reflect upon these, often hidden, assumptions. Silvana Rueda of Harvard and the New Futures Scholars Program has written about how cultural conceptions of time differ and can be an important aspect of consideration in the world of work.[36] Workspaces that are cognizant of embedded cultures and subcultures and that hold them as points of consideration in tasks and processes can invite and benefit from the strengths of that diversity and can mine the assets of deliberate diversity.

Table 2: The Thinking and Learning Tendencies Related to Cognitive Flexibility/Adaptive Expertise

Thinking and Learning With Adaptive Expertise Involves:

- making connections.
- dis-embedding information and skills to apply them across domains—using them in new ways.
- turning concepts inside out to examine them from different perspectives.
- thinking creatively about the uses and application of knowledge and skills.
- self-regulating one's metacognitive processes by reflecting on and managing one's thinking across levels and across domains.
- seeking future oriented feedback for improving performance and understanding.
- building progressive learning paths that use task and process feedback towards developing learning paths.
- using instances of failure as forms of opportunity.
- holding a mastery or growth mindset.
- collecting information about how minds, cognitively and affectively, work and using it to do one's best learning and thinking—to support the pursuit of expertise across domains.
- learning about and reflecting upon the nature of cultures—their processes and interactions—in places of learning.

Let's circle back to the example at the outset and consider how it might help Malik to have adaptive expertise to call upon as he starts his new position. To be successful, he will need to figure out what of his current knowledge is applicable to his new situation and be alert to information that is similar but not helpful. This calls for cognitive flexibility, unlearning and metacognitive self-regulation—all aspects of adaptive expertise. He is not a novice because he has considerable information about materials science and the deep structure of the information—atomic and molecular structure, density and so forth. Thus, he will be able to use this information to ask informed questions about the similarities and differences to die casting and to chart learning paths as he engages in progressive problem-solving in his new space.

While he will be able to leverage his expertise, he also needs to be acutely aware of misconceptions that it may introduce and critical exceptions to the knowledge he already holds. If Malik has information about how his mind works, he will realize that his brain is wired for default patterns of thinking that may no longer apply and that he needs to be alert to when he is making unwarranted assumptions in his new position. Malik may be able to leverage what he has learned about the nature of learning from feedback in the past to seek feedforward information that will help him attain expertise quickly. Finally, he needs to flexibly navigate his new work culture and to navigate the differences from his past work culture.

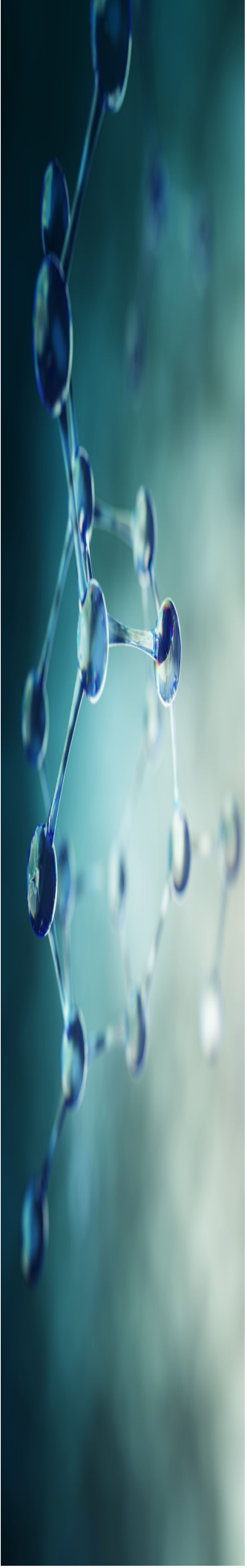
What Does Research Suggest About the Learnability of Adaptive Expertise?

An abundance of cognitive and neuroscience research supports the idea that Adaptive Expertise can be taught and that versions of it are accessible to novices.[37] Agentive, adaptive and self-regulating behaviors can support lifelong learning. These behaviors encompass learnable skills related to higher-order thinking such as metacognitive awareness, goal-setting behaviors, the ability to self-assess against goals, to ask questions and have the tools to go about answering those questions. These skills help individuals in future learning pursuits and in their daily work, thus investment in their development is worthwhile.

A longstanding tension in the research on the teaching of thinking skills is whether it is best to teach skills in isolation or situated within context.[38] As considered in the Agency and Transfer Briefs, when skills are taught in context, learners emerge with deeper, more nuanced understanding; however, skills are often embedded in the context in which they were learned and are, therefore, less transferable. An approach to resolving this tension has been to infuse the teaching of thinking skills in context *and* to attend to helping people to dis-embed the skills to transfer them to other contexts.[39] For example, Luisa is working in a job that involves coding, where she is introduced to the logic of how code is written. As part of the mentoring process, she is taught the metacognitive skill of taking a mental walk through her code and picturing the logic of each step to search for gaps. An added step prompts Luisa to envision other opportunities that involve searching for logic gaps and mentally walking through the steps, supporting broader transfer of higher order thinking skills to other areas of work and beyond. In the future, as computers take over more and more of the coding process itself, Luisa will be better positioned to tell the computer what it needs to do and to oversee the process.

As people learn more about how their minds work, developing their own user's manual of sorts, it increases their ability to learn and to understand possible pitfalls. Here are some examples of what one might learn. The research findings on memory reveal that we can use our minds better to manipulate dynamic information when we don't have to hold the information in mind. If workers know this, they may choose to use *visualization tools* (paper or computer-based) to hold information while they think about it. Thinking moves that are as straightforward as making a simple diagram, listing details, or making a visual web of connections, free up space in the mind to think about how the information interacts and changes. The research on "desirable difficulties" suggests that instead of simplifying problems to the extent that learners can grasp them without struggle, there is value in *some amount and types of struggle* because it advances engagement and understanding.[40] Knowing this information might encourage workers to engage longer in trying to solve problems before asking to be told what to do and might motivate managers to support them with time and space to think.

The research literature also offers details on how to support the learnability of the skills underlying adaptive expertise. For example, we know that *Seeking Future-Oriented Feedback* is an important aspect of adaptive expertise. Research shows that certain types of feedback are most helpful to building learning paths. Adaptive experts care about feedback that will help them to become increasingly capable (task, process, and self-regulatory feedback) and have less interest in "self" evaluative feedback (either positive or negative). *Task feedback* refers to feedback on aspects of how the task is being completed; it looks at the task both as a whole and its individual components to consider what improvements could be made. *Process feedback* refers to feedback related to the processes of carrying out the task; it often relates to strategies for completing the task in the future, to ways one might deepen their engagement in the task, or might automatize aspects to make their processes more efficient. *Self-regulatory feedback* refers to the commitment and control of how someone monitors, directs and regulates actions related to their goal.[41]



The case of Imani illustrates how each type of feedback can contribute to adaptive expertise in the workplace. Imani is learning to manage inventory for a hair salon. She seeks feedback from Nia, who has experience managing inventory. Nia looks over how Imani has organized the product and offers task feedback to suggest that organizing hair color by the continuum of shades will make it easier for them to quickly see available shades each time they are coloring a client's hair. She offers process feedback that Imani might find it easier to organize the bottles if she works brand by brand since each brand has the shade information in a different place. Nia may also invite Imani to reflect upon how she feels about the task and whether doing it at the very end of the day when Imani is tired is the best timing for her personally—self-regulatory feedback that will help Imani plan out how she approaches her work goals.

While reviewing the extensive literature on the learnability of adaptive expertise is beyond the scope of the current brief, a future focus of the Next Level Lab will be to articulate these research findings and their actionable implications for Workforce Development.

How Might We Realize the Promise of Developing Adaptive Expertise in Workforce?

We have argued for a role for Adaptive Expertise in addition to Classical Expertise in workplace development. The ability to orient quickly and effectively to new problem spaces and domains is critical to work in the changing world of the 21st century. Adaptive expertise is highly learnable, and the components of adaptive expertise can be infused into workforce development programs—including those that are work-based. The importance of adaptive expertise in a rapidly changing world is underscored by the workforce disruptions of 2020, during which so many workers lost their jobs and now need to seek new and different opportunities and the broader future of work context. As discussed in the brief on Transfer, the task is better framed in terms of how to leverage prior knowledge and skills than one of "reskilling." Adaptive expertise can play a critical role as people increasingly need to orient to new bodies of knowledge and competencies.

That said, we don't view the challenges of the enterprise lightly. There will be questions and needs that arise in relation to providing for the development of Adaptive Expertise within the workforce. Here are a few examples:

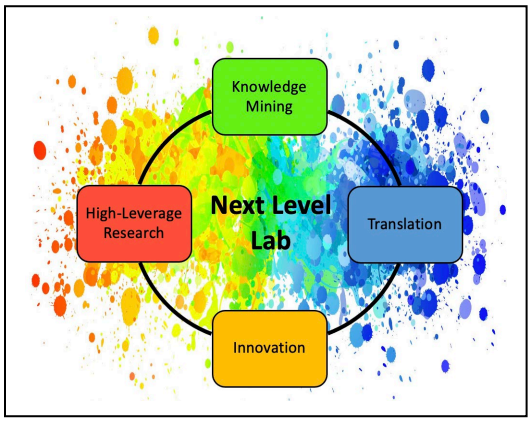
Managers would need to view workers as more than cogs in fixed processes and to think about flexibility in helping the employee learn across possible contexts. In some respects, this is like teaching for explicit transfer as in the transfer brief, but here the goals are focused less on mapping particular skills and more on broader "learning to learn" skills.

Managers and workers would need patience with the process of development and to adopt a deliberately developmental approach. [42] One would expect smaller incremental gains initially with an adaptive expertise approach and may see exponential gains later as skills interact and build upon each other.

It will be important to consider what measures are needed to assess impact. This is complicated by what may not be a linear or incremental growth process. There may be instances in which workers hold more adaptive expertise than their mentors. While this can also happen in the case of classical expertise, it is more likely with adaptive expertise. Consideration would need to be given for how to handle such instances.

The Next Level Lab is pursuing this work as we further articulate the findings from research in cognitive science, neuroscience, and learning sciences, that inform approaches to teaching adaptive expertise in upcoming publications. We plan to design intervention components that engage learners in the key features of adaptive expertise and to conduct studies and assess the impact of doing so.

About the Next Level Lab:



This work was developed through the Next Level Lab: Applying Cognitive Science for Access, Innovation, and Mastery (AIM) at the Harvard Graduate School of Education (HGSE) with funding from Accenture Corporate Giving (ACC). Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the funder. The Next Level Lab is pursuing this work as we articulate the findings from research in cognitive science, neuroscience, and learning sciences that inform approaches to education and workforce development. Our work sits at the intersection of mining extant research of promise; conducting research questions with the potential for high leverage impact; translating research on learning and the mind for public use; and innovating in the space of technology and learning to develop new visions for what is possible in developing human potential.

We are a small research lab. We view our mission as one of providing purpose and guidance to the field. Buckminster Fuller talked about the power of small influences in his description of a trimtab in this quote.

> *"Something hit me very hard once, thinking about what one little [person] could do. Think of the Queen Elizabeth again: The whole ship goes by and then comes the rudder. And there's a tiny thing on the edge of the rudder called a trim tab. It's a miniature rudder. Just moving that little trim tab builds a low pressure that pulls the rudder around. It takes almost no effort at all. So I said that the individual can be a trim tab. Society thinks it's going right by you, that it's left you altogether. But if you're doing dynamic things mentally, the fact is that you can just put your foot out like that and the whole ship of state is going to turn around…."* -Buckminster Fuller.

It is our hope that our small lab can function as a trimtab to create better outcomes for humankind.

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