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ABSTRACT

Research findings related to constructivism have been applied to development of the Equipped for the Future (EFF) Framework and Continuum of Performance, a multi-dimensional developmental description of performance serving as a foundation for EFF-based instruction and assessment of learner progress. Acquiring expertise is a complex developmental process in which new knowledge is built on prior knowledge. To develop expertise, learners need a richly structured knowledge base. They need to learn cognitive and metacognitive strategies for using and applying new information. Scaffolding instruction helps learners develop their fluency, independence, and range of performance as they move along a developmental continuum from novice to expert. The second half of this report presents three examples of program practices that support constructivism and reflect EFF theoretical foundations. The examples show the following: (1) how teachers and students use the EFF Framework to examine prior knowledge, construct new knowledge in light of past experiences, and use this information and their thinking processes to monitor, develop, and alter their understanding; (2) how teachers and students use the EFF Framework to identify, reflect on, and revise their own mental models of adult role performance; and (3) how teachers use the EFF Framework to help learners develop fluency, independence, and range of performance as they move from novice to expert. Appendixes include a glossary and a list of 25 references. (YLB)

EFF Research Principle: An Approach to Teaching and Learning That Builds Expertise

EFF Research to Practice Note 2

EFF Research Principle: An Approach to Teaching and Learning That Builds Expertise

By Marilyn K. Gillespie

What Do We Mean by an Approach That Builds Expertise?

The conceptual framework for Equipped for the Future (EFF) is based in part on a theory of knowing and learning known as constructivism. This theory conceives of learning as an active process of knowledge construction. Learners use their prior knowledge and experience to shape meaning and acquire new knowledge.

Within this approach, learning is viewed as a process of activating our prior knowledge related to a topic we want to learn about; questioning, interpreting, analyzing, and processing new information and concepts in light of our past experiences; using this information and our thinking processes to monitor, develop, and alter our understanding; and integrating our current experiences with our past experiences (see Fosnot, 1992; Lambert & Walker, 1995; Mayer, 1998; Larochelle, Bednarz, & Garrison, 1998; Duffy & Jonassen, 1992; Brooks & Brooks, 1993; Cromley, 2000). Work in this area is closely linked to cognitive science research related to the development of expertise (see Bransford, Brown, & Cocking, 1999; Glaser, 1992).

This *Research to Practice Note* will describe how research findings related to constructivism have been applied to the development of the EFF Framework and the **EFF Continuum of Performance**, a multi-dimensional developmental description of performance that serves as a foundation for EFF-based instruction and assessment of learner progress. Among the key findings addressed are the following:

- Acquiring expertise is a complex developmental process in which new knowledge is built on prior knowledge.
- To develop expertise, learners need a richly structured knowledge base. They need to learn cognitive and metacognitive strategies for using and applying new information.
- Scaffolding instruction helps learners to develop their fluency, independence, and range of performance as they move along a developmental continuum from novice to expert.

The EFF publication *Results That Matter: An EFF Approach to Quality* presents five key principles that reflect the theoretical foundations of EFF. Program practices that support these principles provide guideposts by which programs, teachers, students, and their communities can assess their implementation of the EFF Framework. They help practitioners to better answer the questions "What does it mean to practice EFF?" and "What does EFF implementation look like in action?" These *Research to Practice Notes* will help you to:

- identify the research basis for the principles;
- learn key concepts and terms associated with the principles;
- see examples of how other programs have implemented the program practices;
- reflect on how you and your program can implement the program practices.

Research Findings on Building Expertise

Building expertise is a complex developmental process.

Most of us were taught in accordance with a "knowledge acquisition" model of learning (Mayer, 1998). In school, we were required to accumulate knowledge about a subject in separate "bits" of information. The order in which we learned

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> Rather than seeing learning as the rote acquisition of knowledge, researchers have come to see learning as a process of sense-making. Learners do not simply absorb, passively receive, or record objective knowledge that is "out there." They actively construct and interpret knowledge by integrating new information and experiences into what they already know.
>
> —Mayer (1998)

these facts was tightly sequenced into a hierarchy of behavioral objectives. After enough drills or practices, we were tested to ensure we had mastered these objectives before we proceeded to the next objectives (Shepard, 2000).

Toward a model of "knowledge construction." Although learning content knowledge is important to developing expertise, new cognitive research has revealed that it is not enough to fully prepare learners to use that knowledge in the real world. Over the past two decades, research studies have closely examined how experts in a growing number of fields (including math, science, music, reading, and history) learn and apply what they have learned. There is now strong evidence that experts do not just know *more* facts. They are not "smarter," nor do they necessarily have better memories than other people. Rather, they have developed a more complex, richly structured knowledge base related to their field. (For a review of research on the development of expertise, see Bransford, Brown, & Cocking, 1999; Donovan, Bransford, & Pellegrino, 1999; and Pellegrino, Chudowsky, & Glaser, 2001.)

How experts acquire and use knowledge. Experts with a strong knowledge base are able to (1) extract a level of meaning from content information that is not apparent to novices by structuring what they know into meaningful patterns and relationships, (2) organize their knowledge around core concepts and big ideas, (3) apply cognitive strategies to select and remember information that is relevant and eliminate what is unimportant, and (4) use metacognitive strategies to "conditionalize" their knowledge by knowing when certain concepts are useful and fluently retrieving the information necessary to solve a problem at hand. This complex knowledge base extends experts' ability to use what they know and to transfer knowledge from one problem or context to another (von Glasersfeld, 1987).

Adult performance along a developmental continuum. The EFF Assessment Consortium has drawn on this understanding of the development of expertise to define and develop a continuum of performance that shows how adults grow and learn throughout their lives, constructing new knowledge, skills, and abilities that allow them to respond flexibly to change. The **EFF Continuum of Performance** enables us to see how competence in a Standard develops along multiple dimensions as learners move from the novice to the expert level. Four key **Dimensions of Performance** distinguish performance along this developmental continuum for each of the EFF Standards: the **Knowledge Base, Fluency, Independence,** and **Range** dimensions. Understanding these Dimensions of Performance helps teachers to plan instruction, as well as to determine *how well* students are able to use the skills and knowledge associated with each Standard.

For reflection...

- *Can you think of areas in your life as a parent, family member, worker, or community member where you might be considered an expert?*
- *What kinds of knowledge, skills, and strategies have you developed over time?*
- *How do you organize what you know around "big-picture" ideas?*
- *How did you become more fluent and independent in performing this role?*

A richly structured knowledge base includes knowing how to use and apply cognitive and metacognitive strategies.
Our knowledge of what strategies are and how they work in the development of expertise comes out of a strand of cognitive research called information processing (Hartman, 2001; Pressley & Woloshyn, 1995; Greeno, Resnick, & Collins, 1997). This research on how the brain processes information has shown that new content knowledge we acquire is first stored in our short-term memory. However, our short-term memory has only a limited capacity to hold information. We have to process this information in some way or it will fade quickly. Learning strategies are defined as any behavior, thought, or action that allows learners to process information so that it can more efficiently be stored in and later retrieved from long-term memory (Weinstein & Hume, 1998).

Since I began developing performance tasks for EFF, I look at the student's learning process differently...I am much more observant because I have to describe the strategies that students use to apply their knowledge to complete the task. I have learned to watch more carefully and then work to put my observations into words.
—Nancy Gepke, Tacoma, Washington

Experts as good strategy users. Until recently, we have known little about how these strategic processes work since they are often used automatically and unconsciously by experts. However, through closely monitored research asking experts to "think aloud" as they work, we have begun to see how powerfully learning strategies influence expert learning. We now know that these strategies can be explicitly identified and taught to more novice learners (Pressley & Woloshyn, 1995).

Cognitive and metacognitive strategies. Learning strategies can be divided into two basic types. Cognitive strategies help us to remember and organize content information. For example, when we read, we might apply a cognitive strategy to skim the title, pictures, and headings of a text to get the gist of what we will read. We might take notes to help us remember the main points. A good reader will also know when it is possible to skip over sections of text and when it is important to read every word carefully. When learning a large number of facts, a good strategic learner will "study smarter" by working to understand the "big picture" and then dividing the facts into categories through a classification scheme, diagram, or outline.

Metacognitive strategies. Metacognitive strategies consist of knowledge about strategies and about one's own thinking processes. They are the "executive managers" of knowledge and include planning, monitoring, evaluating, and revising one's own thinking (Hartman, 2001). Good metacognitive strategy users engage in an ongoing process of identifying what their prior knowledge of a topic is, what they don't know, and what they need to learn. Metacognitive strategies enable learners to plan and self-regulate their work and to judge under what conditions to apply which cognitive strategies.

Strategy acquisition and EFF. Each of the EFF Content Standards identifies strategies as key components of using the Standard to carry out tasks in everyday life. In addition, cognitive and metacognitive strategies are also being explicitly identified and described as an integral part of the Knowledge Base dimension of the EFF Performance Continuum for each Standard. What the

For reflection...

- *How does your program currently emphasize "knowledge construction" as well as "knowledge acquisition"?*
- *What are some ways your program includes the teaching of cognitive and metacognitive strategies as part of instruction?*
- *Where can you go to get more information about learning strategies and how to teach them?*

strategies are changes as one moves along the developmental continuum from novice toward expert. For example, within the Standard *Read With Understanding*, at the novice level a reader might be expected only to be able to restate what was read. As readers move along the continuum, higher-order processing skills such as synthesis and analysis are required.

DIMENSIONS OF PERFORMANCE	Assessing Learner Performance: *EFF Assessment Consortium (2002) EFF/NRS Data Collection Project Interim Report*
Knowledge Base *What do learners know?*	1. What vocabulary do learners have related to the skill? Related to the subject area? 2. What content knowledge do learners have related to the skill? Related to the subject area? 3. What strategies do learners have for organizing and applying content knowledge? • Can learners recognize or create new relationships or connections? • Can learners identify information that is important to the task/problem? • Understand when information or concepts apply?
Fluency	How fluently can learners perform? • How much effort is required? • How consistently do learners start and finish, getting to the desired outcome? • How well are barriers controlled or overcome?
Independence	How independently can learners perform? • How much help is needed from others? • How much initiative is shown in getting started? • How often do learners generate their own strategies to complete the task?
Range	1. What kinds of tasks do learners carry out? • How complex is the task? • How many different kinds of tasks can learners perform? 2. In what contexts can learners perform? • In what kinds of contexts? • In how many different situations can learners perform?

Scaffolding helps learners to develop their fluency, independence, and range of performance as they move from novice to expert.

Teaching to the zone of proximal development. In addition to developing learners' knowledge base, teachers using an EFF approach also work with learners to develop their fluency, independence, and range of performance. In helping learners to move along the continuum in relationship to these dimensions, EFF teachers have drawn on the work of another thinker whose work is closely associated with constructivist theory: the Russian psychologist Lev Vygotsky (Vygotsky, 1978; Dixon-Krauss, 1996; Wertsch, 1991). Vygotsky found that new capabilities in a novice learner are first developed during collaboration with teachers or more competent peers and then internalized to become part of the individual's **mental model** of the world. Vygotsky called the distance between what an individual can accomplish independently and what he or she can accomplish with the help of someone who is more competent the **zone of proximal development**. The role of education, he believed, is to provide learners with experiences that are within their zone of

proximal development—with tasks that are slightly above their level of independent functioning yet can be accomplished with sensitive guidance.

Scaffolding instruction. Vygotsky viewed the social environment as a necessary scaffold or support system that allows a learner to move forward and continue to build new competencies, just as scaffolding is used by a painter to reach parts of a house that would otherwise be out of reach (Berk & Winsler, 1995). In the process of jointly performing a task, the teacher or a more skilled peer can point out links between the task and ones the learner already knows, helping the learner to stretch his or her understanding into the next development level. Within EFF classrooms that use this approach, the teacher's role is to first structure the task and the learning environment so that the demands on the learner are at an appropriately challenging level and then to continually adjust the amount of intervention and the range of tasks to the learner's level of independence and fluency. In this way, teachers can use the developmental continuum as a guide for learning and instruction.

For reflection...

- *In what ways does your program design activities to scaffold instruction?*
- *How might scaffolding be applied in a classroom of multi-level learners?*

Building Expertise in Your Program

Results That Matter: An Approach to Program Quality Using Equipped for the Future (Bingman & Stein, 2001) provides a vision for program-level system reform (referred to as the EFF Quality Model). The **EFF Quality Model** identifies Program Practices that reflect the theoretical foundations of EFF and provides a guidepost by which administrators, teachers, students, and communities can assess their implementation of the EFF Framework. As you reflect on the examples below, think about how your program might answer the questions "What does it mean to practice EFF?" and "What does EFF implementation look like in action?"

EXAMPLE 1:
Teachers and students use the EFF Framework to examine prior knowledge, to construct new knowledge in light of their past experiences, and to use this information and their thinking processes to monitor, develop, and alter their understanding.

Jenny Bolte is a teacher in a worksite-based program in Virginia. One of her students, a carpenter's helper named Donnie, initially came to the program to work on his reading skills. Before learning how to use the EFF Framework, Jenny might simply have tested Donnie to find out his reading level and then found workplace literacy materials he could read, accompanied by comprehension questions he could answer. Instead, Jenny started off by introducing Donnie to the Worker Role Map and Common Activities. The language of the Worker Role Map helped Donnie begin to talk about a pressing and immediate problem he was facing. His supervisor wanted him to go for a promotion to First-Class Carpenter. Donnie was not sure if he wanted to do so or not. He didn't know what was involved and wasn't sure whether his skills were up to the task.

Jenny introduced Donnie to the EFF Content Standards. It became clear to both of them that the Standard *Learn Through Research* might give Donnie the tools to help him make a decision about the promotion. The first component of the Standard

Learn through Research
- Pose a question to be answered or make a prediction about objects or events.
- Use multiple lines of inquiry to collect information.
- Organize, evaluate, analyze, and interpret.

helped him to think about what he already knew about being a First-Class Carpenter and what he needed to find out. The second component encouraged him to use multiple lines of inquiry to collect information. He decided first to talk with people at work. Jenny recommended Duke West, the HR Maintenance Training Coordinator. Donnie agreed. "Who else?" she questioned. After some thinking, he said, "How about Sid?" They decided his co-worker Sid would be a "good one to ask" as well. Jenny suggested they also try to get a copy of the training manual for the job so they could analyze what kinds of reading and writing the job required. Once all the information was collected, Jenny would help Donnie with the third component: organizing, evaluating, analyzing, and interpreting what he had learned in order to make his decision about whether to go for the job.

In her work with Donnie, Jenny used a constructivist approach to teaching and learning that allowed Donnie to use his prior knowledge to construct new knowledge related to a real-world purpose. Instead of using a textbook, they had arrived at the content for instruction through an interaction between the EFF Framework and Donnie's understanding of his immediate needs. Since what Donnie wanted to learn was rooted in a real-life context, a much wider repertoire of skills came into play. To complete this task, Donnie needed to develop his reading and writing skills, but he was doing so in light of real-world needs and applications. His reading material was the training manual for his job. His writing tasks included drafting and revising questions for interviews and making a "pros and cons" chart to analyze his findings. When they were done, Jenny would help Donnie reflect on what he had accomplished: to look more closely at the knowledge, skills, and learning strategies he had used to complete this task; to think about how he might transfer what he had learned to other parts of his life; and to determine what he wanted to learn next.

For reflection...

- *How is Jenny's approach to teaching and learning similar to or different from your own?*
- *How might Donnie have changed his view of himself as a learner as a result of this experience?*
- *What kinds of program practices support or hinder a constructivist approach to instruction?*

EXAMPLE 2:
Teachers and students use the EFF Framework to identify, reflect on, and revise their own mental models of adult role performance.

Many adult learners come to the classroom with existing mental models of themselves that create a barrier to learning. An example can be seen in the story Marty Duncan told of her work with E. W., who came to a Vermont literacy program a year after having lost her husband of 30 years. For years, E. W. had depended on her husband for assistance with reading and had held a lifelong belief that her own "thick-headedness" was the reason she hadn't learned how to read. She lacked content knowledge with respect to reading, but she also was not able to use what she did know because she lacked strategies for when and how to apply her knowledge of reading. Marty scaffolded E. W.'s learning by connecting reading and writing to something she already knew about: grocery lists. At the same time, she also helped E. W. to examine her knowledge of herself as a learner and to develop metacognitive strategies for overcoming her internal barriers to comprehension. Slowly, as E. W. learned how to reflect on her success at remembering what she learned, she also became a more independent learner more and more willing to suggest next steps. By focusing on reading skills *along with* metacognitive strategies to revise and monitor her own learning, E. W. was able to overcome her internal barriers to learning.

For reflection...

- *How might the learning outcomes for E. W. have been different if Marty had focused on reading skills alone, without building in a process for her to identify and revise her mental model of herself as a learner?*
- *How have you worked with students who have been able to change their mental models of adult role performance? What kinds of teaching and learning made this change possible?*

EXAMPLE 3: Teachers use the EFF Framework to help learners develop their fluency, independence, and range of performance as they move from novice to expert.

EFF Trainer Andy Nash describes an EFF classroom in Chula Vista, California, where a group of adult English language learners expressed a need to find out more about affordable eye care. Their teacher, Judy Wurtz, turned to two Standards, *Learn Through Research* and *Speak So Others Can Understand*, to guide the development of these skills in a project where students researched available low-cost eye exams and glasses.

Since these students had limited English language skills, the teacher broke the learning activities down into a series of discrete steps. She used guided language scripts and worksheets to scaffold each step. For example, in the first step, the learners practiced using the yellow pages and then worked in teams to find telephone numbers of eye care centers in a phone book. Next, the learners developed and practiced scripts for what to say when they phoned the eye care center. They then made phone calls. Judy helped learners to develop a simple chart to keep track of the information they got from the calls. The class even attended a community event where they made contact with an agency participating in a national project to provide eye care for students. As they worked together, Judy was helping her students to gain the independence and fluency they needed to perform this task on their own. That many succeeded is evidenced by Judy's report in her teaching log that eight students received eye appointments and most of them got glasses. As a next step, Judy might consider having learners think about expanding their range of performance by using similar skills to make other kinds of appointments in their roles as parents, family members, workers, or citizens.

For reflection...

- *This teacher used a performance-based approach to teaching ESOL learners. How might the use of performance-based instruction help your students to develop their fluency, independence, and range of performance on tasks they need for everyday life?*

Glossary

Cognitive strategies: Any behavior, thought, or action a learner engages in during learning that is intended to influence the acquisition, storage in memory, integration, or availability for future use of new knowledge and skills. (See Weinstein & Hume, 1998, p. 12; Pressley & Woloshyn, 1995.)

Constructivism: A theory of learning and knowing that holds that learning is an active process of knowledge construction in which learners build on prior knowledge and experience to shape meaning and construct new knowledge. (See Lambert & Walker, 1995.)

Continuum of Performance: A multidimensional, developmental description of performance on an EFF Standard ranging from the novice level to the expert level. The continuum is built around the four Dimensions of Performance, and performance levels are defined by identifying key features of performance at various points along the continuum. (See Stein, 2000, pp. 58-59.)

Dimensions of Performance: The theoretical foundation, based in cognitive science, on which the EFF Continuum of Performance for each skill is built. The Dimensions of Performance identify developmental differences in performance on the EFF Standards related to four areas: (1) structure of the knowledge base, (2) fluency of performance, (3) independence of performance, and (4) range of conditions for performance. (See Stein, 2000, pp. 59-60; Bransford, Brown, & Cocking, 1999.)

- **Structure of the knowledge base:** The organization and application of knowledge, skills, and strategies evidenced in performance.
- **Fluency of performance:** The ease, fluidity, and/or automaticity evidenced in performance.
- **Independence of performance:** The degree of initiative and self-reliance evidenced in performance.
- **Range of conditions for performance:** The degree to which tasks and task contexts are familiar or unfamiliar to the learner, the extent to which tasks are structured ("scaffolded") or unstructured, and the complexity of tasks.

Metacognitive strategies: Metacognitive strategies consist of knowledge *about* strategies and about one's own thinking processes. They are the "executive managers" of knowledge and include planning, monitoring, evaluating, and revising one's own thinking. (See Bransford, Brown, & Cocking, 1999; Hartman, 2001.)

Performance task: A learning activity with embedded assessment that meets learners' purposes and addresses all compo-

nents of an EFF Standard. It informs all steps of the instructional planning, teaching, and assessment cycle. It addresses a real-world activity and can be analyzed according to the Dimensions of Performance. (See Ananda, 2000; McGuire, 2000.)

Scaffolding: The structure and supports a teacher or more knowledgeable helper provides to allow a learner to perform a task he or she cannot yet perform independently. (See Vygotsky, 1978; Dixon-Krauss, 1996; Wertsch, 1991.)

Zone of proximal development: The distance between what an individual can accomplish independently and what he or she can accomplish with the help of someone who is more competent. This concept was first developed by Vygotsky (1978), who saw the role of education as to provide learners with experiences that are within their zone of proximal development—with tasks that are slightly above their level of independent functioning yet can be accomplished with sensitive guidance. (See also Dixon-Krauss, 1996; Wertsch, 1991; Berk & Winsler, 1995.)

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