

Equipped for the Future Solve Problems and Make Decisions Performance Continuum

PERFORMANCE LEVEL 1

Solve Problems and Make Decisions

How adults at Level 1 Solve Problems and Make Decisions:

- Anticipate or identify problems.
- Use information from diverse sources to arrive at a clearer understanding of the problem and its root causes.
- Generate alternative solutions.
- Evaluate strengths and weaknesses of alternatives, including potential risks and benefits and short- and long-term consequences.
- Select alternative that is most appropriate to goal, context and available resources.
- Establish criteria for evaluating effectiveness of solution or decision.

Level 1 Indicators

Use Key Knowledge, Skills, and Strategies

Adults performing at Level 1 can:

- Anticipate or identify a problem or conflict, and gather relevant information about the problem/conflict and its root causes from at least one familiar source, through use of simple strategies such as drawing on personal experience, asking questions, and reading/listening to input of others.
- Demonstrate through talk, simple drawings or simple role-plays, a basic understanding of problem/conflict and its root causes by use of a few simple strategies such as recalling/restating key information, and posing the problem as a question to be answered; and draw at least one logical causal link between the problem/conflict and its context.
- Propose a limited number of solutions that require few sequenced steps and limited new information or resources.
- Evaluate the proposed solutions, and choose one based on its apparent causal connection to the problem and its appropriateness given context and available resources
- Plan and carry out the selected solution process; use a few simple strategies to monitor progress toward a solution such as trial and error, further questioning and seeking suggestions; and adjust approach as necessary based on feedback.

Show Fluency, Independence, and Ability to Perform in a Range of Settings

Adults performing at Level 1 can solve problems and make decisions, with noticeable effort and hesitation, and supported by substantial outside help, guidance, suggestions and prompting, to accomplish very simple, well defined and highly structured tasks that require very simple but intentional solution strategies, in a few comfortable and familiar settings

Level 1 Examples of Proficient Performance

Adults performing at Level 1 can Solve Problems and Make Decisions to accomplish a variety of goals, such as:

- Determine a list of parent education topics to be addressed by the local adult learning center in response to students' concerns about their children's behavior, health and safety
- Address complaints from co-workers about untidy conditions in the employee break room

Equipped for the Future Solve Problems and Make Decisions Performance Continuum

PERFORMANCE LEVEL 2

Solve Problems and Make Decisions

How adults Level 2 Solve Problems and Make Decisions:

- Anticipate or identify problems.
- Use information from diverse sources to arrive at a clearer understanding of the problem and its root causes.
- Generate alternative solutions.
- Evaluate strengths and weaknesses of alternatives, including potential risks and benefits and short- and long-term consequences.
- Select alternative that is most appropriate to goal, context and available resources.
- Establish criteria for evaluating effectiveness of solution or decision.

Level 2 Indicators

Use Key Knowledge, Skills, and Strategies

Adults performing at Level 2 can:

- Anticipate or identify a problem or conflict, and gather and organize relevant information about the problem/conflict and its root causes from more than one familiar source, through use of strategies such as simplification by constraining the problem into parts, considering the problem from a divergent point of view, basic research and comparison/contrast of data.
- Demonstrate through talk, writing or drawing, a basic understanding of problem/conflict and its root causes by use of a range of simple strategies such as reformulating the problem, summarizing and paraphrasing key information, and drawing simple analogies; and draw appropriate causal links between the problem/conflict and its context.
- Propose, and/or adapt from similar problem situations, multiple solutions that require sequenced steps and use of some additional information or available resources.
- Evaluate the proposed solutions, and choose one based on its apparent causal connection to the problem and its appropriateness given context and available resources
- Plan and carry out the selected solution process; use a range of simple strategies to monitor progress toward a solution such as interim summary and evaluation of activities, solicitation of external “expert” review, and some prediction based on a recognition of patterns in behaviors or events; and adjust approach as necessary based on feedback.

Show Fluency, Independence, and Ability to Perform in a Range of Settings

Adults performing at Level 2 can solve problems and make decisions, with some effort and hesitation, and with some outside help, guidance, suggestions and prompting, and can sometimes lead others, to accomplish simple, fairly well-defined and structured tasks that require fairly simple but multi-step solution strategies, in a range of comfortable and familiar settings

Level 2 Examples of Proficient Performance

Adults performing at Level 2 can Solve Problems and Make Decisions to accomplish a variety of goals, such as:

- Determine how to continue English language studies when current class has ended for summer break
- Plan meals for a week that family members will like, on a limited grocery budget
- Arrange for a reliable, on-time means of transportation to and from school or work
- Pursue a plan for alleviating stress that is negatively affecting one’s health
- Modify “ideal” vacation plans to fit within a limited budget
- Find ways to minimize violation of class ground rules concerning attendance and lateness

Equipped for the Future Solve Problems and Make Decisions Performance Continuum

PERFORMANCE LEVEL 3

Solve Problems and Make Decisions

How adults at Level 1 Solve Problems and Make Decisions:

- Anticipate or identify problems.
- Use information from diverse sources to arrive at a clearer understanding of the problem and its root causes.
- Generate alternative solutions.
- Evaluate strengths and weaknesses of alternatives, including potential risks and benefits and short- and long-term consequences.
- Select alternative that is most appropriate to goal, context and available resources.
- Establish criteria for evaluating effectiveness of solution or decision.

Level 3 Indicators

Use Key Knowledge, Skills, and Strategies

Adults performing at Level 3 can:

- Anticipate or identify a problem or conflict, and gather and organize relevant information about the problem/conflict and its root causes from multiple familiar and some unfamiliar sources, through use of a range of strategies such as research, studying analyses of similar problems, classification and categorization of resulting data, and drawing some inferences and generalizations based on that data.
- Demonstrate through a variety of representations such as speech, writing, graphics, simulations and computer modeling, an understanding of problem/conflict and its root causes by use of a range of strategies such as analyzing key information, identifying predictable patterns in behaviors or events, and drawing extensive analogies; and integrate learning into a logical and coherent position on the causal links between the problem/conflict and its context.
- Propose multiple, innovative solutions that require complex sequenced steps and use of additional information or available resources.
- Evaluate the proposed solutions, and choose one based on its strong causal connection to the problem and its appropriateness given context and available resources
- Plan and carry out the selected solution process; use a range of strategies to monitor progress toward a solution, such as active hypothesis testing and verification, and prediction and judgment based on testing/verification procedures as well as on a recognition of patterns in behaviors or events; and adjust approach as necessary based on feedback.

Show Fluency, Independence, and Ability to Perform in a Range of Settings

Adults performing at Level 3 can solve problems and make decisions, consistently and with minimal effort, and with little need for guidance, help or prompting, and can lead and support others in problem-solving, to accomplish complex, minimally defined and structured tasks that require complex, multi-step solution strategies, in a range of comfortable and familiar settings

Level 3 Examples of Proficient Performance

Adults performing at Level 3 can Solve Problems and Make Decisions to accomplish a variety of goals, such as:

- Select and vote for a political candidate who you believe will most likely solve a problem you have identified in the community
- Identify and change behaviors that are weakening one's performance in job interviews
- Address disruptive behavior by students in the local learning center
- Select an in-home caregiver for an elderly family member who can no longer care for herself
- Address credit problems that have resulted from lack of understanding of credit card rules and regulations

Equipped for the Future Solve Problems and Make Decisions Performance Continuum

How to Read the EFF Performance Continuum for *Solve Problems and Make Decisions*

Each performance level of the EFF Performance Continuum for each EFF Standard is divided into four sections:

Section 1: The Definition of the Standard

Section 1 is the definition of the Standard. The definition of the standard in the components of performance is a useful tool for communicating to adult learners and their teachers the essential features of the construct for each standard. By “unmasking the construct” in this way (making it clear how the skills of solving problems and making decisions are defined), adult learners are better able to articulate their own learning goals for improving proficiency and teachers are better able to focus learning and instructional activities that build toward the goal of increasing ability to Solve Problems and Make Decisions to accomplish everyday activities.

The definition of the EFF Standard Solve Problems and Make Decisions is repeated in the same form at each level of the continuum. This repetition serves as a reminder that the integrated skill process defined by the components of performance for this standard is constant across all levels, from novice to expert levels of performance. Thus, the standard does not change from level to level. It remains a consistent focal point for learning and instruction. What changes from level to level is the growth and complexity of the underlying knowledge base and the resulting increases in fluency and independence in using the standard to accomplish an increasing range and variety of tasks. These changes are reflected in the descriptions of key knowledge, skills, and strategies at each level (Section 2); descriptions of fluent and independent performance in a range of settings at each level (Section 3); and the examples of real-world activities that can be accomplished at each level (Section 4).

Section 2: Key Knowledge, Skills, and Strategies

Section 2 of the performance continuum for Solve Problems and Make Decisions contains descriptions of some of the key knowledge, skills, and strategies that form the basis for proficient performance on the standard at each level. This listing of key knowledge, skills, and strategies is specific to each level and is the foundation for designing assessments to measure performance at that level. Beyond serving as guide for assessment development, the key knowledge, skills, and strategies described at each performance level can also be used to identify instructional objectives or can be included in the criteria used for placement of learners in instructional levels.

Content Knowledge for Problem Identification and Representation

The first bullet under Key Knowledge, Skills and Strategies related to ability to Solve Problems and Make Decisions addresses behaviors that demonstrate ability to recognize a problem to be solved (whether it is already a problem or is likely to become one), and then to access whatever

Equipped for the Future Solve Problems and Make Decisions Performance Continuum

information is needed to understand the nature of the problem, why the problem exists and what factors have contributed to it. While problem identification is constant at every level, at level 1 the sources of information available to increase understanding of the problem situation, and ways to access that information, are limited and familiar to the problem solver (activating one's own schema, remembering one's own experience, asking others about their experience, possibly reading simply-written materials). While at this novice stage of problem solving the available information is fairly concrete, it is nevertheless critical that the problem-solver be able to distinguish relevant from irrelevant information about the situation in order to get a clear picture of root causes of the problem.

Development along the Continuum of Performance is marked by ability to tap a greater number of increasingly complex and less familiar or easily-accessible sources of information. The information itself may be more abstract. Therefore, development is also characterized by an evolving ability to organize relevant information from these varied sources around key principles or themes in order to fully understand the problem situation. The problem solver shows increasing ability to combine bits of relevant information into a meaningful whole, a "bigger picture", and to compare new information with relevant, previously-acquired information. By level 3, full understanding necessitates not only literal interpretation of, but also generalizations and inferences drawn from, coherently-organized data related to the problem to be solved.

In order to solve a problem once identified, effective problem-solvers utilize their understanding of the problem situation to create mental models or internal representations of the problem in a form that is "solvable", i.e., that allows the problem solver to attend to the information most immediately relevant and that suggests the best possible solution strategies. The second bullet under Key Knowledge, Skills and Strategies on the EFF Performance Continuum related to ability to Solve Problems and Make Decisions deals with representation of a problem; however, for the purposes of teaching and assessing problem-solving skills, representation here is not only a matter of internal meaning-making but also a mode of external communication of one's internal meaning-making – one's "mental model" of the problem. Development along the continuum is characterized by the number and sophistication of methods used to communicate understanding of the problem and its root causes, as well as by the quality and complexity of the causal connections drawn between the problem itself and other elements of the problem situation. At level 1, available representations are few, simple and concrete, focusing on fairly superficial features of a situation or individual statements/articulations of fact. At level 2 we see a growing repertoire of methods to represent the problem (increasing the likelihood of clear communication to others) and some movement beyond concrete treatment and toward integration of information. By level 3 the problem solver uses a wide range of methods and is increasingly able to provide representations of problem situations that focus on underlying principles and feature coherent organization of relevant information around them

Strategic Knowledge for Problem-Solving

As indicated above, the soundness of a problem-solver's representation of a problem situation will have a direct impact on the number and quality of strategies available to that person for solving the problem. This strategic knowledge that follows from content understanding is the focus of the third and fourth bulleted categories under Knowledge, Skills and Strategies at each

Equipped for the Future

Solve Problems and Make Decisions Performance Continuum

level of Solve Problems and Make Decisions. We treat these bullets together, as they together address the ability to generate, evaluate, and select among alternative solution paths – the best strategies in the best combinations or sequences -- that are suggested by one’s problem representation.

Development along the Performance Continuum with reference to generating alternate solutions to the problem is characterized by a growing number of solution strategies available to the problem-solver, but also by increasing sophistication of those strategies and complexity of the combination or sequence of those strategies necessary for a positive outcome. At level 1 the problem-solver can generate a small number of (but more than one) fairly simple options, utilizing a few primarily general strategies suggested primarily by existing problem-solving schema. At level 2 the problem-solver generates a larger number of alternatives to choose from, and as domain-specific content understanding is increasing at this level, the available strategies will include some that are domain-specific as well as general. Further, the potential solution paths, each featuring some combination of those strategies, are becoming slightly more complex. By level 3, rich content understanding and a coherent and principled representation of the problem situation allow the problem-solver to choose among a large store of both domain-specific and domain-independent strategies, and to combine them in innovative ways, in order to generate many alternative solutions to the problem.

While the ability to generate alternative solution strategies is described developmentally along the Continuum, the act of evaluating and selecting among these strategies is treated as a constant at all levels. In every case, at each stage of development, the problem solver must be able to use the information available in the problem representation as the basis for criteria to evaluate options for a solution. A further important point here is the recognition that there may no one externally-defined “correct” procedure for solving a given problem. In the case where a variety of solutions may be “correct”, it is important at every level of problem-solving that the particular problem context and resources available are taken into consideration as one evaluates and chooses solution options.

Meeting the Need to Solve Problems and Make Decisions

The final bullet under Knowledge, Skills and Strategies used at each level of Solve Problems and Make Decisions addresses actual implementation of the selected solution strategy and monitoring of its outcomes. Some aspects of the activity described here remain constant across all levels of the Performance Continuum. At each level, the problem-solver enacts the selected strategies in the decided-upon combinations – in other words, pursues the selected solution. And at each level the problem solver makes changes in that approach, or not, depending on whether the approach produces the desired outcome – in other words, whether or not the problem is then perceived to be solved. What changes from level to level, and what introduces the critical metacognitive aspects of problem-solving here, is the ability to monitor what happens while, and after, one implements the selected solution strategy. Development from novice toward expertise in this area is marked by the number and complexity of ways that a problem-solver can seek and secure useful feedback about how well the solution strategy is working toward the solution goal. At level 1 monitoring activities are intentional but few and simple, focusing primarily on discovering individual surface or obvious changes. However, by level 3 the number and range of

Equipped for the Future

Solve Problems and Make Decisions Performance Continuum

these activities have expanded to include many sophisticated, often technically complex procedures that allow the problem solver to see patterns of change, make predictions about future change, and draw conclusions based on sound data.

Section 3: Fluency, Independence and Ability to Perform in a Range of Settings

Section 3 is the description of fluency, independence and ability to perform in a range of settings expected for proficient performance on the standard at each level. Like the description of key knowledge, skills and strategies in Section 2, the descriptions in Section 3 are specific to each level and are intended to serve as a basis for guiding assessment, learning and instruction that is appropriate to that level.

With regard to Solve Problems and Make Decisions, key features of this section are descriptions of the level of effort required to accomplish a problem-solving task (relative difficulty or ease with which one engages in the problem-solving process) and the amount and kinds of external support needed to plan and implement a solution process. At the novice level, individual performance is noticeably effortful; the problem-solver depends on direction and prompting from others within highly structured activities to be able to communicate an adequate model of the problem, select appropriate solution strategies, and monitor outcomes. In the movement toward expertise, individual performance depends less and less on external direction or structure; the problem solver engages in, and eventually can initiate the process, with increasing ease and comfort. In a group setting this developing expertise may also be enacted in the individual's willingness and ability to lead others through the problem-solving process.

Section 4: Examples of Applications of the Standard

Section 4 of the performance level descriptions provides a short list of examples of the purposeful applications of the standard (activities) that can be accomplished by an adult who is proficient at each level. This list of examples is illustrative and not exhaustive. Like Sections 2 and 3, the descriptions of activities in Section 4 are specific to each performance level. These examples of things that adults can accomplish in the real world at each level of performance on the continuum are useful to adult learners and to their teachers as ways of making concrete the purpose and need for attaining increasing proficiency in performance on the standard. By making it clear what can be accomplished at each level, the descriptions of activities in Section 3 also provide motivation for higher levels of learning. The listing of real-world accomplishments also provides guidance for selecting and designing the content for instructional materials and assessments.

Problem-solving tasks here are defined with reference to two related features:

- The relative complexity of the problem to be solved, and
- The number and relative complexity of the potential solution paths.

At level 1, learners are expected to solve problems and make decisions in the context of tasks where the problem situation is very simple and very easily defined. Once the problem is identified and represented in tasks at this level (for instance, “people are not washing their own coffee cups after using them in the employee break room”), learners are required to generate and

Equipped for the Future

Solve Problems and Make Decisions Performance Continuum

evaluate few, but more than one, very simple alternative solutions (for instance, “put up a sign”, or “provide disposable cups”). In level 2 tasks the problem situations are still fairly simple and defined (“I need to decide how to feed my family this week on what we have left in Food Stamps”), but require learners to generate alternative solutions featuring multiple steps and/or combinations of strategies (“find out how much total money we have to spend on food, find out prices of things, come up with a couple menu options”, etc.) Finally, by level 3 the tasks are characterized by complex, ill-defined and often novel problem situations (“My credit is terrible – I don’t know why and I don’t know how to fix it, but I have to!”). They require learners to generate multiple, complex and sometimes innovative solutions (“learn credit card rules and regulations, learn why immediate problems have arisen, get credit counseling/help to contact companies and set up payment plans, get a second job or some other source of additional income, develop or adjust current budget”, etc.)

Equipped for the Future Solve Problems and Make Decisions Performance Continuum

Background to the EFF *Solve Problems and Make Decisions* Performance Continuum

The EFF standard *Solve Problems and Make Decisions*, one of the three interrelated and sometimes overlapping EFF standards that are categorized as “Decision-Making Skills”, highlights one domain of adult knowledge and skills that is critical for adults to be able to draw from in order to carry out their responsibilities in their roles as family members, workers, and citizens. Defined generally as the ability to identify a problem situation, ask appropriate questions, make logical predictions and come to informed decisions, problem-solving is broadly acknowledged as an important “learning to learn” skill across many domains of content knowledge and activity. Problem-solving is often cited by employers and practitioners in workforce development – along with other skills related to teamwork and leadership capacity – as a critical “behavioral skill” for successful and productive employees. And behavioral scientists and field workers point to the importance of people’s “general orientation”, or a positive “set” or attitude toward problem-solving, that allows them to define a process for finding out what they want (“problem” being defined as an unmet want) and how to get what they want in the most effective way, within a variety of adult activities and relationships.

While the ability to solve problems and make decisions is acknowledged as a desirable focus of adult learning and development, explicit treatment of problem-solving is rarely found in the traditional, academics-focused adult basic skills curriculum outside of mathematics (and even in that domain, within fairly narrow parameters). So teaching and assessing problem-solving in adult basic/literacy/ESOL education, and doing so as necessary in complex, real-world adult contexts, across several domains of adult activity, is a fairly new endeavor. That has made our job -- to develop a Performance Continuum for the standard that will support valid and reliable assessment of individual performance on the standard -- a challenging one, and our understanding of competent adult performance in solving problems and making decisions continues to evolve.

The empirical basis for the three performance level descriptions for the Solve Problems and Make Decisions Performance Continuum is data on adult learner performance collected by EFF field researchers who developed and piloted activities and performance tasks based on this EFF standard in their ABE, GED, and ESL classes. We are particularly grateful to the teachers and learners who “tread new ground” with this standard in order to provide rich descriptions of learner performance of the standard in their instructional contexts. Our current data does not support definitions of performance levels below or above the three levels we have described. In the future, research to support the description of higher performance levels or of “pre-Level 1” performance levels for more beginning level learners may be developed.

The EFF approach to defining performance levels for *Solve Problems and Make Decisions* depends on a conception of problem-solving as a domain-independent, integrated skills process that requires significant domain-specific content understanding. Specifically this process calls for

- Ability to identify, fully understand, and represent (internally and for others) a problem to be solved;
- Ability to generate, evaluate and choose the best among solution options;

Equipped for the Future Solve Problems and Make Decisions Performance Continuum

- ability to select and use appropriate strategies (whether general or domain specific), in appropriate sequence or combination, to solve the problem;
- ability to plan, carry out and monitor the effectiveness of a process for using these strategies, and to flexibly adjust the approach if feedback warrants.

In addition to analysis of EFF field research data, we conducted a review of available research regarding problem-solving. In the background resources we studied, we found broad agreement that the development of problem-solving proficiency is demonstrated through progressively more efficient, fluent, and independent performance in solving increasingly complex, novel and ill-defined problems.

The EFF approach to defining the standard *Solve Problems and Make Decisions* outlined above has been influenced by the then-groundbreaking work of the Secretary's Commission on Achieving Necessary Skills (SCANS). In the report that summarizes that work (USDOL, 1991), problem-solving is defined as the ability

- to recognize that a problem exists (i.e. there is a discrepancy between what is and what should or could be),
- to identify possible reasons for the discrepancy,
- to devise and implement a plan of action to resolve it,
- to evaluate and monitor progress, and
- to refine the plan as indicated by findings

Furthermore, EFF's definition of the standard *Solve Problems and Make Decisions* as an integrated process of applying knowledge and using strategies in meaningful contexts owes much to cognitive science research on the nature of learning and the development of expertise. As early as 1984, Bransford and Stein characterized the "IDEAL" problem solver as one who can

I identify the problem;
D define and represent the problem;
E explore possible strategies;
A act on the strategies; and
L look back and evaluate the effects of these activities.

In a more detailed characterization (one that directly addresses the metacognitive processes of organizing information around key concepts and adjusting solution strategies based on self-monitoring – important aspects of the EFF definition) Baxter, Elder and Glaser (1996) describe the competent problem-solver as one who

- Provides coherent explanations based on underlying principles (rather than describing superficial features or making single statements of fact);
- Generates a plan for solution based on adequate representation of the problem situation and possible procedures and outcomes;
- Implements solution strategies that reflect relevant goals/subgoals; and
- Monitors actions and flexibly adjusts approach based on performance feedback.

From a similar perspective, Mayer and Wittrock (1996) have defined problem-solving as cognitive processing directed at achieving a goal when no solution method is obvious to the

Equipped for the Future Solve Problems and Make Decisions Performance Continuum

problem solver. Such processing involves the subprocesses of representing, planning and executing, particularly the acts of

- Identifying the problem,
- Forming an internal representation,
- Encoding the representation,
- Planning,
- Selecting strategies, and
- Monitoring solutions.

Based on this definition of the cognitive process of problem-solving, the Center for Research on Evaluation, Standards and Student Testing (CRESST) at the University of California in Los Angeles has developed an approach to the assessment of problem solving skills. The CRESST approach, as articulated by Harry O’Neill (1997), focuses on

- Domain-specific knowledge (content understanding);
- Problem-solving strategies: either domain specific (“troubleshooting”), or domain independent (multiple problem representations, analogies, metaphors);
- metacognition (planning, self-monitoring); and
- motivation (effort, self-efficacy)

In other words, according to O’Neill, to solve problems well requires knowing something (and being able to search for information to improve one’s understanding); using intellectual tricks (problem-solving strategies); planning; monitoring progress toward solving the problem; and being motivated to find a solution.

The following is a brief discussion of additional research that supports key elements of the EFF definition of *Solve Problems and Make Decisions*.

The “content” of problem-solving: knowledge

The summary of CRESST’s approach above suggests that domain-specific content understanding is a critical concern in effective problem solving. As pointed out by McDaniel and Schlager (1990), herein lies a challenging aspect of teaching and assessing “general” or “domain-independent” problem-solving skills: the knowledge and skills required for effective problem-solving appear to differ across problem types (for instance, understanding the relationships among problem elements vs. knowing specific facts, data trends, principles, language, symbols, etc). Moreover, researchers seem to agree that most real-world problems require rich domain-specific knowledge – as O’Neill puts it, “You have to know something”.

In the approach to problem-solving illustrated on the Performance Continuum for the EFF standard *Solve Problems and Make Decisions*, domain-specific knowledge includes understanding of the body of facts and procedures available to be brought to bear to a problem situation along with relevant information from belief systems and “mental models”. It also encompasses key concepts around which to organize such information, and the relationships

Equipped for the Future Solve Problems and Make Decisions Performance Continuum

between those concepts. This domain-specific knowledge is built on previously acquired information (prior knowledge) and the “intelligent use” of new information.

One important function of prior knowledge in the activation of domain-specific content understanding is what Nitko (2004) calls “schema-driven problem solving”. Our schemas, the distillations of previously acquired knowledge and experiences, help us to recognize familiar things about a situation, what we can expect to happen, and how we typically act in such a situation. If we recognize a problem as part of or very similar to one of our existing schema, we can apply a solution strategy stored in that schema. Schema are effectively activated when we can make an accurate mental representation, or “mental model” of the problem. Conversely, if for some reason we misrepresent the problem we may trigger the wrong schema and implement strategies that don’t work. In that case we need to reconceptualize the problem – change our mental representation – in order to draw from the appropriate body of prior knowledge to find appropriate solution strategies.

Successful problem-solvers can also acquire and integrate new domain-specific knowledge when their current schemas do not provide them with sufficient resources to address the problem situation. Sternberg (1986) discusses three related cognitive processes that indicate effective integration of new information in problem-solving activity; in this view, problem-solvers

1. selectively encode information (that is, identify, from the host of information available, which information is relevant to the problem at hand, and attend to it);
2. selectively combine the relevant information into a meaningful whole, in which associations between relevant pieces of information are understood (if possible using the single optimal way for generating a solution to a particular problem); and
3. selectively compare the new information with relevant, previously acquired information

This is what Mayer et al. would later call “intelligent use of information” in problem-solving as they articulated the SCANS Information Competency – an integration process that involves the ability to identify relevant information, distinguish it from irrelevant information, and then integrate the relevant information to solve problems. And the EFF standard addresses these cognitive processes that are involved in acquiring, interpreting, evaluating and communicating domain-specific information necessary to solve a problem

The “content” of problem-solving: solution strategies

If the need for rich domain-specific content understanding poses a challenge for the teaching and assessing of problem-solving skills, the nature of the solution strategies employed by effective problem-solvers raises even more interesting issues. Researchers and practitioners appear to be engaged in an ongoing controversy concerning whether adults should be taught problem-solving strategies that are general – that is, “domain-independent” -- or strategies that are specific to a content/curriculum area. It seems clear that domain –specific strategies are less applicable across domains but more powerful within the domain. And according to Nitko (2004), it appears that problem-solvers tend to use both kinds of strategies under different conditions; when people are unfamiliar with a content area they use general strategies, but as they develop expertise in domain-specific content understanding they increasingly use content area-specific strategies.

Equipped for the Future Solve Problems and Make Decisions Performance Continuum

Ultimately, knowledge-based problem-solving methods within a particular domain provide much better solution strategies than more general methods; we need only think about “troubleshooting” a technical problem as an illustration. Nevertheless educators, workforce development specialists, social service providers and others working with adults continue to stress the development of general problem-solving skills to be applied across the multiple domains of learning and activity that are the focus of their efforts. The EFF approach to this dilemma has taken 2 close paths. On the one hand, the 16 EFF standards include some in which problem-solving strategies are tied to a particular knowledge domain (*Use Math to Solve Problems and Communicate*). In the case of the EFF standard *Solve Problems and Make Decisions*, however, an integrated domain-independent problem-solving process is defined, and growing expertise is marked on the Performance Continuum for the standard by increasing range and sophistication of both general and domain-specific problem-solving strategies available to be applied to a particular problem situation. This approach brings us back again to the importance of domain-specific content understanding in the EFF standard definition and Performance Continuum, as developing knowledge within a domain will suggest an increasing array of domain-specific solution strategies to choose from. Content knowledge and strategic knowledge, then, are integrally related in the development of problem-solving expertise.

**Equipped for the Future
Solve Problems and Make Decisions Performance Continuum**

Research Bibliography

Bransford, J. and Stein, B. (1984) *The Ideal Problem Solver: A Guide for Improving Thinking, Learning and Creativity*. W.H. Freeman and Co.

Bedell, J. and Lennox, S. (1997) *Handbook for Communication and Problem-Solving Skills Training: A Cognitive-Behavioral Approach*. John Wiley and Sons, New York.

McDaniel, M. and Schlager, M. (1990) “Discovery Learning and Transfer of Problem-Solving Skills”. *Cognition and Instruction*. Lawrence Erlbaum Associates, Mahwah, NJ

Nitko, A.J. (2004) *Educational Assessment of Students*. Prentice-Hall, Pearson, Columbus, OH

Occupational Information Network (O*Net) Consortium (2003). *O*Net Online: Skills Search*

O’Neil, H. (1999). *A Theoretical Basis for Assessment of Problem-Solving*. Presentation at the Annual Meeting of the American Educational Research Association, Montreal, Canada

O’Neil, H., Allred, K. and Baker, E. (1997). “Design of Teacher-Scored Measures for Workforce Readiness Competencies”. *Workforce Readiness: Competencies and Assessment*. Lawrence Erlbaum Associates, Mahwah, NJ

O’Neil, H. and Schacter, J. (1997). *Test Specifications for Problem-Solving Assessment*. Center for the Study of Evaluation, National Center for Research on Evaluation, Standards and Student Testing (CRESST), University of California at Los Angeles

Qualifications Curriculum and Assessment Authority for Wales (2003). *The Common Requirements Across the National Curriculum: Problem-Solving Skills*

Sternberg, R. (1986) *Thinking and Problem Solving (Handbook of Perception and Cognition)*. Academic Press

U.S. Department of Labor (1991). *Report of the Secretary’s Commission on Achieving Necessary Skills (SCANS)*