Elevating Knowledge from Level 1 to Level 3

(Excerpted from the *Faculty Guidebook*)

by Kip Nygren (Civil & Mechanical Engineering, United States Military Academy at West Point)

The process of elevating knowledge from Level 1 to Level 3 can be described in terms of moving from Level 1, terminology and related information; to Level 2, comprehension and understanding; and then to Level 3, transferring and applying knowledge in new contexts.

This paper offers:

1. A methodology for elevating knowledge that provides guidance for elevating learning to Level 3.
2. A special matrix of descriptions of how five types of knowledge vary as learners progress up the levels.
3. Ten specific techniques for helping to improve learning performance.

Finally, the focus of inquiry for each level is provided from both faculty and student perspectives to guide the formulation of critical thinking questions relevant for learning and assessment at each of the three levels of knowledge construction.

Levels of Learner Knowledge

Level 1 **Information** *"Memorization"*	You can talk about a concept, process, tool, or context in words and can provide definitions or descriptions. You are best with questions about facts.	
	A learner at this level can answer:	*"Where is…?"* *"Can you list the three…?"*
Level 2 **Conceptual Understanding** *"Teaching"*	You can construct an appropriate model in your mind pertaining to a particular item of knowledge. You also can link items of knowledge to each other.	
	A learner at this level can answer:	*"How would you compare or contrast…?"* *"What is the main idea of…?"*
Level 3 **Application** *"Transfer Knowledge to a New Situation"*	You can apply and transfer a particular item of knowledge to different situations and contexts. You can generalize the knowledge to determine ways to apply it, testing boundaries and linkages to other information. You are able to teach this knowledge to others.	
	A learner at this level can answer:	*"What would result if…?"* *"How would you apply what you learned to develop…?"*
Level 4 **Working Expertise** *"Problem Solvers"*	You can solve complex problems by applying and generalizing multiple concepts, processes, and tools to produce a quality problem solution. You are seen as an expert in your field.	
	A learner at this level can answer:	*"Can you propose an alternative...?"* *"Can you construct a model that would change…?*
Level 5 **Research** *"Creative Enterprise"*	You have innovative expertise which can be used to develop new understanding. You often make new linkages among concepts and problem solutions which have not been seen before.	
	A learner at this level can answer:	*"Can you formulate a theory for…?"* *"Can you think of an original way to…?"*

Transferable Knowledge

"All new learning involves transfer" (Bransford & Brown, 2000). This statement defines the essence of education as opposed to training. A broad education allows individuals to effectively respond in new situations instead of simply being trained to perform explicit tasks in consistent conditions. Because transfer of learning involves generalizing concepts that can be applied in a variety of contexts, measuring students' ability to transfer knowledge represents a true indication of the quality of a learning experience. However, the ability to transfer knowledge (Level 3) first requires preparation for learning and the attainment of knowledge Levels 1 and 2.

Preparation for Learning

Before knowledge can transfer successfully, there must be favorable conditions to support the attainment of knowledge at Level 3. Three steps of the Learning Process Methodology (why, orientation, and prerequisites) do just that. Level 1 knowledge (information) requires obtaining definitions, facts and information. The Learning Process Methodology divides this acquisition into two steps: vocabulary and information.

The next goal is to obtain Level 2 knowledge which is comprehending and understanding the concept. At this level, the learner should be able to pose and attempt to answer critical thinking questions as well as explain the topic effectively to someone else. Successful attainment of Level 3 means that one has the ability to generalize the new knowledge and transfer it for application in new contexts.

Elevating Knowledge

Knowledge is not dispensed by a teacher, rather it is constructed by the student. As previously discussed, the construction of knowledge requires a firm informational base which can be validated with the successful answering of directed questions. The foundation also requires cornerstones of prior knowledge to which the new knowledge can be connected. Understanding and comprehension of new knowledge emanates directly from the learner's pre-existing knowledge. At this stage, inventorying what we already know is critical to activate new learning. Teachers can help connect new concepts to the preconceptions that learners bring to the classroom with Level 2 (comprehension) links that correct, enlarge and organize the knowledge structure. Once this model of the new concept is in place, its reliability can be assessed with critical thinking questions that focus on the assumptions or logic of the model.

The new knowledge structure or model can be turned into "knowledge skill" for the learner through problem solving in a familiar context to reinforce the framework and to initiate the generalization and transfer of the knowledge. The knowledge expertise becomes stronger as the learner transfers and applies the skill in slightly different contexts. Eventually the learner will be able to use the skill in a completely new and unfamiliar context with the teacher acting as a consultant. The ultimate achievement of knowledge Level 3 occurs when the new knowledge can be generalized to apply in any appropriate context. Following is a formal methodology for elevating knowledge to Level 3.

ELEVATING KNOWLEDGE METHODOLOGY 1 → 2 → 3

Step		Explanation	Level
1	Informational base	Establish and solidify an informational base.	1
2	Prior knowledge	Identify the cornerstones for the knowledge. Knowledge is built upon a foundation of prior knowledge.	2
3	Inquiry questions	Identify the key inquiry questions for comprehension and key issues for constructing the knowledge.	2
4	Test conditions	With the framework in place, test the conditions of the structure; use critical thinking to explore the assumptions or logic of the knowledge model.	2
5	Familiar context	Transfer and apply the knowledge to a familiar context to enrich understanding.	low 3
6	Similar context	Transfer and apply the knowledge to another context that is similar.	low 3
7	Distant context	Transfer and apply the knowledge to a context that is some distance from the original context.	3
8	Unfamiliar context	Transfer and apply the knowledge in a totally unfamiliar context with the teacher acting as consultant.	3
9	Generalize	Independently make a generalization of the new knowledge.	4

Simple Example of the Methodology—Change Car Oil

Step 1 Establish and solidify an informational base.

Identify the tools required to change the oil find three possible facilities at which to change the oil; know how to add and measure engine oil; know the type of oil filter required, etc.

Step 2 Identify the cornerstones for the knowledge.

Determine the student's prior knowledge about the need for lubricants in any type of machine, the basics of engine oil systems, and the purpose of the filter.

Step 3 Identify the key inquiry questions for comprehension.

What are the reasons for the order of the steps involved in changing oil? What would happen if a particular step were left out of the process? What happens to the old oil?

Step 4 With the framework in place, test the conditions of the structure.

What would happen if there were less oil than recommended? More oil?

Step 5 Find a context you are familiar with and transfer and apply the knowledge to that context.

Demonstrate or explain in detail how to change the oil in your own car.

Step 6 Transfer and apply the knowledge to another context that is similar.

Demonstrate or explain in detail how to change the oil in a pickup truck.

Step 7 Make a transfer, and apply the knowledge to a context that is some distance from the original context.

Demonstrate or explain in detail how to change the oil in a riding lawn mower.

Step 8 Pick a totally unfamiliar context, and transfer and apply the knowledge with teacher as consultant.

Explain why there is no need to change the oil in a chain saw engine.

Step 9 Generalize the new knowledge.

Discuss possible means to provide lubrication in a wide range of machines from air-conditioner units to turbo-jet engines.

Knowledge Forms

Knowledge forms include the following:

Concept—an idea that represents a set of relationships.

Process—a sequence of activities.

Tool—an instrument to accomplish a task.

Context—conditions relevant to performance.

Way of Being—a set of attitudes, actions, or values.

Table 1 illustrates levels of knowledge from Level 0.5 to Level 4 based upon each of the knowledge forms.

The Most Difficult Steps in the Method

1. The Pre-learning phase (Steps 1-5 in the LPM)

   The learner and the teacher must agree why the learning objective is important, gain mutual orientation to the learning issues and context, and activate relevant prerequisite knowledge.

2. Achievement of Level 2

   Comprehension of the principles, theories, and models that have developed in an area of knowledge facilitates and enhances successful application. However, learners vary in their need for exposure to simple application opportunities as a way to clarify their Level 2 understanding and to motivate deepening of their understanding.

3. Generalization of the knowledge to higher Level 3

   Extensive experience with using knowledge in varied contexts is the basis for increasingly sophisticated internalization of both theoretical knowledge and problem-solving expertise.

Techniques for Improving Learning

Make sure that the cornerstones to learning are in place.

There are many ways to make sure that these foundational blocks of information are in place. Ask directed questions that require you to link personal experiences, prior knowledge, informational readings, or key aspects of examples that are provided. Use a reading log or reading quiz to assess your preparedness for learning. Before participating in a discussion, ask yourself a couple of inquiry questions or summarize what you understand about the concept. Finally, inventory what you think the key cornerstones are for this learning exercise.

Connect to previous knowledge by inventorying learner experience.

Conduct a learning assessment survey to determine your level of content knowledge, engage in tasks that will reveal your preconceptions, and work to organize your preexisting understanding into conceptual frameworks, such as can be demonstrated with a concept map.

Discipline the process.

The most efficient and least frustrating learning occurs with a step-by-step process. This can be facilitated by testing understanding and judging when you can move to the next step. Be prepared to move back a level if the knowledge structure is not strong enough to add the next "floor."

Test the robustness of understanding with critical thinking questions.

Step 4 requires that learners test the quality of their own learning before going to application. Is the frame strong enough?

Develop learner participation.

Ultimately, students must take control of their own learning and monitor their own learning progress. A powerful metacognitive strategy is for students to track their progress and use reflective essays to ask and answer their own critical thinking questions.

Understand the knowledge forms.

Use the descriptions and guidance in Table 1 to clarify and assess your current understanding and performance level.

Generalize understanding.

Write a paragraph about applying your knowledge in a familiar context, then another paragraph about applying your knowledge in an unfamiliar context, and finally a paragraph that generalizes your knowledge by describing similarities and differences between the two contexts and identifying common underlying principles.

Transfer knowledge to a far context.

For example, after learning about using oil in a familiar context, like a door hinge, and a slightly less familiar context, like a riding lawn mower, discuss how an airplane pilot might monitor the oil in the jet engines of an airliner to ensure that the engines operate efficiently in flight.

Motivate and inspire your own learning while maintaining high expectations.

Persistence to achieve learning goals is clearly affected by the student's motivation to learn. Pay close attention to the first five steps in the LPM to ensure that you understand and are committed to the

learning challenge. Authentic problems that are important in the learner's community or related to career goals are particularly stimulating; work to find ways to consistently make connections between these things and what you're learning.

Control the affective domain to limit frustration.

As discussed previously, learner frustration, or boredom, is closely related to the level of the learning challenge and the time allotted to achieve it. When working to elevate your own learning you can increase or decrease the allocated time for things such as a practice test or essay to adjust the challenge.

Essential Inquiry at Each Step

Critical thinking requires a healthy level of skepticism and a set of skills to validate sources of information, to monitor one's internal process, and to assess the quality of the resulting solutions, conclusions, decisions, or new knowledge. Critical thinking questions are central to the validation of new knowledge and can be differentiated as to the level of difficulty in both formulation and response. The scale below, which is based on the first three Levels of Learner Knowledge, provides examples of the role inquiry plays in the achievement of knowledge levels.

Level 1—Information

1. Inquiring about a specific fact in a specific context
2. Inquiring about a set of facts related to a specific area

Level 2—Conceptual Understanding

3. Asking about an inferential relationship between two facts or a fact to a context
4. Determining the similarities or differences between things
5. Asking to clarify the meaning of implicit relationships in a model or a discussion
6. Making indirect inferences and connections (e.g., a $\rightarrow$b and b $\rightarrow$ c then a $\rightarrow$ c)

Level 3—Application

7. Identifying explicit assumptions when using this knowledge
8. Identifying implicit assumptions when using this knowledge in varying contexts

Concluding Thoughts

Learners can become familiar with knowledge elevation for each type of knowledge by using the descriptors and suggestions in Table 1. Consistent use of the Methodology for Elevating Knowledge will enable them to engage in metacognitive strategies that leads to Level 3.

References

Authentic Learning. (n.d.). Retrieved July 12, 2004 from <http://chd.gse.gmu.edu/immersion/knowledge-base/strategies/constructivism/authentic.htm> (George Mason University Instructional Technology Program).

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). How people learn: Brain, mind, experience, and school. Washington, DC: National Academy Press.

Table 1 Levels of Knowledge Across Knowledge Forms

Levels of Knowledge	All Forms of Knowledge	Concept	Process	Tool	Context	Way of Being
Level 0.5 **Pre-Information (Language)**	Structures in own words	Knows meaning of words	Follows grammar and syntax	Recognizes key symbols	Decodes acronyms	Recognizes critical words within disciplines and cultures
Level 1.0 **Information**	Memorizes and repeats information Assesses quality of data	States facts and definitions Draws pictures and diagrams	Describes steps in a method Initiates use of a method	Uses step-by-step instructions Recognizes purpose and intended use	Repeats stories Describes events	Follows social conventions Responds to traditions
Level 2.0 **Conceptual Understanding**	Produces good inquiry questions Analyzes models effectively	Articulates understanding Describes relationships and linkages	Rationalizes use of steps Knows criteria for quality outcomes	Comprehends instruction sets Knows full range of use	Condenses a story Shares implications	Values well-reasoned arguments Values accepted models & theories
Level 3.0 **Application (low level)**	Applies in a familiar context Analyzes results	Combines with related ideas Links principles and practices	Documents use of steps in a method Links the steps together	Locates instructions Uses basic features and functions	Requires guidance Able to serve as a trainee	Notices mismatch of a principle and its application Accepts expected results
Level 3.5 **Application (high level)**	Applies in new contexts Synthesizes new solutions	Clarifies boundaries Understands why a theory will work	Internalizes use of a theory Links methods together	Uses hidden features Adapts instructions	Responds to subtle prompts Able to serve as a teacher	Harmonizes theory with practice Collaborates for better outcomes
Level 4.0 **Working Expertise**	Efficient in producing quality results Proposes criteria to define quality	Evaluates alternative models Generalizes understanding	Customizes methods for future use Monitors quality in real time	Debugs fluently Creates customized tools	Provides prompts for others Serves as a consultant	Serves as a role model Interacts with a larger community