How to Guide Your Lifelong Learning

R. Russell Rhinehart

Develop Your Potential Series for CONTROL Magazine
Vol. 34, No. 6, June, 2021, pp. 59-61

Congratulations! You now need to manage your own learning! Once becoming a professional, one does not continue to learn by going to class, to understand and memorize instructor-given facts and concepts. Further, the learning is no longer credentialed by test results on teacher-devised exercises.

To manage your continued learning, you need to understand the learning process. Bloom's Taxonomy is one categorization: Mental activities associated with traditional learning (remembering, understanding, and applying) are important intellectual activities, but they are the lower levels of cognitive skills. By contrast, professionals also need to independently operate in the upper cognitive levels – analyzing, evaluating, and creating.

Table 1 is a categorization of cognitive skills developed by a committee led by Benjamin Bloom and published in 1956. The table includes a description and examples. This categorization is regularly used in analyzing instructor-provided education.

Table 1 – Bloom's Taxonomy of Cognitive Abilities

Level	Name	What the person does:	Examples:
6	Create	Create something new: Purposefully integrate parts or concepts to design something new that meets a function.	Design a device to meet all stakeholders' approvals within constraints.
5	Evaluate	Judge goodness, sufficiency, and completeness of something, choose the best among options, know when to stop improving.	Decide that a design, report, research project, or event planning is finished when considering all issues relevant to the context.
4	Analyze	Two aspects related to context: One: Separate into parts or stages, define and classify the mechanistic relationships of something within the whole.	One: Describe and model the sequence of cause-and-effect mechanisms.

		Two: Critique, assess goodness, determine functionality of something within the whole.	Two: Define and compute metrics that quantify measures of utility or goodness.
3	Apply	Independently apply skills to fulfill a purpose within a structured set of "givens".	Properly follow procedures to calculate a value, use software features to properly present data.
2	Understand	Understand the relation of facts and connection of abstract to concrete.	Find the diameter of a 1" dia. pipe, convert units, qualitatively describe staged equilibrium separation phenomena.
1	Remember	Memorize facts and categorization.	Spell words, recite equations, name parts of a valve, read resistance from color code, recite the 6 Bloom's levels.

Unfortunately, classroom education tends to keep students operating in the three lower cognitive levels – follow the instructor, memorize and understand, then demonstrate by application on simplistic problems or lab exercises. The instructor prescribes the topics and method of learning, and student proficiency is evaluated by the instructor. When such education is perceived by the student as professional preparation, this conventional learning environment misdirects the students' perspectives about what it means to be a professional partner in the enterprise. The job of a practitioner is not to learn, but to do. Not to follow, but to lead. Learning is valued when it is necessary to support doing, but the schooldays view of "learning for learning's sake" is viewed as a diversion. Further, in independent learning, the topics are chosen by the student, and proficiency is evaluated by the student, neither are done by the instructor.

To shift the perspective away from the classroom environment, to prepare students for lifelong, independent learning, here is a categorization of methods of learning:

Stage 1 – This is instructor-led learning, with generic testing is on trivial questions. There is a benefit to instructor-led learning. Novices don't know what they need to know, and they benefit from direction, close learning supervision, and detailed guidance about every step and concept.

There are several unfortunate aspects of the Stage 1 method. The idealization misdirects the learner's view of reality of an application. Further, when the school environment keeps students in the lower cognitive levels, by the time of college graduation, the system has progressively selected those who are fittest for this be-a-follower environment and low-level cognitive activity.

Once one has gained experience, self-directed learning is more efficient because it focuses on the learner's need of the topics and, also, on acquiring an adequate level of skill to meet the need. Instructor-directed learning is not bad, but it guided by someone else's perception of the appropriate topics; so, it diverts the learner's focus and attention away from their specific needs.

Stage 2 – At an intermediate learning stage, Stage 2, the learner has the fundamental basis, and only needs a brief an overview of the procedure. The learner has the knowledge to fill in the gaps. A brief training session to see if the learner can apply the procedure is all that is needed to be observed by the trainer. As an analogy, initial driver's education to the beginner is an extensive, multi-session, multi-concept, instructor-led training. That would be Stage 1. But, by the time you have bought your third car, all you need from the salesperson is a brief overview of how to operate it. That would be Stage 2. Certifications, in-house training, corporate universities, and short-courses could be classified as Stage 2 methods.

Stage 3 – At this stage, the self-learner learns in isolation, perhaps from books, monographs, webinars, professional magazine articles, white papers, or product bulletins. The learner, then self-tests for competence, and applies the methodology to offer a solution. Perhaps the boss asks other resident experts if the answer seems right. Mostly it is right, but nuance or context may be missing, or a small issue erroneously or incompletely learned. And feedback from the expert review will help the learner make appropriate learning and self-evaluation correction.

The self-learner progressively learns how to self-validate that the application is properly done and that the result is right within the context.

Stage 4 – Finally, the individual can create new procedures, grounded in fundamentals, meeting multiple objectives or an application context, and can defend the validity of the knowledge. Rather than learning what others have discovered, they create knowledge. We seek to raise graduate students to Stage 4, then reward them with a PhD when they get there. Industry also coaches employees toward this level of learning proficiency; and rewards them with senior technical position when they get there. The titles do not mean that they know everything, but that they know how to analyze and evaluate to achieve the right method or conclusion.

Table 2 summarizes the four stages.

Table 2 – Stages in Learning

Stage	Name	Description
1	Novice	Typical Classroom – Novices follow the instructor-led progression, and memorize and understand what they are told.
2	Training	Learner has the fundamentals to understand; but relies on an instructor to be the guide and certifier of competency.
3	Self-Learn	Independently read or watch, come to understand and be able to apply, self-test and decide when competent, final validation is by other experts.

4	Create New	Independently create new procedures, descriptions, equations, which are grounded in valid principles and validated with comprehensive tests.

A question is, how far along this progression of learning stages can colleges take engineering undergraduates? I don't think very far.

Notably, knowledge leads the professor's attention. That focus is about the science and fundamentals, and usually in an isolated context to permit defensible claims. This contrasts the application within complexity of engineering practice. The academic values of discovery and possibility are not those of the industrial environment of constrained application. Further, there are many new topics and fundamentals that students need to learn, and school necessarily needs safe and low-effort approaches for grading. So, it is expedient to keep students in the lower cognitive levels. Furthermore, the 17 to 20-year-olds have a much different life experience, perspective, professionalism, and maturity than a 40-year-old. We should not expect the undergraduate student, a novice in many aspects, to be able to work at the independent Stage 4 level. If they did, we would not need teachers to plan the courses or validate the student proficiency.

Neither can we expect colleges to be able to provide education far away from Level 1.

What about credentialing organizations that offer continuing education classes and training courses? This also is important, but this is Stage 2.

The post-classroom stages of professional learning are more aligned with a master-apprentice relation, and the coaching would be from the practice-grounded context-grounded supervisor. A schoolroom experience is fully capable the Stage 1 learning, and training courses for Stage 2 learning, but neither for lifelong learning.

The Message

The acquisition of advanced degrees and certifications is evidence of continued learning, which is good, and useful, but it keeps you in learning Stages 1 and 2, where you are dependent on others to shape your personal growth. You need to take charge of your progress.

School kept you in Stage 1 for about 18 years. You succeeded, and the comfort of returning "home" can be a strong pull. Stage 1 and 2 methods can be of value, appealing, and the collection of credentials image-boosting; but work to rise into Stage 3, then 4.

In our community, technical topics usually dominate the concepts of learning. At least as important to engineering effectiveness are the soft skills (communication, interpersonal, political, etc.). Seek to grow in all areas.

Use the Stage 1-4 model to monitor your own learning, and the Bloom's Taxonomy to monitor your level of cognitive activity. As you are doing things (at work, home, or play) observe what stage or level you are in. All are important. Just, don't stay in the lower stages and levels.

Coach your employees to move to Stage 3.

I placed an article in CONTROL magazine listing about 20 things to do to become your own teacher ("Self-Guided Learning", R. Russell Rhinehart, CONTROL, Vol. 30, No. 3, March 2017, pp 69-70). Use those suggestions as a DIY guide to develop your potential.

- - - - - - -

Russ Rhinehart started his career in the process industry. After 13 years and rising to engineering supervision, he transferred to a 31-year academic career. Now "retired", he enjoys coaching professionals through books, articles, short courses, and postings on his web site www.r3eda.com.