

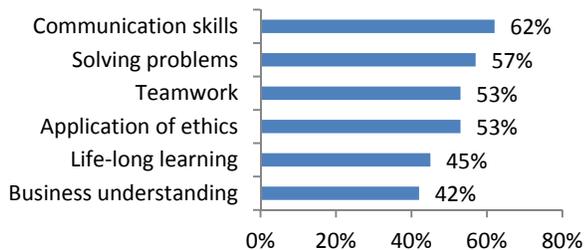
Lifelong Learning

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The data is compelling. Practicing engineers value lifelong learning skills. Meta-cognitive or reflective skills that are critical to being an effective, self-directed lifelong learner do not necessarily develop on their own. Instructors play a critical role in helping students develop the meta-cognitive skills that they need to succeed not only in college but also all through life.

Through the course of a four year NSF project, we interviewed over 140 engineers and conducted case studies of six engineering firms from varying industries. Over 2000 engineers or engineering graduates also responded to surveys. All of this data enabled us to draw conclusions about the ways of thinking, skills, values and identities of practicing engineers. This report on lifelong learning is one of a series of brief reports on ideas for further enhancing the connection between engineering courses and engineering practice.

What skills are essential in engineering work?



Lifelong learning ranks among the top five skills identified by engineers as essential in their work.

What is lifelong learning?

Lifelong learning is the continuous building of skills and knowledge throughout the life of an individual. In a lifelong learning model, people learn by doing – individually, in groups, and from each other. And they put learning into practice and reflect upon the learning. Instructors are guides encouraging students to acquire knowledge and reflect on their learning. Research shows that reflection and practice are necessary for deep learning. This level of meta-cognition – thinking about the process of knowing - is

one that instructors can help students to practice. That is, instructors can help students learn by asking them to think about their learning processes and reflect on what they experience.

Different types of knowledge

Instructors have a variety of opportunities to help students develop lifelong learning skills, in part, because learning operates on multiple levels:

- Recalling a fact, concept, or theory (declarative knowledge)
- Knowing how to apply it (procedural knowledge)
- Knowing when to apply it (contextual knowledge)
- Knowing why it is appropriate in a particular situation (conceptual knowledge).

In other words, you can know something at one level (recognize it) and still not know it (know how to use it).

Educational Options

As professionals move through their careers, they will direct their own learning. They will have multiple options – face-to-face, blended, and online. The University of Wisconsin – Madison, [Department of Engineering Professional Development](#) is the premier institution in continuing education for engineers. More than 10,000 students representing more than 5,000 businesses participated in 300 courses in 2012. Its Masters in Engineering Professional Practice was ranked **#1 for Online Engineering Education** by *US News and World Report*. Massive open online courses (MOOC) include [Kahn Academy](#), [Udacity](#), [Coursera](#), and [edX](#).

Share your passion for learning

Sharing your passion for learning with students is contagious. Teach them how to learn. Professional education neither begins nor ends in a classroom – it's a lifetime journey. [Learning is dynamic](#).

Instructional Principles

To help students become self-directed, lifelong learners, instructors should help students learn to

1. Assess the demands of the task,
2. Evaluate their own knowledge and skills,
3. Plan their approach,
4. Monitor their progress, and
5. Adjust their strategies as needed.

These key meta-cognitive skills are critical to being an effective lifelong learner ([Ambrose et al, 2010](#)). Research shows that students tend not to apply meta-cognitive skills as well or as often as they should. They need your support and significant practice.

Strategies

Research suggests strategies that work. The strategies below come from [Ambrose et al, 2010](#). Modeling and scaffolding are two general strategies that work well.

First, model your meta-cognitive processes: Show students how you would approach an assignment and walk them through the phases of your thinking process. Let them hear you “talk out loud.”

Second, scaffold students in their meta-cognitive processes. Give cognitive supports early and then gradually remove them as students develop greater mastery. Or move from tasks with considerable instructor-provided structure to tasks that require greater or even complete student autonomy.

Finally, make the development of meta-cognitive skills part of your course goals or learning outcomes. More specific strategies follow.

1. Be more explicit than you may think necessary.
2. Provide performance criteria with the assignment.
3. Make planning the central goal of an assignment.
4. Use peer reviews.
5. Have students do guided self-assessments.
6. Prompt students to analyze the effectiveness of their study skills.

7. Present multiple strategies that a task or problem can be conceptualized, represented, or solved.
8. Address students’ beliefs about learning.

The world changes quickly

Because the world changes quickly, the following learning activities will help ensure that students keep up-to-date and build lifelong learning skills:

- Refer to professional societies - their journals, student organizations, and websites.
- Design assignments that compel students to do literature reviews and secondary research. [Help with Research | Wendt Commons](#)
- Explicitly integrate complimentary skills including communication and teamwork.

“One reason for developing lifelong learning skills, particularly those associated with software, is that the world changes quickly and software you learn today may be gone in five years,” according to John D. Lee, Industrial and Systems Engineering, UW-Madison.

“The software was Adobe Catalyst and the first step was to identify a promising set of tutorials that could help them learn. One of the challenges of learning new material is finding the resources to learn that material efficiently. For Catalyst there are many video and textual tutorials, such as Lydia.com. In class we discussed the challenge of finding good tutorials. After students went through some introductory tutorials, they completed a series of assignments based on what they learned online. We discussed challenges they faced and strategies to search for solutions on-line.”

ACKNOWLEDGEMENT – Much of this information is adapted from Ambrose, et al, [How Learning Works – 7 Research-based Principles for Smart Teaching](#). We encourage you to review the entire book.

If you have questions or additions, contact [Teaching and Learning Services](#), Wendt Commons: tls@engr.wisc.edu. A digital version of this report can be found here: hplengr.engr.wisc.edu/resources.htm

