InFocus | Engineering as Knowledge-How

By Jon A. Schmidt, P.E., SECB

Four years ago in this space ("Engineering Knowledge," November 2007), I characterized the difference between engineering knowledge and scientific knowledge in terms of their goals – "knowing how" to accomplish something, as opposed to "knowing that" the universe operates in a particular way. Although I did not elaborate at the time, the scare quotes were deliberate, because the question of whether knowledge-how and knowledge-that are, in fact, two distinct types of knowledge has been hotly debated among philosophers over the last several decades.

Gilbert Ryle is widely credited with establishing the popular view that knowledge-how cannot be reduced to a form of knowledge-that. In a 1945 paper ("Knowing How and Knowing That," *Proceedings of the Aristotelian Society*, Vol. 46, pp. 1-16), Ryle argued that the contrary position – which he called "the intellectualist legend" – leads to a vicious regress. If every intelligent action (the exercise of knowledge-how) requires a previous contemplation of relevant propositions (the exercise of knowledge-that), then such contemplation itself – as an intelligent action – also requires a previous contemplation of relevant propositions, and so on to infinity. In other words, the intellectualist has it backwards – knowledge-how is logically prior to knowledge-that, because in order to obtain and use knowledge-that, one must first possess the knowledge-how to do so!

The most prominent attempt to rebut Ryle's thesis is a 2001 paper by Jason Stanley and Timothy Williamson ("Knowing How," *Journal of Philosophy*, Vol. 98, No. 8, pp. 411-444). They essentially claimed that sentences of the form "X knows how to Y" are equivalent to sentences of the form "X knows that Z is a way for X to Y." The success of their argument basically hinges on accepting the dubious notion that the content of knowledge-that need not be something that is capable of verbal expression. This is evident from their paradigm example:

> "Hannah knows how to ride a bicycle" is true relative to context if and only if, for some contextually relevant way *w* for Hannah to ride a bicycle, Hannah knows that *w* is a way for Hannah to ride a bicycle.

The authors offer no specific suggestions for what could possibly constitute *w*. Consequently, I do not find their analysis convincing, especially since it involves a considerable amount of qualification using various technical theories of syntactics, semantics, "propositional attitudes," and "modes of presentation."

Some additional contrasting concepts may help to clarify the matter further:

- Knowledge-that is theoretical; knowledge-how is practical.
- Knowledge-that is aimed at truth; knowledge-how is aimed at success.
- Knowledge-that is manifested in words; knowledge-how is manifested in actions.
- Someone who possesses knowledge-that is informed; someone who possesses knowledge-how is skilled.
- Someone who lacks knowledge-that is ignorant; someone who lacks knowledge-how is incompetent.

This suggests, again, that engineering knowledge is largely knowledge-how, rather than knowledge-that. A 2010 paper by Julie Gainsburg, Carlos Rodriguez-Lluesma, and Diane E. Bailey ("A 'Knowledge Profile' of an Engineering Occupation: Temporal Patterns in the Use of Engineering Knowledge," *Engineering Studies*, Vol. 2, No. 3, pp. 197-219) would seem to confirm this. It reported that at least two-thirds of the knowledge used by structural engineers on a daily basis is "practice-generated" rather than "historically established"; i.e., gained by means of experience instead of formal education or reference materials. Although the authors focused on how engineering knowledge is acquired, I think that their findings also reflect the fundamental difference in nature between knowledge-how and knowledge-that.

This explains why new graduates are not allowed to sit for a professional engineering licensure examination right away. If the test is truly going to assess someone's competence, and not just gauge the amount of information that each candidate has accumulated, then it has to cover the kind of knowledge-how that only comes from experience. Essay problems are more conducive to this than multiple-choice questions, and it is unfortunate that the various exams administered by the National Council of Examiners for Engineering and Surveying (NCEES) – except, of course, for the new 16-hour Structural one – have been converted entirely to the latter in recent years.

The predominance of knowledge-how in engineering also has ethical implications. As I have discussed previously ("Rethinking Engineering Ethics," November 2010; "Engineering Ethics as Virtue Ethics," May 2011), the traditional approaches to engineering ethics tend to be deontological (rule-, duty-, or obligation-based) or consequentialist (outcome-based); that is, grounded in knowledge-that of universal principles. By contrast, virtue ethics is character-based; that is, grounded in knowledge-how to behave properly, which may vary depending on the context. Instead of following a deterministic algorithm, a virtuous individual exhibits good judgment, navigating each unique situation as it arises and making decisions in the midst of uncertainty.

Anyone who has been reading my "InFocus" columns over the years knows that this is precisely how I have repeatedly characterized the practice of engineering. Knowledge-that is a necessary and important foundation for every engineer, but knowledge-how is integral to what we do on a daily basis for our clients and the general public.▪

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Remember the Hyatt

As discussed in the January 2011 issue, this year marks the 30th anniversary of the deadliest structural engineering failure in United States history. A non-profit organization is currently raising funds for a permanent memorial to honor those killed and injured by the collapse of the skywalks at the Hyatt Regency hotel in Kansas City, Missouri on July 17, 1981. The Skywalk Memorial Foundation needs roughly $400,000 to cover design and construction. Generous financial assistance from the nation's structural engineering community would highlight the crucial role that we play in modern society and the importance of taking further steps to reduce the likelihood of a similar disaster in the future. To learn more about the project and to make your tax-deductible donation before the end of the year, please visit **www.skywalkmemorial.org**.