Abstract - Research shows that novices and experts organize knowledge very differently. Experts may make huge leaps up an educational ladder of inference and often forget how to explain the reasoning process through which they arrived at their complex, deep understandings. Shortcuts become invisible. In an educational setting, this phenomenon is called “curse of knowledge.” It describes how being an expert in something may make it more difficult to infer what a novice requires in order to develop a deep, working knowledge of engineering and scientific content.

In the paper, the authors explore potential faculty development strategies to increase awareness of the “curse of knowledge” and offer approaches through which faculty can use their expertise for effective teaching. Several approaches are offered: (i) principles to make messages sticky, (ii) developing more reflective approaches to understanding learning and teaching, (iii) encouraging construction of teaching portfolios, and (iv) ascertaining knowledge that students have at the beginning and throughout a course.

Index Terms – Faculty development, curse of knowledge, prior knowledge, novice/expert.

INTRODUCTION

Engineering and science faculty members are widely recognized for their outstanding expertise in their discipline, yet questions about the efficacy of engineering and science education have been raised in many forums. In attempting to improve engineering and science education, at least two potential reasons have been offered as partial explanations for this phenomenon:

- Lack of education and experience in teaching, especially for newer faculty members [1,2]
- Greater interest in research than teaching [3]

Faculty development professionals, who work with faculty members to improve their teaching, must sift through these and other potential reasons to identify productive avenues for creating faculty development programs. In addition to the potential reasons listed above, Wieman [4] has suggested that the curse of knowledge may be another reason that makes teaching challenging for these experts in engineering and science. Wieman describes the curse of knowledge as “the idea that when you know something, it is extremely difficult to think about it from the perspective of someone who does not know it.” The “curse of knowledge” is one example of the important role that prior knowledge plays in learning and teaching [5,6]. A number of practices reflect the importance of prior knowledge including pre-tests and concept inventories. Related to this area is the recognition of differences between how novices and experts approach learning.

In this paper, we explore what is known about the curse of knowledge. Then, in the following section, we offer faculty development approaches for addressing this phenomenon.

THE CURSE OF KNOWLEDGE

The “curse of knowledge” is the difficulty that results from knowing something. It is the “knowing” of something that makes it difficult to “readily re-create” the state of mind of not knowing [6]. Faculty members will sometimes describe this challenge by noting how difficult it is to respond to introductory level questions from students when they (the faculty member) are constantly operating at a more sophisticated level in the discipline.

Camerer, Loewenstein, and Weber [7] coined the term “curse of knowledge” to counter the “conventional assumption in such [economic] analyses of asymmetric information is that better-informed agents can accurately anticipate the judgments of less-informed agents.” A classic example of this problem asks subjects to “tap” out well known songs with their fingers and then try to predict how many of these “tapped” melodies will be recognized by listeners. “Tappers” always overestimate - because they are so familiar with what they are tapping, they assume listeners will easily recognize the tune [8]. In a study by Hinds, she showed that “those with more expertise were worse predictors of novice performance times and were resistant to debiasing techniques intended to reduce underestimation” [9]. Birch suggests that there “are important similarities between curse-of-knowledge findings with adults and the false-belief findings with children” [10]. An example of a false-belief limitation in children can be demonstrated by posing the following scenario to a child: A person, Marge, leaves her keys on the kitchen table and goes outside to work in the yard. Her husband, Steve, while cleaning, moves the keys to the key rack. When Marge returns, where does she look for the keys? Children younger than 4 think Marge will look at the key rack [10]. Wieman points out similar results are seen in science education – “students actually express disbelief that anyone could hold a certain misconception, yet we had seen those same students actually express this very misconception themselves, just a few months earlier!” He also mentions brain imaging studies that show the brains of “novices” and “experts” respond differently to problems. The point of this section is that research in various fields has
shown experts with their greater knowledge inaccurately predict the performance and behaviors of novices. In fact the “curse of knowledge” is connected with a wider range of biases. Wieman goes further, “I would argue that well intentioned physicists are achieving poor educational results because the “curse of knowledge” makes it very difficult for them to understand how physics is best learned by a novice student, or to accurately evaluate that learning,” and “it is dangerous and often profoundly incorrect to think about student learning based on what appears best to faculty members, as opposed to what has been verified with students” [3].

**FACULTY DEVELOPMENT APPROACHES FOR THE CURSE OF KNOWLEDGE**

The role of prior knowledge and novice/expert thinking in faculty professional development is not well understood for several reasons. First, faculty development professionals may assume that because faculty members are expert in their discipline, then they are well equipped to communicate material in their field of expertise. As a result, little attention has been given to the potential challenges presented by expertise. If challenges are encountered, the particular challenge is responded to individually rather than holistically. Second, faculty development professionals may be unfamiliar with research on the “curse of knowledge” and related phenomena and have not applied this research to development of strategies and activities for faculty members. Third, because faculty professional development activities are largely voluntary, there is no mandatory tracking or rating of such development activities that might yield information related to the “curse of knowledge.”

The curse of knowledge presents a paradox for faculty development. In one respect, expertise and the path to expertise. If challenges are encountered, the particular challenge is responded to individually rather than holistically. Second, faculty development professionals may be unfamiliar with research on the “curse of knowledge” and related phenomena and have not applied this research to development of strategies and activities for faculty members. Third, because faculty professional development activities are largely voluntary, there is no mandatory tracking or rating of such development activities that might yield information related to the “curse of knowledge.”

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**APPROACH NO. 1: STICKY STORIES**

Heath and Heath [6] believe that there is a solution to the curse of knowledge – and that is to transform ideas to make it more likely that novices can grasp them. They recommend attention to six principles to overcome the effects of the curse of knowledge:

- **Simplicity** – “To strip an idea down to it core, we must be masters of exclusion. We must relentlessly prioritize.” Sound bites – no. Proverbs – yes [6, p. 16].
- **Concreteness** – “Speaking concretely is the only way to ensure that our idea will mean the same thing to everyone in our audience” [6, p. 17].
- **Credibility** – “We need ways to help people test our ideas for themselves-a ‘try before you buy’ philosophy for the world of ideas” [6, p. 17].
- **Emotions** – “We are wired to feel things for people, not abstractions” [6, p. 18]. In “Time to Think,” Kline points out the need to respect feelings, “allowing sufficient emotional release to restore thinking” [13, p. 35].
- **Unexpectedness** – “We can engage people’s curiosity over a long period of time by systematically ‘opening gaps’ in their knowledge-and then filling those gaps” [6, p. 16]. For most experts, it is curiosity related to the discipline that engaged them. Because they are curious, it may be more difficult for them to remember and understand how to provoke curiosity on the part of their students. As a first step, they have to step beyond a mindset that because they are now curious about their content, their students will be also. Sharing opportunities for curiosity is critical to engaging novices.
- **Credibility** – “We need ways to help people test our ideas for themselves-a ‘try before you buy’ philosophy for the world of ideas” [6, p. 17]. For example, various pedagogical approaches, e.g., problem-based learning, inquiry-based learning, project-based learning, and challenge-based learning, advocate starting with a question, problem, or challenge that may intrigue learners [12]. If learners become engaged by the problem, question, or challenge, they may want to learn more about content which they could use to address the situation posed by the teacher. Research has provided evidence to support the efficacy of these context-first approaches [12].
Stories – “Research shows that mentally rehearsing a situation helps us perform better when we encounter the situation in the physical environment. Similarly, hearing stories acts as a kind of mental flight simulator, preparing us to respond more quickly and effectively” [6, p. 18]. Stories also assist with the issue of relevance by demonstrating how content matters in the real world. They help to make content more personal – more accessible – to learners. Stories also are powerful memory aids.

At Texas A&M University, members of the Center for Teaching Excellence have offered workshops on developing effective lectures. Workshop facilitators ask faculty members to try tapping melodies to determine whether colleagues can recognize the melody. They present principles of sticky stories and ask workshop participants to apply these principles to constructing a lecture in their courses. Participant response to the lecturing well workshops has been very positive.

**APPROACH NO. 2: REFLECTION, RECOGNITION, REDUNDANCY**

Just telling faculty members about the “curse of knowledge” and reminding them that they may have difficulty in predicting what knowledge, concepts, and skills novices will need to master the master and what faculty members can do to help novices develop may not be sufficient to bring about a change in teaching practices on the part of faculty members. Just like other learners, faculty members could hear about the “curse of knowledge,” but suffer from “illusion of comprehension” [14]. That is, a faculty member may think they understand how to address the “curse on knowledge” in their teaching, but be unable to apply it. For example, experts may forget the amount of repetition [15] and the steps that helped them construct new knowledge. They may also discount the significance of experiencing error in the learning process. Working at a more sophisticated level means that they may skip steps without realizing it. For these reasons, faculty development opportunities are enhanced when they encourage faculty members to reflect on the knowledge in their discipline, recognize where they may be skipping steps in communicating with students, and think about multiple approaches for making content accessible to students.

One approach for promoting reflection among faculty members has been called “Decoding the Disciplines” [16]. In this approach, the starting point is to ask faculty members to think about a particular portion of a course (e.g., a concept, technique, or procedure) that has been especially difficult for students in the course to learn. Next, instead of immediately asking faculty members to think about how an expert addresses this difficult task. At this point, the approach asks faculty members to think about how an expert addresses this difficult task. At this point, the approach asks an expert to do something experts are well qualified to do: Think about how an expert accomplishes a task. With that step complete, the approach now asks the expert faculty member to consider how the expert’s approach might be modeled for learners. Although it is possible for experts to be tripped by their “curse of knowledge”, the modeling step does not ask experts to tell someone how to do something. Instead, the modeling step asks experts how to demonstrate the expert’s approach, i.e., how could the expert let a classroom full of learners see her/his thought process? This approach to promote reflection on the part of faculty members may help them apply their understanding of the “curse of knowledge” to their teaching. Another approach to promote reflection would be to start by asking faculty members what a well-prepared lecture does well and what weaknesses it has that could be addressed in other ways. A well-prepared lecture is typically designed to deliver content rather that encourage curiosity or provide opportunities for students to test or apply information presented – making it their own. Further, it may present a topic from a single perspective rather than providing multiple ways to grasp content. Because student engagement is critical to avoid the “illusion of comprehension” and promote learning, inspiring curiosity and providing opportunities for ownership of information are critical to the learning process. As a result, inspiring curiosity and encouraging ownership may require different teaching strategies.

**APPROACH NO. 3: PORTFOLIOS**

A third approach to faculty development opportunities intended to address the “curse of knowledge” would be teaching portfolios [17]. For the purpose of this paper, teaching portfolios include specialized course [18] or scholarship of teaching and learning portfolios. These can provide a structure and process for faculty members to consolidate their thinking about their approach to teaching, results on student learning outcomes, and continuous improvement. These documents are best when produced with help of a mentor who can ask questions that help clarify information presented.

Because they are intended to be relatively short documents that contain a good deal of information, simplicity and concreteness are keys to successful portfolios. The recommended process of reflection and mentor feedback helps produce documents that are clear and concise in their expression of faculty goals for student learning and their assessment of degree of success. The portfolio provides a roadmap describing the development of faculty member as teacher and a benchmark from which to move forward on attainment of student learning outcomes. Portfolios encourage attention to detail that can help balance the impact of the curse of knowledge.

**APPROACH NO. 4: EXPANDING STUDENT FEEDBACK**

Student feedback collected at the end of a course does not assist the instructor in the class in which it is collected and may not be returned in a timely manner to assist with course preparation for the following semester. Many faculty members engaging in faculty professional development choose to participate in mid-semester evaluation or use more
frequent evaluation tools such as the one-minute paper [19-21] to collect student feedback.

Expanded student feedback connects well to two recommended responses to the curse of knowledge – emotions and stories. Faculty members may like an idea they recommended responses to the curse of knowledge – 21] to collect student feedback.

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**Conclusions**

This paper has described the “curse of knowledge” as one impediment in the quest of faculty members to design meaningful learning opportunities for students. The concept suggests that the greatest strength that faculty members have – their expertise – can also function as their greatest weakness in facilitating learning. Faculty professional development programming can help faculty overcome this potential barrier. Suggested strategies included encouraging utilization of principles to make messages sticky, developing more reflective approaches to understanding learning and teaching, encouraging construction of teaching portfolios, and ascertaining knowledge that students have at the beginning and throughout a course.

**References**


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