of learning retention, observing of a zoology course that “students lost information on animal parts, technical terms, and structures, but the ability to interpret and apply suffered almost no loss at the end of 15 months” (Semb & Ellis, p. 268). Somewhat ominously, Conway, Cohen, and Stanhope (1992) take the opposite position.

“Our findings suggest that the integrative conceptual links necessary for understanding are lost, and what remains in memory is fragmentary and unrelated knowledge of specific details and general concepts. Maybe this is one of the reasons why former students so often remark that they know nothing of a knowledge domain they once knew to an expert level: it is not that they do not have knowledge of the domain, but rather that they no longer understand that knowledge.” (Conway, Cohen, & Stanhope, p. 474)

Arguing for the adoption of distributed practice to counteract the fact that “newly acquired information is vulnerable and easily slips away,” Robert Lindsey and his colleagues identify grades as a disincentive for long-term learning. “The reward structure of academic programs,” they say, “seldom provides an incentive to methodically revisit previously learned material.” Consequently, a focus on grades “is costly for the long-term goal of maintaining accessibility of knowledge and skills” (Lindsey, Shroyer, Pashler, & Mozer, 2014, p. 1).

Much as other researchers have done, I studied patterns of long-term learning and forgetting using a cross-sectional design, identifying students who had completed the classes under study one, two, three, four, five, and six semesters previously. This allowed me to collect two years of evidence in one round of testing. However, a cross-sectional design has drawbacks. Most significantly, I can only speak about the loss of learning over time generally, since the semester-by-semester groups are proxies for individual students.

Aware that I had an imperfect design but in the belief that the project could, nonetheless, meaningfully address the three questions listed above, I invited a group of department chairs and course leads to participate in the project. Five chairs and/or course leads accepted the invitation. The courses represented by this group were Biology 264, Biology 265, Health Science 280, and Sociology 105. The department chairs or course leads then provided objective multiple-choice questions from common final exams or based on shared outcomes. Importantly, all of these courses have face-
to-face (F2F) and online sections. Students from both the online and the F2F groups were invited to participate. With the generous assistance of Scott Bergstrom, I distributed email invitations to 1,870 students who had completed these courses in the prior six semesters. From that group, 247 students opened the survey and a total of 216 completed it. No students who had taken the courses in Fall 2014, the +1 semester, participated in the study.

BIO 264: Human Anatomy and Physiology 1  
Face-to-Face n = 40; Online n = 10  
BIO 265: Human Anatomy and Physiology 2  
Face-to-Face n = 57; Online n = 5  
HS 280: Medical Terminology  
Face-to-Face n = 4; Online n = 38  
SOC 111: Introduction to Sociology  
Face-to-Face n = 37; Online n = 25

Students who took any additional courses in related fields within the six-semester window of the study were excluded from the study. So, while BIO 265 students took BIO 264 before participating since it is a prerequisite course, they were excluded if they had taken additional Biology courses. Similarly, students who took HS 280 were excluded if they subsequently had taken course that might reinforce that learning and SOC 111 students were excluded if they had taken additional courses in Sociology. Additionally, students were only invited to participate in one survey even if they were eligible for more than one. My working hypothesis was that the study would produce a steep forgetting curve. I was overly pessimistic. I did find evidence that our students forget too much too soon, but the rate of forgetting is not as steep as I had anticipated.

The first chart shows overall retention of learning (F2F and online). All courses show a substantial drop from two to three semesters after instruction. BIO 265 and SOC 111 rise slightly in the fourth semester. After dropping off sharply in the fifth semester, SOC 111 again rises six semesters after instruction as does HS 280. This “improvement” is not evidence that students remember more as time passes but is, rather, a weakness of the cross-sectional design. What looks like improvement is much more likely to be evidence that the students who took the course in that semester were a stronger group.
I take the fact that the bulk of the scores are between 64% and 40% as a strong indication that our students forget too much too soon. I hasten to remind the reader that the participants earned A, A-, or B+ credit in the four courses no more than six semesters prior to the study. If, as Conway, Cohen, and Stanhope assert (1992), “better students retain more than poorer students” (Conway, et al., p. 479), what are we to infer regarding the retention of the students who earned passing grades below the B+ level?

Distributed practice, a well-established principle in psychological literature, is one way to reduce the rate of forgetting. Distributed practice is spacing the intervals between study sessions as opposed to massing the study or practice. In a review article summarizing hundreds of studies of different uses of distributed practice, researchers found: “[T]o remember something for 1 week, learning episodes should be spaced 12 to 24 hours apart; to remember something for 5 years, the learning episodes should be spaced 6 to 12 months apart. Of course, when students are preparing for examinations, the degree to which they can space their study may be limited, but the longest intervals (e.g., intervals of 1 month or more) may be ideal for cumulative examinations or achievement tests that assess the knowledge students have gained across several years of education.” (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013, p. 37)

I believe that we need to get out of the habit of thinking of learning for the short-term: a quiz next week and a final exam coming up in a month. Greater retention of learning and greater educational quality will follow as we learn to think in terms of remembering and using learned material five, ten and even more years in the future.

Researchers have recently shown that “integrating personalized-review software into the classroom yields appreciable improvement in long-term educational outcomes” (Lindsey et al, 2014, p. 5). If we will imagine our influence extending beyond the semester, perhaps we can imagine an educative assessment program that uses distributed practice to promote long-lasting learning.

Imagine a system that asks students to return to key outcomes and core principles from Foundations, for example, but with increasing disciplinary sophistication. Imagine an invitation that appears in I-Learn or in the Testing Center software inviting a junior to review principles from the Foundations of Science and International Foundations courses she took as a freshman. Imagine a senior who receives a similar invitation to describe how principles from the Teachings of the Living Prophets course he took in his second year connect to the psychology seminar he took last semester.

Given the gaps in the data, the erratic rates of participation, and the limited range of courses included in this project, I can only generalize from my findings at some peril. However, all the data seem to align in support of one conclusion: our students forget too much, too soon. I encourage curriculum, assessment, and academic leaders to think of learning quality not just in terms of the
currency of and the fluency in what is learned but also in terms of what is retained beyond the horizon of the semester. I hope that the findings presented here inspire more insightful questions, better methods, and additional inquiry into the rate of learning loss and more importantly, into ways to slow forgetting and enhance retention.

References


