

1. Summary of What I Have Learned

For students to effectively learn new knowledge, instructors are able to utilize various approaches based on cognitive science. In particular, the approaches help students enhance their memorizing knowledge given by the instructors. Willingham [1] suggested the three principles of memory leveraging cognitive science. First, “*Memories are formed as a residue of thought.*” It means that students become effective in memorizing knowledge when they can devote most of their attention and thought to it. Second, “*Memories are lost mostly due to missing or ambiguous cues.*” Accordingly, in order to minimize forgetting, instructors should establish specific and distinctive cues that enable students to categorize and bring back their memory. Third, “*Individuals’ assessments of their own knowledge are fallible.*” In other words, students are underestimating the required efforts to memorize new knowledge. Thus, instructors should provide them with a way to exactly assess their knowledge.

In addition to the creation and maintenance of memory, instructors can support students to improve their learning performance by employing prior knowledge that is activated, sufficient, appropriate, and accurate [2]. To do that, instructors should provide students with methods or guidance to activate relevant prior knowledge, address gaps, avoid applying prior knowledge in the wrong context, and revise inaccurate knowledge. Another key to improving students’ learning performance is knowledge, which they have learned, organizations that include more interconnections and are based on deep and meaningful features [2]. Instructors should supervise students’ knowledge organizations and help them structure proper knowledge organizations.

If students are able to leverage prior knowledge to obtain new knowledge and properly organize the newly learned knowledge, they should move on to the next stage: Mastery. To

develop mastery, they should have a set of component skills, practice combining and integrating these components to develop greater fluency and automaticity, and then understand the conditions and contexts in which they can apply what they have learned [2]. Ambrose et al. [2] emphasized that instructors should reflect on these elements of mastery when they plan their course and prepare teaching tools and methods.

2. How to Apply Knowledge about Learning in My Discipline

Building Construction is a discipline in which students learn construction technology, construction materials and methods, and construction management including cost, schedule, safety, and process management. It requires students to understand fundamental knowledge on the construction process as well as to integrate the obtained knowledge to apply it in real construction projects.

In the fundamental level courses, such as *Construction Materials and Methods* and *Construction Plans and Estimates*, and *Construction Management*, Willingham's three principles of memory can be mainly leveraged to help students memorize the terms used in the construction field and the fundamental mechanism of the construction process. However, in the capstone- and graduate-level courses, the students should integrate and apply the knowledge acquired from the fundamental courses to resolve the project-wide problems. Thus, the instructor should examine students' prior knowledge is correct and sufficient as well as provide knowledge organizations that enable students to interconnect the fundamental knowledge. Some strategies provided by Ambrose et al. [2] can be employed. In particular, the graduate-level courses involve some students who have industrial experiences as prior knowledge. In this setting, the instructor should try to align the experiences with the academic knowledge given from the courses. Finally, when the instructor designs the high-level courses, he/she should consider how to expose and reinforce students' component skills and knowledge; how

to build fluency and facilitate the integration of the skills and knowledge; and how to facilitate transfer the skills and knowledge into applications.

3. Reference

1. Willingham, D.T., *What will improve a student's memory*. American Educator, 2008. **32**(4): p. 17-25.
2. Ambrose, S.A., et al., *How learning works: Seven research-based principles for smart teaching*. 2010: John Wiley & Sons.