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# Supporting Students' Skillful Learning: Lessons Learned from a Faculty Development Workshop

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Patrick Cunningham is a Professor of Mechanical Engineering at Rose-Hulman Institute of Technology. His professional development is focused on researching and promoting metacognition, self-regulated learning, and reflection among students and faculty in Engineering Education. Dr. Cunningham has been a PI/Co-PI on two NSF-funded grants and led Rose-Hulman's participation in the Consortium to Promote Reflection in Engineering Education (CPREE). He is also a regular contributor to the Improve with Metacognition blog. Dr. Cunningham teaches a range of courses across undergraduate levels with specialization in dynamic systems, measurement, and control. In his teaching he seeks to apply what he has learned from his research, spurring student reflection and metacognitive growth, so that they may become more skillful learners. Skillful learners are capable, independent, and adaptable thinkers who are able to succeed wherever their career paths lead. Dr. Cunningham has industry experience through 7 co-op experiences as an undergraduate student, 2 sponsored projects as a graduate student, and as a consultant after joining the faculty at Rose-Hulman. He holds B.S., M.S., and Ph.D. degrees in Mechanical Engineering from Purdue University and was an NSF Graduate Research Fellowship recipient.

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Dr. Holly M. Matusovich is an Professor in the Department of Engineering Education. She is current the Assistant Department Head for Undergraduate Programs and the former Assistant Department Head for Graduate Programs in Virginia Tech's Department of Engineering Education. Dr. Matusovich is recognized for her research and practice related to graduate student mentoring. She won the Hokie Supervisor Spotlight Award in 2014, was nominated for a Graduate Advising Award in 2015, and won the 2018 Graduate Student Mentor Award for the College of Engineering. Dr. Matusovich has graduated 10 doctoral students since starting her research program in Spring 2009. Dr. Matusovich co-hosts the Dissertation Institute, a one-week workshop each summer funded by NSF, to help underrepresented students develop the skills and writing habits to complete doctorate degrees in engineering. Across all of her research avenues, Dr. Matusovich has been a PI/Co-PI on 12 funded research projects including the NSF CAREER Award with her share of funding nearly $2.3 million. She has co-authored 2 book chapters, 21 journal publications and more than 70 conference papers. She has won several Virginia Tech awards including a Dean's Award for Outstanding New Faculty, an Outstanding Teacher Award and a Faculty Fellow Award. She holds a B.S. in Chemical Engineering from Cornell University, an M.S. in Materials Science from the University of Connecticut and a Ph.D. in Engineering Education from Purdue University.

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Cheryl Carrico is owner of E4S, LLC. Her current research focus relates to STEM career pathways (K-12 through early career) and conceptual understanding of core engineering principles. She is currently a Member-at-Large for the Pre-college Division of ASEE. Dr. Carrico's consulting company specializes in research, research evaluations, and industry consulting. Dr. Carrico received her B.S. in chemical engineering from Virginia Tech, Masters of Engineering from North Carolina State University, MBA from King University, and PhD in Engineering Education from Virginia Tech. Dr. Carrico is a certified project management professional (PMP) and licensed professional engineer (P.E.).

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Rachel McCord Ellestad is a a Lecturer and Research Assistant Professor in the Engineering Fundamentals Division at the University of Tennessee in Knoxville. She received her Ph.D. in Engineering Education from Virginia Tech. Her research interests include the impact of metacognitive and self-regulated learning development on engineering student success, particularly in the first year.

**Dr. Stacy Tantum, Duke University**

Stacy Tantum received the B.S. in Electrical Engineering and Economics from Tufts University in 1994, and the M.S. and Ph.D. degrees in Electrical Engineering from Duke University in 1996 and 1998, respectively. She is currently an Associate Professor of the Practice in the Electrical & Computer Engineering Department at Duke University. Her research interests include statistical signal processing with applications in the areas of machine learning for efficient sparse model inversion and marine mammal ocean acoustic signal processing, and engagement and retention in engineering education.

**Dr. Sophia T. Santillan, Duke University**

Sophia Santillan joined Duke as an assistant professor of the practice in summer 2017. As a STEM educator, she is interested in the effect of emerging technology and research on student learning and classroom practice. After earning her bachelor's, master's, and doctoral degrees from Duke, Santillan taught at the United States Naval Academy as an assistant professor and at the high school level, where she taught across the four-year math curriculum, including advanced courses. She also designed, proposed, and taught two introductory engineering courses for high school students. She currently leads an interdisciplinary initiative to improve girls' and women's math/STEM identity using a social identity framework and a problem-based learning approach.

**Dr. Rebecca Simmons, Duke University**

Rebecca Simmons is an Associate Professor of the Practice in the Department of Mechanical Engineering and Materials Science at Duke University. She arrived as a freshman to Duke in 1996 and has never left; she completed both her B.S.E and Ph.D. in Mechanical Engineering and Material Sciences. She teaches a variety of design courses and is passionate about helping her students build creative confidence, think outside of the box, and design their life with personal metrics of success. She hosts a podcast called This Engineering Life, the undergraduate series.

# Supporting Students Skillful Learning: Lessons Learned From a Faculty Development Workshop


## Abstract

We describe the implementation of an on-campus workshop focused on supporting faculty as they develop metacognitive interventions for their educational contexts. This on-campus workshop at Duke University included engineering faculty as well as other faculty from other departments on campus and was developed and presented by members of the Skillful Learning Institute. Perspectives of the hosts and the presenters provide a more complete view of the purpose, context and logistics, and lessons learned for faculty workshops. Two prominent lessons for such workshops in general emerged related to making the ideas and information more easily assimilated: the need for more concrete and varied examples and the need for more time to process ideas and activities.


## Introduction

This Lessons Learned paper in lightning talk format focuses on describing our experience running a workshop for supporting faculty development in metacognition instruction. While important, this paper does not focus on describing specific metacognitive interventions but instead focuses on strategies for providing faculty development through on-campus workshops. Outcomes of this lessons learned paper should benefit those faculty and administrators looking to provide development opportunities for faculty and staff at their institutions. Additional information on metacognition and specific interventions can be found here: https://skillful-learning.org/ .

Metacognition, knowing about and regulating our thinking processes, is a key skill for learning more effectively and efficiently, in academia, as a professional, and throughout life [1]. It can be developed with focused instruction, practice, and feedback [2]. Few engineering educators have training or expertise in pedagogy [3], let alone facilitating students' metacognitive growth, *i.e.*, the development of their learning skills. However, understanding learning processes and helping others become more skillful learners require development of new knowledge and abilities. The workshop was designed to help educators at Duke University translate knowledge to practice. It also provided a learning opportunity for the presenters to refine plans and materials for the Skillful Learning Institute (SLI), an NSF sponsored virtual short course for educators. Herein, we provide perspectives of the host site and the presenters. By providing the two perspectives, our lessons learned are enriched and should help those who invite speakers in for faculty development and those who are creating faculty development activities. Hosted before the pandemic, the workshop design consisted of an initial virtual session, a two day in-person workshop, and a follow-up virtual session.

## Purpose of Workshop

*Host Site Motivation.* A formalized group of faculty in the engineering school at Duke University meets regularly with the goals of building a community of engineering faculty focused around education and collaboratively supporting each other in efforts to improve courses as well as mentoring of independent study projects or extracurricular student groups. One of the group's initiatives to support these goals is hosting an on-campus, education-focused workshop annually, in which the group invites leaders in education research to share their findings and

recommendations. The faculty group selected metacognition as the focus of the first workshop, as it directly relates to both helping students improve their self-assessment of their learning and supporting faculty in their efforts to facilitate effective learning.

*Workshop Development Team Motivation.* Our driving motivation for developing this workshop was to build engineering educators' capacities to engage students in constructive metacognitive activity. It also provided an opportunity to develop and refine new materials for an NSF grant where we will offer virtual training to a broader range of engineering educators. In our prior work, we recognized the need to develop educators' capacities beyond just using our materials. Our expanded focus is to equip engineering educators to be able to construct meaningful activities that prompt students' metacognitive activity and awareness along with models for how to interact with students about their learning processes. This focus on educator development drove choices for significant time allocated for reflection and guided practice.

**Structure of workshop**

*Pre-workshop Virtual Session.* We conducted a one-hour virtual session with participants with the purpose of providing a theoretical overview of metacognition, to gather information on participants' metacognition backgrounds and potential goals they might have for the two day workshop.

*In-Person Sessions:* Day 1 focused on taking participants step by step through the Backwards Design Process in three steps: Learning Objectives, Acceptable Evidence, and Activity Plans [4]. For each step, we provided an overview of the importance of the step, an example of the step in action, working time for participants, and a short debrief and share time with the larger group. To support this work, we developed an activity planning document that participants could use to track their progress through the Backwards Design process (see Appendix). On Day 2, after reviewing feedback and discussing with our team, we decided to start off with a more thorough example of using the Activity Planning Document to develop a metacognitive intervention for a classroom context. We started with a problem identified by one of the workshop hosts, helping students engage in learning more before an assignment. We went through each step of the planning document to provide participants with a concrete example of how to apply the process. We then provided work time. This allowed us to circulate around the room and spend one-on-one time with participants to answer questions and give feedback. After the working time, we reviewed tips and tricks we had learned about conducting metacognitive interventions from previous research, including where to plan interventions and how to view metacognitive development as an iterative process. To further support participants, we reviewed a method for providing meaningful feedback to students on the learning process. We ended our session with the participants by discussing readiness for change and how this can help direct their interactions with students.

*Follow-up Virtual Session.* We held a virtual follow-up meeting to share progress on the implementations developed during the in person sessions as well as to provide space for questions from participants. We used an assessment survey to gather questions, points of clarification, and challenges participants may have after attempting implementations for discussion.

**Workshop Context and Logistics**

The workshop required resources on the part of the host institution and SLI. In terms of financial and material resources, the host institution funded travel for most of the team, with the SLI team also contributing some financial resources to enable bringing the whole team. This was mutually beneficial as the host school had more engagement with the team and SLI had opportunities to refine our craft. Material resources included copies of the workbooks participants used during the activities mostly brought by SLI and a physical space for the workshop with presentation capacity provided by the host school. The host school also provided lunch for workshop participants as well as working meals for SLI and host school participants. In terms of time resources, two phases of the workshop were scheduled outside of the host institution's semesters to minimize conflicts due to class schedules. A pre-workshop virtual session was held shortly after the conclusion of the fall semester, and the in-person sessions were held the two days prior to the start of the spring semester. This timing not only made the workshops more accessible by scheduling them such that class schedules would not preclude participation, but it also afforded participants an opportunity to contemplate and assimilate the ideas behind metacognition prior to the in-person sessions during which they would reflect and engage in guided practice.

**Lessons learned from faculty development perspective**

In meeting our purpose of describing our collective experience and lessons learned through offering this workshop, we have three key recommendations for faculty developers attempting to design workshops on complex topics such as metacognition:

*Plan for the time it takes to understand, process, and apply - to assimilate - new concepts for teaching and learning, even when educators are motivated to do so.* The pre-workshop virtual session one-month ahead of and the guided worktimes during the workshop were built in for this purpose, but it is easy to underestimate the time and support needed for this. Although we anticipated that participants would leave the workshop with lessons or activities nearly ready for classroom use, the workshop time was just insufficient for introducing content and having participants engage with that content as thoroughly as we desired. Moreover, spacing the material out over time, e.g., 1-2 weeks in between workshop segments, could enable more thorough processing and reflection between each step and between creation of the activity and discussing interacting with students through the implementation of the activity.

*Introduce the backwards design element and general intended flow of the workshop prior to the workshop and include examples.* Knowing the key organizing element for the workshop (backward design model) and flow would help participants know what to expect and scope their goals to align with the elements of the workshop. A few detailed examples of the backwards design activities would also help educators assimilate new concepts. More and varied examples, for varied contexts and course types, that are better integrated into the earlier instruction would have been helpful.

*More is not always better.* Although we leveraged parts of existing workshops, we added some new content we believed to be important for constructively engaging students in their metacognitive growth. An example of this was our discussion on student readiness for change. This is an important topic when we discuss changing learning behaviors, but we are still in the process of learning about this ourselves and with limited time to distill it to focused, actionable

components, it was perhaps too much. Participants were still trying to sort out their activities and we were trying to discuss considerations for interacting with students when implementing activities. More careful consideration of readiness to engage in new topics is important.

**Lessons learned from attendees (host location) perspective**

*Theory **and** practice are both important.* Host location organizers found the in-person workshops provided an appropriate balance of discussion and active practice and achieved the dual goals of introducing a new pedagogical concept and facilitating its implementation. The workshops also validated previous faculty experiences with a mismatch between what students believe they understand and their demonstrated understanding on an assessment. The organizers left the initial virtual session excited to implement metacognitive activities, however they felt that their understanding of the process was not yet solid enough to continue with confidence. In this regard, the intuition shared by SLI and the host institution was correct - it was helpful for participants to be given the time to digest the concepts introduced at the initial virtual session before the subsequent in-person sessions during which they could engage with the material through guided practice.

*Examples contextualize theory.* During the host location's faculty group's discussions following the workshops, attendees shared their experiences implementing metacognitive activities, as well as their uncertainties regarding how to choose from among the wide range of potential activities. Host location organizers recommend that future workshops incorporate discussions of a variety of examples of effective activities and specific (and perhaps even individualized) implementation guidelines and timelines. Additionally, smaller faculty discussion groups during the workshop could be formed strategically, so that groups are determined by similarities in class content and/or structure. This change may enable faculty to use group discussion time to develop course-specific material. Although such changes may necessitate scheduling the subsequent workshop sessions over a longer period of time, host location organizers believe such a structure would provide time for reflection and discussion of each topic or example.

**Conclusions and future directions**

We shared findings from the perspectives of the host and faculty development team and found synergy among the two groups. First, participants felt the need for more time to process the new ideas and activities they engaged with throughout the workshop. It is possible participants experienced a level of cognitive overload where too many new ideas are engaged at once, or a previous idea has not been sufficiently processed prior to engaging another new idea. This is a continual tension in learning. Plan more time for practice and assimilation than you think is needed. You are the expert(s) and have thought a lot about the content. Remember to make time for participants to do the same. Second, participants desired more concrete and varied examples to spark participants' imaginations and aid development of their activities. We are implementing our own advice. For the future, the SLI is being designed with 1-2 weeks between virtual workshops to enable more processing and work before encountering the next topic. Complete and varied examples are being created to provide helpful support to participants. Remember, the content was new to you once too, and you either leveraged or created examples to help you assimilate the concepts too.

**References**


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## Appendix

Skillful Learning Institute Workshop Activity Working Document