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Creating the Skillful Learning Institute: A Virtual Short Course for Building Engineering Educators' Capacity to Promote Student Metacognitive Growth

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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. In May of 2018, Dr. Cunningham received the Rose-Hulman Board of Trustee's Outstanding Scholar Award for his research work. 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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Abstract

The Skillful Learning Institute is preparing a ***virtual short course*** experience for engineering educators to expand the explicit engagement of engineering students in their metacognitive development, which is currently lacking. Participants will develop a unique metacognitive activity for their context. The ultimate goal is to enhance the education of engineers through explicit metacognitive training, and we focus on instructors for their enduring and multiplicative impact on current and future engineering students, and secondary impacts on their colleagues. We have designed the short course as a series of three two-hour synchronous virtual workshops over a six-week period in the summer. The experience is designed to build instructors' capacities to teach metacognition and to continue to use and develop engaging metacognitive activities. By eliminating the time and cost of travel, this project will enable populations that might otherwise be limited in attendance such as professional-track faculty, teaching focused faculty, community college faculty, adjunct faculty.

Introduction

The Skillful Learning Institute (SLI) is preparing a ***virtual short course*** experience for 25-30 engineering educators to expand the explicit engagement of engineering students in their metacognitive development, which is currently lacking. Metacognition is instrumental in being able to independently assess and direct one's learning - a lifelong skill to propel ongoing growth and development. As such, metacognition is important for engineers because it empowers them (i.e., builds their agency and self-efficacy) to handle ambiguity inherent in navigating and solving engineering problems. In this short course participants will develop a unique metacognitive activity for their context using a backward design process of identifying the workshop participant's intended results, evidence necessary to measure the result, and learning experience to enable the intended results. In addition, fundamental information on metacognition, examples of metacognitive activities, and ways to support students as they navigate their metacognitive journeys will be provided. Our goals are to 1) enhance the education of engineers through explicit metacognitive training, and we focus on instructors for their enduring and multiplicative impact on current and future engineering students, and secondary impacts on their colleagues. And, 2) to fit the needs of different stakeholders and to improve access to a broader, more diverse, set of instructors with knowledge of metacognitive practices. Our broadening participation includes institution consideration (e.g., HBCUs, MSIs, and community colleges) and faculty variety (e.g., teaching faculty, tenure, professors of practice).

Description of Workshop

<u>Virtual Short Course Plan</u>

The short course is organized around three two-hour synchronous virtual workshops, one for each stage of backwards course design: identify desired results; determine acceptable evidence; design the learning experiences (Wiggins & McTighe, 2005). We are designing the short course workshops using backward design (as depicted by the rows in Table 3) as we also guide participants in using backward design to develop their individual metacognitive activities for students in their context (as depicted by the columns in Table 3). We will also employ flipped workshops in the short course to focus on participant's development and needs. Each of the three workshops will have homework completed prior to the workshop to maximize collaborative work on the specific objectives for each workshop. The short course

design also models the use of metacognitive experiences by calling on instructors to engage in planning, monitoring, and evaluating their own understanding and processes.

Before starting the workshops, participants will learn about metacognition through our existing modules (as an example approach) and we will share our learnings on teaching metacognition such as ways to assess and give feedback on metacognitive development through participation in a pre-workshop activity (defined as session W0). The first workshop (session W1) will focus on identifying the specific metacognitive learning objectives each instructor wants to focus on in the intervention they will design for their specific context. The second workshop (session W2) will focus on developing assessment plans for the activity and the third workshop (session W3) will involve designing the activity for implementation and relevant to the participant's context. We plan a follow-up session a few months after the end of the short course for participants to share their implementation experiences (session W4).

Activity Examples for Use in the Short Course. The following are examples of participant activities during the short course:

- Assignment before Workshop 1 Begins
    - Before beginning the short course, participants will watch the two ASEE webinar videos and complete the associated workbooks.
- After completing implementation of their metacognitive activities (W4 following), participants will complete a four-quadrant reflection to capture the experience and lessons learning, as shown in Table 1

Table 1: Four Quadrant Summary Reflection after implementation of metacognition activities

1. Summary of Implementation *In this section, participants will provide a summary of the learning activity they developed, including the learning objectives identified and the assessment plan.*	**2. Personal Reflection on Implementation** *In this section, participants will describe the outcome of their implementation and reflect on the implementation process. Participants will be encouraged to highlight aspects of the implementation that went well as well as challenges that were presented during the implementation.*
3. Peer Feedback Review *Participants will be required to provide peer review feedback on at least two other participants' sections 1 and 2. This peer review feedback will be recorded in section 3.*	**4. Personal Reflection on Peer Feedback** *After peer review feedback has been collected, participants will be asked to reflect on the feedback they received. This reflection will focus on how they will improve their activities and assessment plans for their next implementation.*

Virtual Short Course Mechanics

Participants. A variety of advertising will be used to solicit applications for participation in this short course. To assist with our goal of broadening participation, we will include email announcements through list servs that include community colleges, historically black colleges and universities, minority serving institutions, a variety of ASEE divisions, and several NSF funded programs such as the Dissertation Institute. We anticipate accepting 25 - 30 applications.

Timing. The virtual short course is scheduled for six weeks in late June and July in an effort to span the time between spring and fall academic terms. The three sessions are at least one week apart to allow the participants time to complete their homework and pre-work, including time for reflection on their work.

Workshop details. Table 3 provides information for each workshop including the objectives, activities, pre-work, post-work, and products. During each workshop there will be a combination of instruction techniques to allow participants instructor time, group time, and individual time for learning.
Feedback. We have built in both formative and summative assessments. A short survey will be given after each 2-hour workshop to allow the workshop team to assess, and improve as appropriate, our workshop content, timing, and structure. After the *W4 following* session (see table 2), we will have a summative assessment.

Next Steps

Our short term goal for the SLI is to develop a virtual workshop modality that provides open access to the program to as many diverse stakeholders as possible. We realize that professional development opportunities such as workshops like SLI exist at a potential cost to participants. Many faculty and staff have limited budgets for professional development opportunities. Workshops that require large registration fees and travel expenses can stretch or wipe out small professional development (PD) budgets, if budgets even exist. In addition, a requirement to travel may place undue burden or cause PD to be impractical for those with circumstances or responsibilities that do not allow for travel. We believe that a focus on virtual workshop opportunities will open professional development opportunities to a wider audience.

A primary goal we have for the SLI is to develop a workshop series that uses multiple pedagogical approaches to provide multiple types of touch points throughout the program. To engage participants with content prior to coming to each workshop, we are using a flipped classroom pedagogy. This method allows us to provide ample time for active learning during the workshop sessions. We plan to have participants interacting with both instructors and peers throughout each workshop session. As a follow up to each session, we plan to have one on one meetings with participants to provide individual attention and allow time for questions and feedback.

As a long term goal, the SLI team plans to pursue developing an asynchronous version of the Skillful Learning Institute. We understand that faculty and staff have busy schedules and high demands at different times during the academic calendar. While summer workshops may work for faculty with no teaching responsibilities during summer term, this mode may not be feasible for faculty and staff who support K-12 summer programming, summer bridge programs, research programs, or other summer commitments. We would like to be able to offer participants an opportunity for self-paced participation in the SLI. The world of asynchronous learning will be new for most members of the SLI team. We believe that we can learn a great deal from educators who have used the COVID-19 pandemic as an opportunity to develop asynchronous coursework for their institution or university.

In addition, we plan to further refine the in-person workshop series we have developed and run at several institutions (Cunningham, Matusovich, Carrico, Ellestad, Tantum, Santillan, and Simmons, 2021). By offering our workshops in as many modalities as possible, we open access and allow for a diverse group of educators to learn about how to better support the metacognitive development of their students.

References

Wiggins, G. P., & McTighe, J. (2005). Understanding By Design: Association for Supervision and Curriculum Development.

Cunningham, P., Matusovich, H., Carrico, C., Ellestad, R.M., Tantum, S., Santillan, S., & Simmmons, R. (Under Review). Supporting Students Skillful Learning: Lessons Learned From a Faculty

Development Workshop. Presented at the 2021 ASEE Annual COnference & Exposition. Long Beach, CA.

Table 2: Backward design plan for the flipped workshops in the Skillful Learning Institute short course

	W0 Before	W1 Identify Desired Results	W2 Determine Acceptable Evidence	W3 Learning Experiences	W4 Following
Identify the Desired Results: Workshop Learning Objectives	● Describe metacognition in own words ● Provide a copy of standards of professional conduct for participating in the short course.	● Explain an example of how backwards design can be used ● Select a context to focus on for the remainder of the workshop series ● Identify primary metacognition learning objective(s) for students	● Evaluate strengths and weaknesses of different approaches to assessing metacognition-related learning objectives ● Identify appropriate evidence for the learning objectives identified in W1. ● Select assessment method for learning objectives.	● Evaluate strengths and weaknesses of different approaches to teaching/learning metacognition ● Identify appropriate learning experiences to enable participants to achieve learning objectives ● Identify potential barriers to implementation and develop plan for overcoming barriers ● Develop strategic plan for implementation of intervention	● Evaluate effectiveness of backward design (alignment between learning objective, activity, and assessment)
Determine Acceptable Evidence: Assessment Plan	● Turn in responses to questions so we understand background knowledge of participants before first workshop (need to create submission form for participants to submit homework) ● Describe an application in their own life of using metacognition	● Per detailed design based on the project schedule and consistent with objectives. ● Assessment will leverage product and possibly additional information.	● Per detailed design based on the project schedule and consistent with objectives. ● Assessment will leverage product and possibly additional information.	● Per detailed design based on the project schedule and consistent with objectives ● Assessment will leverage product and possibly additional information.	● Per detailed design based on the project schedule and consistent with objectives. ● Assessment will leverage product and possibly additional information.

Design the Learning Experiences: *During Workshop Activities*		● Per detailed design based on the project schedule and consistent with objectives.	● Per detailed design based on the project schedule and consistent with objectives.	● Per detailed design based on the project schedule and consistent with objectives.	● Per detailed design based on the project schedule and consistent with objectives.
Design the Learning Experiences: *Homework Before Next Workshop*	● Watch ASEE webinar videos (Teaching Metacognition to Help Students Own and Improve their Learning: Parts 1 and 2) and complete the provided workbook activities ● Short reading on backwards design.	● Provide examples of possible student responses and identify metacognition in those responses ● Watch pre-workshop video on assessing metacognition and complete associated questions ● Review Assessment Matrix and identify 3-4 possible assessment methods for discussion (from matrix or other sources)	● Outline of metacognitive activity (logistics, content) - brainstorm list of other possibilities; focused description of activity showing alignment with learning objective and assessment plan	● Implement your metacognitive activity ● Write short review at the completion of your implementation ● Complete peer evaluation of 2-3 implementations ● One-page summary (4 block format) that includes what they did, self-evaluation, peer-evaluation, overall workshop)	
Product		● Brief (up to 200 words) description of context. ● Defined Learning Objective(s) ● Name and explain reasons behind primary metacognition learning objective.	● Assessment plan - Paragraph description of the actions, words, etc that they would expect to see from students if they are engaging in the specific metacognitive skill identified in the learning objective; Identify a measurement method for collecting data on if students are meeting the objective;	● Metacognitive activity materials and completed implementation plan	● 4 block reflection from each participant