ASEE 2022 ANNUAL CONFERENCE
Excellence Through Diversity
MINNEAPOLIS, MINNESOTA, JUNE 26TH-29TH, 2022 ASEE
Paper ID #38318

Collaborative Research: Design and Development: Lessons from Conducting the Skillful Learning Institute

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Collaborative Research: Design and Development: The Skillful Learning Institute

Introduction

The Skillful Learning Institute (SLI) administered a **virtual short course** experience for engineering educators in order to expand the explicit engagement of engineering students in their metacognitive development, this is currently lacking. Metacognition is instrumental for one to independently assess and direct one's lifelong learning - a lifelong skill to propel ongoing growth and development. Because of this, metacognition is essential for engineers because it empowers them to handle the ambiguity inherent to navigating and solving engineering problems. As a result of this short course, engineering educators developed a unique metacognitive activity for their context utilizing a backward design process by identifying the workshop participant's intended results, the evidence necessary to measure the result, and the learning experience to enable the intended results. The goals of this short course were to 1) enhance the education of engineers through explicit metacognitive training and focus on instructors because of their long-term and multiplicative impact on current and future engineering students and secondary impacts on their colleagues. Furthermore, 2) to fit the needs of stakeholders and improve access to a broader, more diverse set of instructors with knowledge of metacognitive practices. The purpose of this paper is to discuss and describe the implementation of this virtual short course, high-level results of our evaluation data, and discuss lessons learned from the short course and future work as a result of this initial implementation.

Description of workshop

<u>Purpose of the short course</u>

The purpose of the short course was to facilitate faculty learning about metacognition and translating that knowledge into learning activities to use with students. The outcomes of the short course were that faculty participants will have:

- Participated in a backward course design approach relative to teaching metacognition by identifying a primary metacognitive learning objective for students, identifying the appropriate evidence to know if that objective was achieved, and identifying the appropriate learning experiences to enable students to achieve learning outcomes.
- Created a metacognitive intervention and prepared for implementation
- Provided feedback to a peer on the intervention creation and implementation using backward design.

Virtual short course implementation

The team came together to develop the virtual short course. Using backward design as a framework, we designed and delivered the short course as three two-hour synchronous virtual workshops over an eight-week period during the summer of 2021 and a fourth workshop for participants to report out on their projects in the spring of 2022. The decision to make the workshop virtual was intentional and independent of the COVID pandemic. The virtual format was intended to eliminate the time and cost of travel, thus enabling the participation of populations that might otherwise be limited in attendance like professional-track faculty, teaching-focused faculty, community college faculty, and adjunct faculty. The three workshops covered one stage of backward course design each: identify desired results; determine acceptable evidence; and plan the learning experiences as depicted in Figure 1 [1]. The virtual course workshops were similarly designed using backward design methods as the team guided participants in backward design to develop their individual metacognitive activities for students in their context.

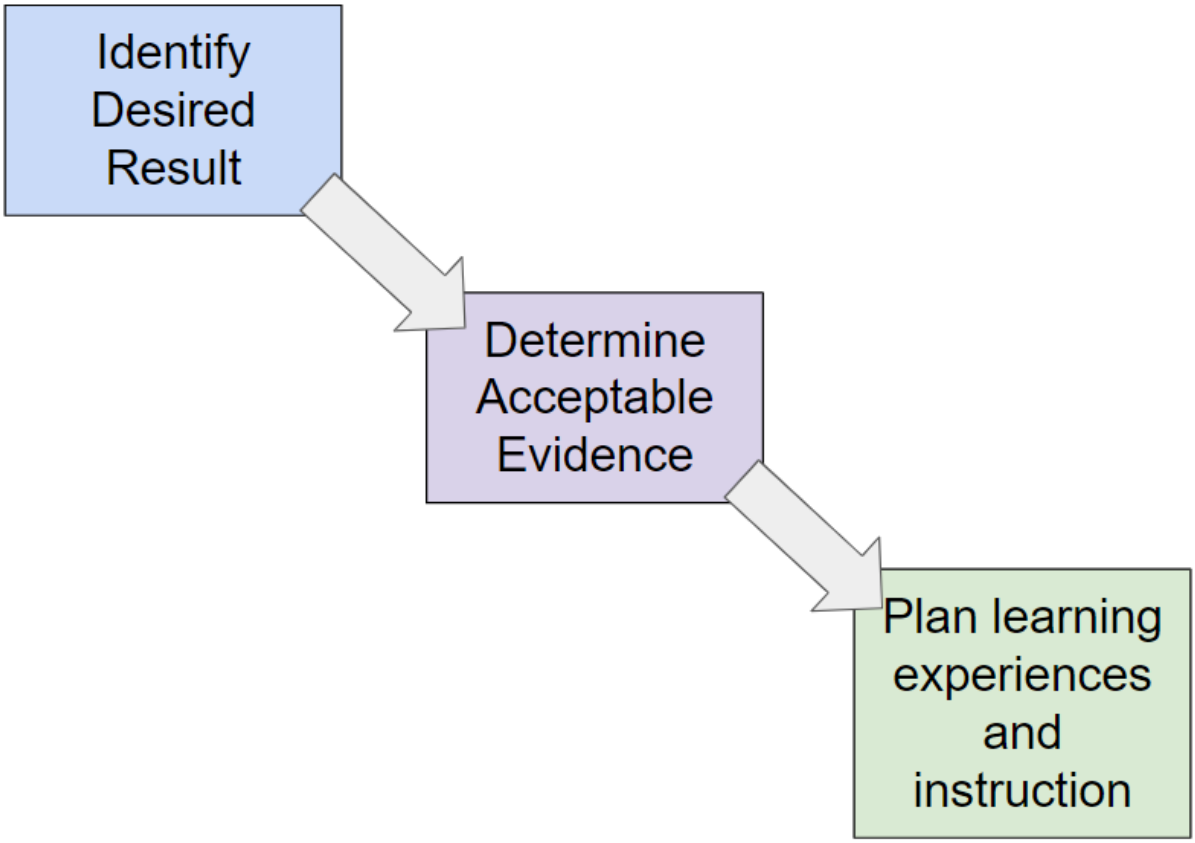


Figure 1. *Three Stages of the Backward Design Process*

Mechanics

Participants: A variety of advertising was used to solicit applications for participation in this short course. To assist with our goal of broadening participation, efforts included email

announcements through listservs 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. As a result, we recruited five participants.

Timing. The virtual short course was 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 were each 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. The below section of the virtual short course description discusses each workshop, including the objectives, activities, pre-work, post-work, and products. During each workshop, a combination of instruction techniques was utilized to allow participants instructor time, group time, and individual time for learning.

Dispersing of materials. The main conduit in which we shared materials was google classroom. We administered each activity, pre-work, post-work, and products for the workshop in google classroom and supplemented with email communication.

Feedback. Built into the workshop was both formative and summative assessments. A short survey was given after each 2-hour workshop to allow the workshop team to assess, and improve as appropriate, our workshop content, timing, and structure.

Virtual short course description

Pre-workshop (Session W0)

Before the start of the workshops, participants learned about metacognition through pre-existing modules. Session W0 included watching an introductory video of metacognition developed by the SLI team. Primer questions leading into the workshop included asking about areas of interest related to metacognition and to introduce themselves to the other participants. Finally, the required readings included the SLI Code of conduct and a brief article on Backwards Design. There were no specific deliverables for the pre-workshop from the participants.

Workshop 1 (Session W1)

Session W1 consisted of the first zoom synchronous workshop. The first workshop was held in mid-June with five participants. The facilitators introduced themselves and explained the goals of workshop one for the participants (Identify desired result). The main facilitator went on to describe the backwards design process and gave an extended example of the whole process based on a cooking class. After fielding questions about Backwards design, the main presenter then went on to explain metacognition and gave an example of formulating a metacognitive learning objectives for a structured programming course. This set up the participants for filling out the

worksheet to identify their desired metacognitive objective (Step 1 of the backward design process). The participants were moved to smaller breakout rooms to work on the worksheet and discuss their desired result. The worksheets working document is shown below in Figure 2.

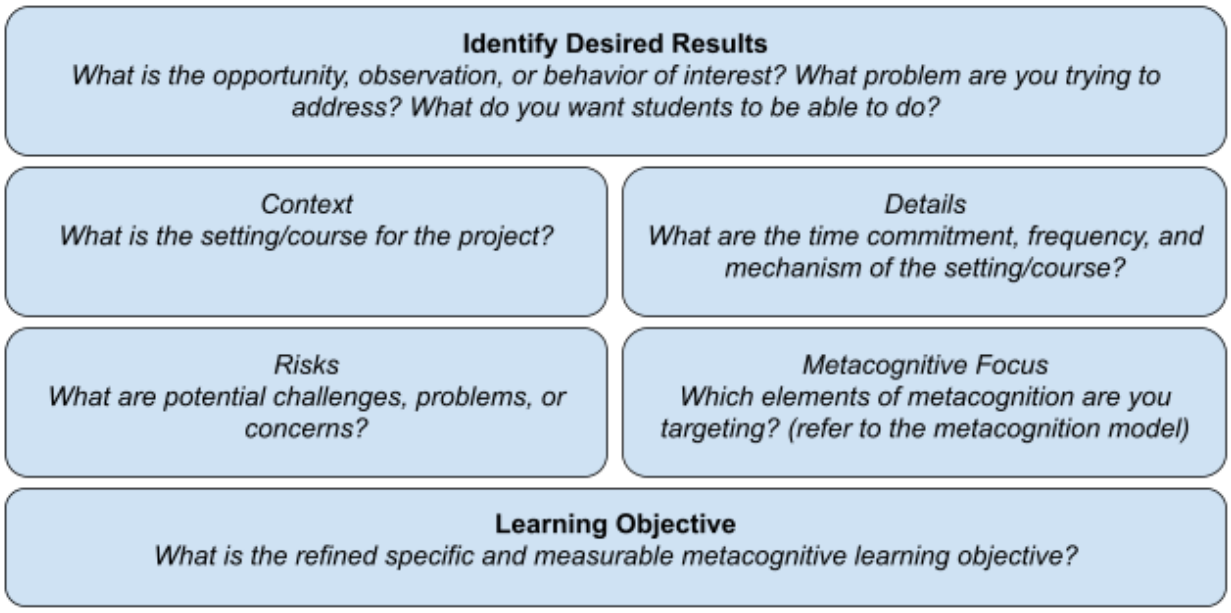


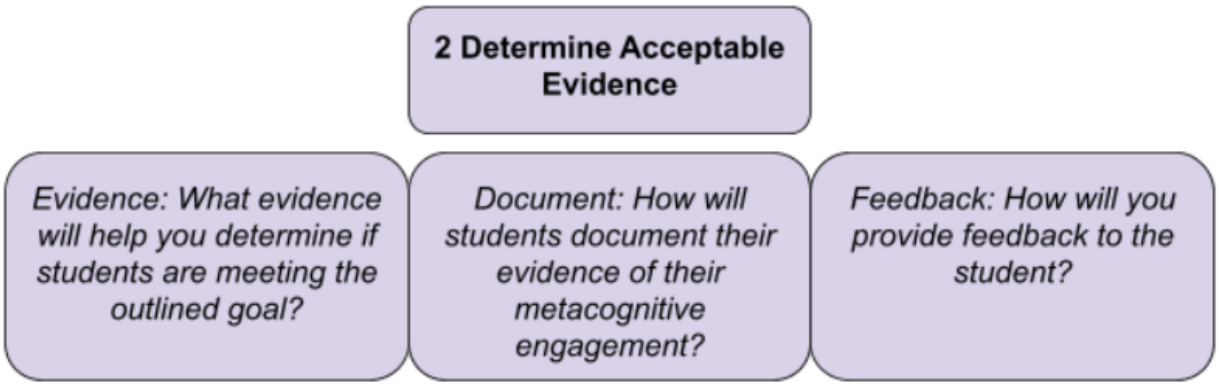
Figure 2. *Workshop 1 working document worksheet*

During the 20-minute breakout session, other workshop facilitators moved from room to room, answering questions and talking with participants and supporting their individual development of desired metacognitive outcomes for their activity. After the breakout session, all participants returned to the main zoom room and a few participants volunteered to share their draft, offer insights, and solicit feedback from the rest of the group. As a follow-up after the workshop, the participants were assigned to complete the document depicted in Figure 2 and submit it. Facilitators then reviewed and gave constructive comments on each of the desired results worksheets.

Workshop 2 (Session W2)

Workshop 2, which occurred two weeks after Workshop 1, was primarily focused on the second step of the backwards design process for determining acceptable evidence. Participants were assigned to watch a pre-workshop video of the A^2CE framework [2] for giving formative feedback and to review a metacognition assessment resource matrix for the participants to select potential assessment techniques that may be useful for each of their Backwards design projects. The assessment matrix was compiled from existing assessment tools [3], [4]. Starting with a review of what was covered in workshop one. The main facilitator then discussed the purpose of assessment and the two primary approaches to assessment (formative and summative assessment). Using the example of a first-year MATLAB lesson, the facilitator then went through an extended example, matching the metacognitive learning objective from workshop 1

with appropriate evidence, assessment tools, and a feedback plan using the A^{2}CE Framework. Using several breakout sessions and an interactive Jamboard, the facilitator had participants work in smaller groups to work through Figure 3 with their personal project example.



Evidence: What evidence will help you determine if students are meeting the outlined goal?	
Document: How will students document their evidence of their metacognitive engagement?	
Feedback: How will you provide feedback to the student?	

Figure 3. *Workshop 2 worksheet for the second stage of the backward design process*

Similar to workshop 1, participants were assigned to complete the document after the workshop and submit it to google classroom. The facilitators reviewed and gave comments on each of the desired results worksheets.

Workshop 3 (Session W3)

Workshop 3 was the final two-hour zoom synchronous session and occurred two weeks after the second workshop. The format was similar to the first two and included pre-workshop homework, two group sessions, and two breakout sessions. The goal of W3 was to identify a learning experience for their metacognitive learning goal with sub-goals of: Identity what *Knowledge* students need; identify the *instruction* students need; develop a *plan* for providing the knowledge and instruction, and develop the *practice* students should do. In addition, consideration for the context of the learning experience was discussed.

The lead facilitator reviewed the first two workshops and the worksheet (Figure 4) from workshop two. The assigned pre-work for workshop 3 was the construction of a four-block diagram aimed at providing the outcomes from W1 and W2 as well as a draft learning experience (outcome of W3), see (Figure 4). In addition to the pre-work, several of Nilsen's [5] self-regulated learning activity table's activities were provided as a starting point of possible activities.

For the third workshop, the final piece of the backward design process possible learning experience that would allow the metacognitive learning objective to be implemented (final box in Figure 1) and measured (assessment plan from workshop 2) were developed.
The workshop format included breakout groups for the participants to discuss and share their filled-out four-quadrant worksheets; participants were instructed to ask critical questions to each other, ensuring there was a metacognitive learning outcome.

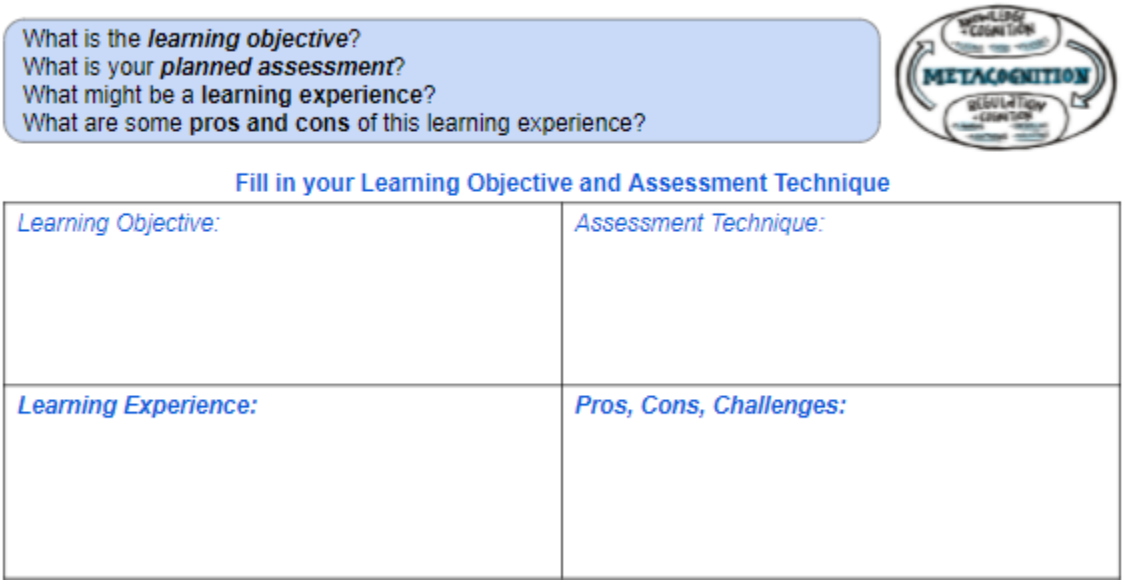


Figure 4. *Four quadrant worksheet to draft learning experience*

After returning from the first breakout session, the facilitator used the same extended example from workshop 2 of designing a Matlab lesson in light of designing a learning experience with the appropriate metacognitive learning outcomes using backward design. Finally, participants re-entered a breakout session to revisit their learning experiences and discuss them with the other participants. From there, workshop 3 ended with plans for one-on-one sessions between facilitators and participants to finalize their plans.

Evaluation

The team did a preliminary evaluation based on two sources of data: 1) participant self-reports on evaluation surveys and 2) observations from the workshop. The actual activities during each session still need to be evaluated pending discussion of the final implementation.

With regard to the first objective, participants did engage in a backward course design, including all of the specific elements noted. However, participants still struggled with understanding how all of the elements fit together. Of the key elements, the assessment piece was the most readily understood by participants. Concerning the second objective, all participants left the workshop with at least a preliminary plan for implementation. With regard to the final objective, participants gave feedback during break-out sessions throughout the backward design process. They will engage in one final meeting to share how their implementations went. That meeting will be held in early Spring 2022.

At a more granular level, each session was also evaluated with regard to the process and content to identify what worked and what needs improvement. With regard to process, across all three sessions, the use of break-out groups and allowing time for discussion were helpful. However, participants would have liked even more discussion and interaction time. Participants also thought there was too much time between sessions. With regard to content, participants had conflicting responses with regard to wanting more examples vs. more time to spend on their own examples. Participants appreciated the resources we provided (e.g., the assessment resources). Overall they thought the content was appropriate for the workshop goals.

Next steps

Immediate next steps include hosting a follow-up session with participants to talk about their intervention implementations and if the desired outcomes were achieved. We will help them think about improvements for the next implementation.

As a team, we will also reflect on our short course approach taking into account the evaluation data and what worked well and what did not work well. For example, we already recognize the need to adjust the start of the workshop ensuring that the participants have time to introduce themselves at the beginning of the series. We believe this will help promote the development of a community of practices. This would be further supported by more time in the breakout rooms for working mid-workshops which will further support the development of a community of practice. In terms of content, we also recognize the need to adjust the workshop sessions to continue to focus on metacognitive outcomes vs cognitive outcomes and this remains challenging. We also think it important to continue to refine the working time and activity scaffolding as participants did not leave the workshop with nearly completed activities as we had hoped.

References

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