

## Facilitator Practices for Problem-Based Learning in First-Year Engineering

**Author:** Hunter, Deirdre-Annaliese Nicole. (2015) Implementing Problem-based Learning in Introductory Engineering Courses: A Qualitative Investigation of Facilitation Strategies. Department of Engineering Education. Virginia Tech. Blacksburg, VA. Doctoral Dissertation.

**Data Source:** Observations (video and audio recordings) and field notes from a one-semester introductory engineering course employing problem-based learning. Five groups were each observed approximately six times during a complete problem cycle (6 weeks) with two observations per week in Weeks 1, 3, and 6. For full details on data collection, please refer to Hunter (2015).

**Theoretical Framework:** The model illustrated on the following pages was developed based on the Cognitive Apprenticeship framework (Collins, Brown, & Holum, 1991a). The relevant portion of Collin's original framework is shown in the table below:

Definitions and associated practices of the six constructs in the Method component of Cognitive Apprenticeship framework (Collins, Brown, & Holum, 1991b), as cited in Hunter (2015).

Construct	Definition	Associated Practices
Modeling	Teacher performs a task so students can observe and build a conceptual model of the processes that are required to accomplish it	<ul style="list-style-type: none"> <li>▪ Think – aloud</li> <li>▪ Verbalize heuristic and control strategies while completing a task</li> <li>▪ Sharing of experiences that relate to the students' current situation</li> </ul>
Coaching	Teacher observes and facilitates while students perform a task and offering hints, scaffolding, feedback, modeling, or reminders	<ul style="list-style-type: none"> <li>▪ Offer feedback or advice</li> <li>▪ Offer encouragement</li> <li>▪ Using questions to guide students</li> </ul>
Scaffolding	Teacher provides supports to help the students perform a task	<ul style="list-style-type: none"> <li>▪ Perform tasks for the students that is beyond their ability</li> <li>▪ Supply tools that can organize students understanding</li> </ul>
Articulation	Teacher encourages students to verbalize their knowledge, reasoning, or problem solving processes.	<ul style="list-style-type: none"> <li>▪ Prompt students with questions</li> <li>▪ Prompt students to verbalize or draw their understanding</li> </ul>
Reflection	Teacher enables students to compare their performance with that of an expert other student, or an internal cognitive model.	<ul style="list-style-type: none"> <li>▪ Provide space for reflection</li> <li>▪ Provide examples of which to compare</li> </ul>
Exploration	Teacher invites students to pose and solve their own problems	<ul style="list-style-type: none"> <li>▪ Prompt students to scope problems or frame questions to solve</li> </ul>

Collins, A., Brown, J. S., & Holum, A. (1991a, Winter 1991). Cognitive apprenticeship: making thinking visible. *American Educator*.

Collins, A., Brown, J. S., & Holum, A. (1991b). Cognitive Apprenticeship: Making thinking visible. *American Educator*, 6(11), 38-46.

**Coach**

Instructor observes while students perform a task & guides them by providing models or scaffolds or prompting them to articulate, monitor, or explore with the aim of bringing student performance closer to that of experts.

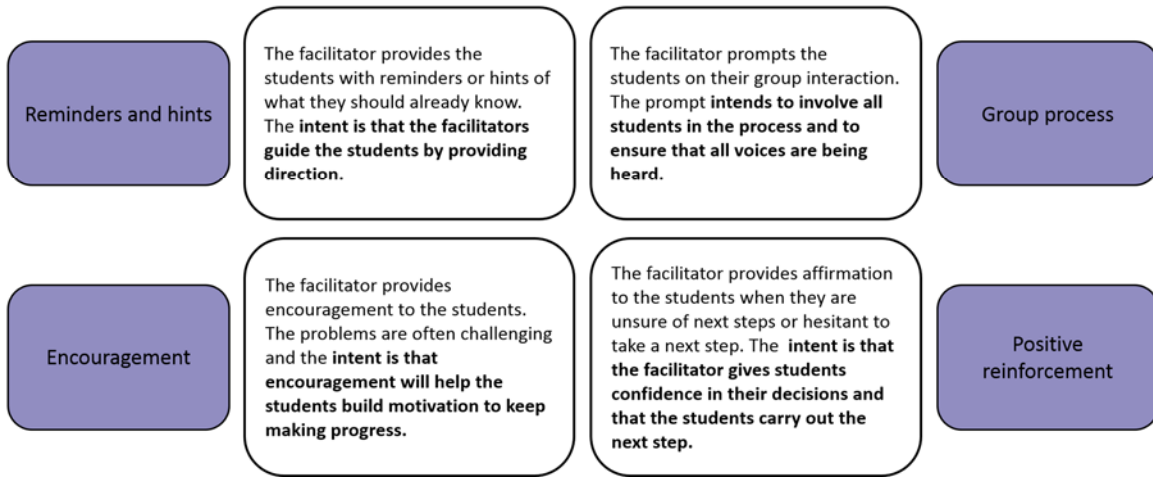


Figure 1 - Definitions of the Coach Subcategories.

**Model**

Instructor provides an example of expert knowledge, understanding, reasoning, or performance of a physical or cognitive task (while verbalizing thought process) to aide students in building conceptual models.

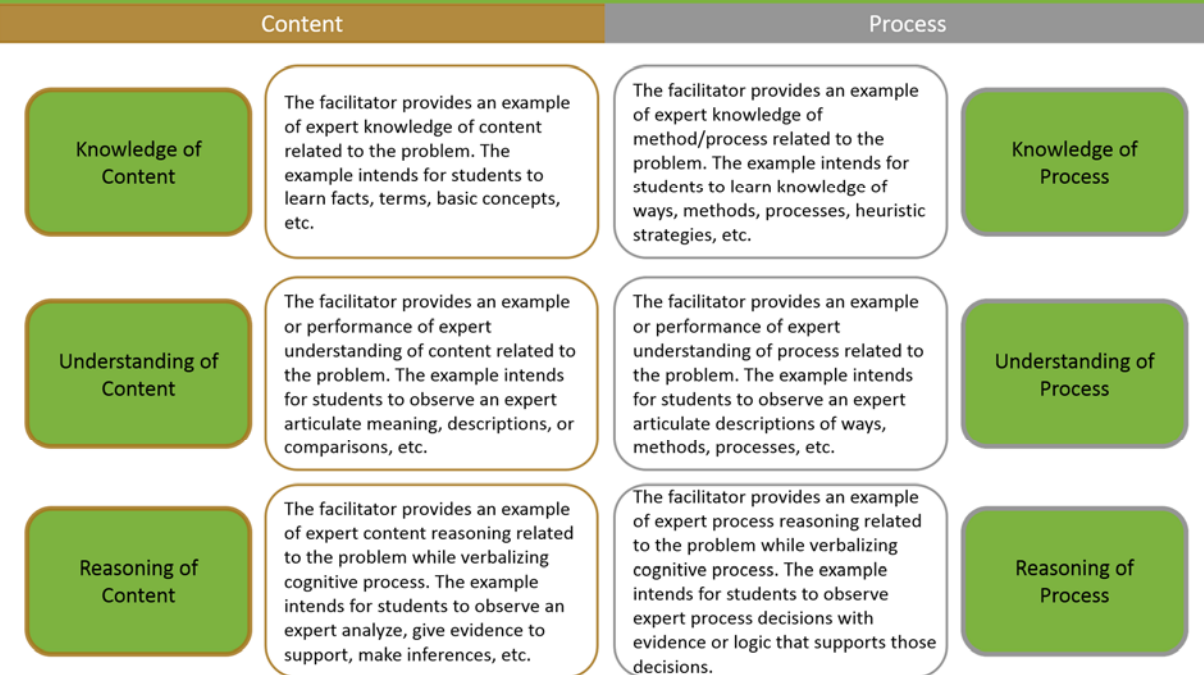


Figure 2 - Definitions of the Model Subcategories

**Scaffold** Instructor provides a support that assists students to perform a task with the aim of bridging gaps in students knowledge or understanding of content or process. e.g.: rubric, framework, format, table/chart, breaking problem into steps

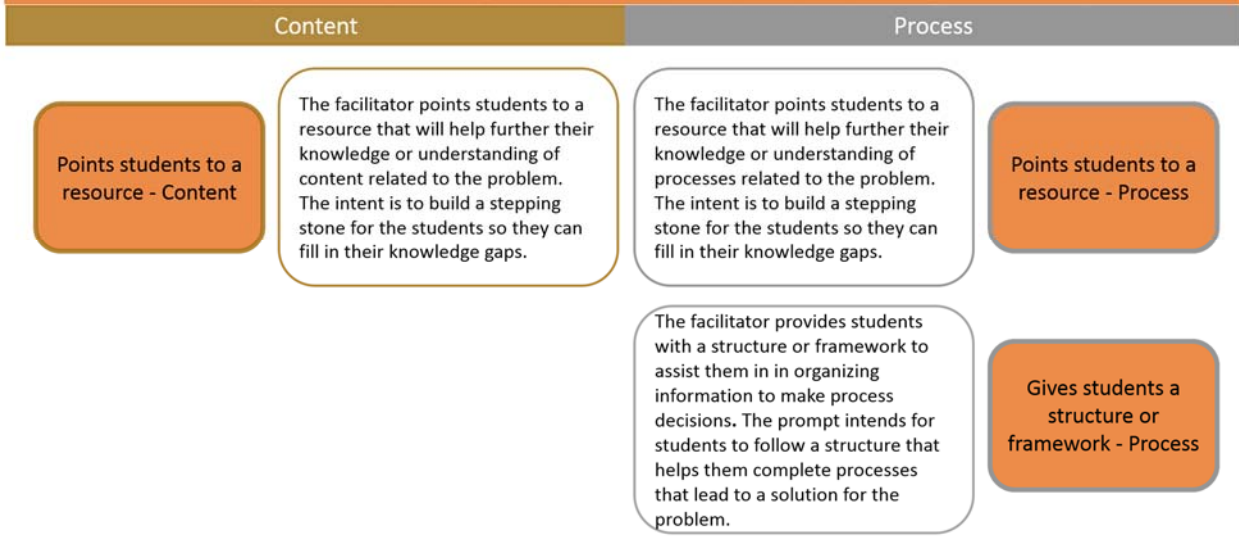


Figure 3 - Definitions of the Scaffold Subcategories

**Articulate** Instructor prompts students to make known their knowledge, understanding, or reasoning of content or problem solving processes with the aim of assisting students to identify the limits of their knowledge and refine understanding.



Figure 4 - Definitions of the Articulate Subcategories

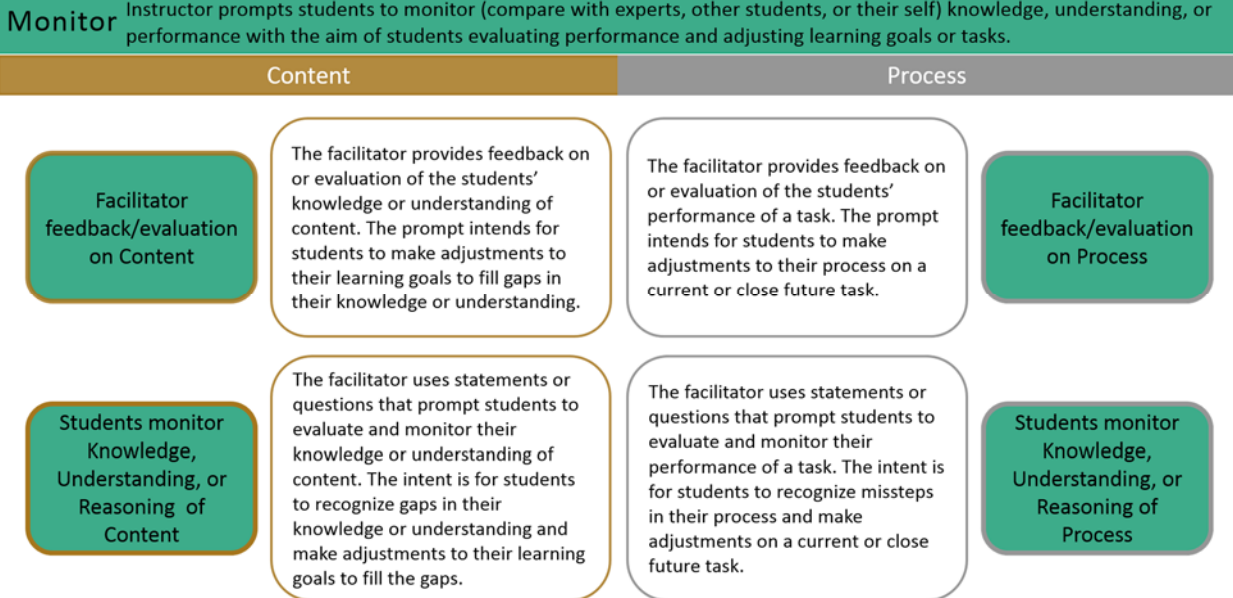


Figure 5 - Definitions of the Monitor Subcategories

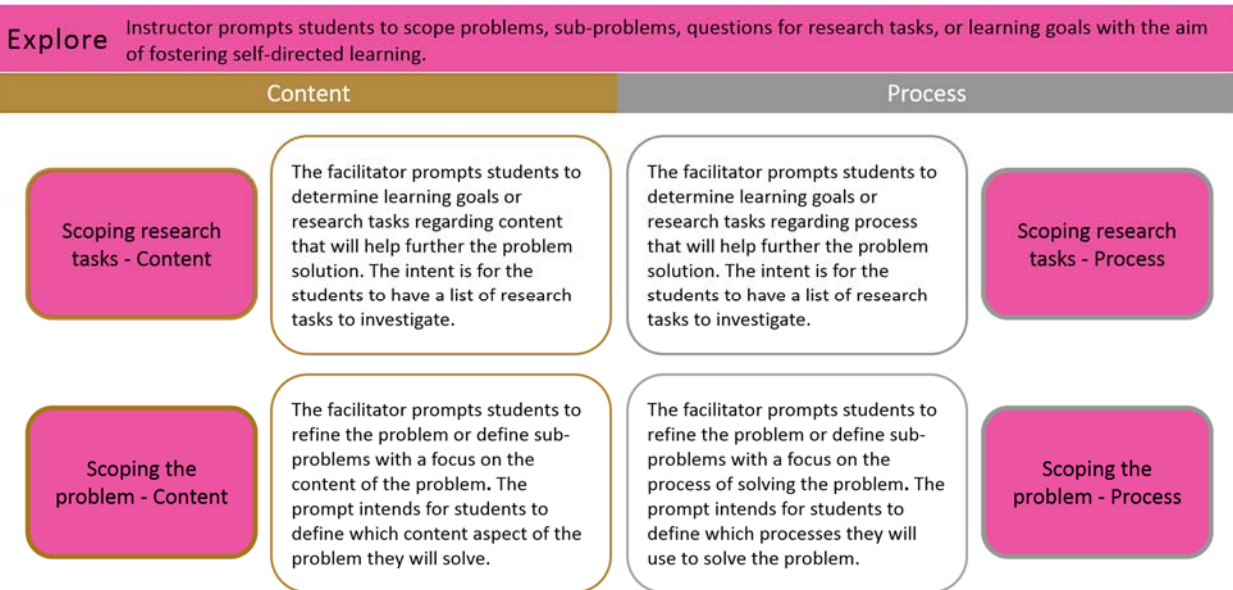


Figure 6 - Definitions of the Explore Subcategories