A bouquet of Bloom's: choosing active learning strategies to align with learning outcomes

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Abstract: Research in STEM education has shown that engaging students in their learning process enhances their ability to recall information and apply concepts in new and varied contexts. To facilitate this student engagement, instructors can incorporate a variety of active learning strategies, such as minute papers and project-based learning assignments, into the learning environment. However, with the overwhelming number of active learning strategies available, how do instructors choose appropriate activities to help students achieve desired learning outcomes? In this collegiate interactive session, participants will practice effectively integrating active learning strategies into a learning experience by: 1) classifying strategies according to Bloom's taxonomy, 2) selecting and aligning strategies with a course learning outcome, and 3) planning the implementation of an active learning strategy in a specific learning experience. By the end of this session, participants will construct a resource of active learning strategies aligned with different levels of learning outcomes to incorporate into their course or learning environment.

FOCUS

The focus of this session is appropriate alignment of active learning strategies with learning outcomes. Active learning strategies are legion, yet we are unaware of efforts to systemically classify active learning strategies by appropriate outcome indicators (e.g. Webb's Depth of Knowledge, [recall, conceptual, strategic, extended thinking]). In the session, participants will practice using Bloom's taxonomy to classify active learning strategies to aid in a selection process when an instructor would like to use an active learning strategy to support an intended outcome. After classification practice, participants will then choose, justify (using the taxonomy), and plan to implement an active learning strategy to pair with a target learning outcome in their own context.

LEARNING OBJECTIVES

By the end of the session, participants will be able to:
- Classify active learning strategies according to Bloom's taxonomy and instructional time commitment
- Select and align an active learning strategy with a learning objective/outcomes from their own context
- Plan to implement an aligned active learning strategy in a specific learning experience

INSTRUCTIONAL STRATEGIES

- Making learning outcomes explicit in the session
- Elicit prior knowledge through an active learning strategy (Think-Pair-Share) about active learning
- Participants with construct a graphic organizer to help them classify strategies and organize their thinking.
- Participants will do small group work
- We will use a gallery walk for group sharing of ideas so that participants can compare contrast their group work/ideas with others'
- We will scaffold participant learning with instructor modeling, small group work, then an individual application (coach, model, fade).
- Participants will reflect, considering their future instructional response to implementing the aligned active learning strategy. How will they know if it 'worked'? How will they respond to feedback (revise or adjust instructional strategy, etc).
- We will solicit feedback (and reflection) in the form of a GOTS and NEEDS exercise at the end of the workshop.

OUTLINE

Introduction: 15 min.
- Facilitator introduction
- Review learning outcomes and session norm-setting
- Introduction to active learning

- Elicit prior knowledge – participants do a Think-Pair-Share around what participants know about active learning, learning outcomes, and Bloom's taxonomy.
  - Review of beginner aspects of course design (LO, Activities, Assessment).
    - Show graphic organizer of where active learning strategies can fit in a full course design (Trefny Center Engineering Learning Framework)

Problem, Justification, Task Setup: 20 min.
- Problem statement – with so many strategies, how choose among them such that active learning strategies are aligned with your objectives/target outcomes?
  - Examples: 1. If LO is to understand complex and important concepts, interactive engagement might be used because it produces deepest leaning, but requires most time and prep. 2. If LO is to recall and recognize certain terms and facts, need less intensive strategy, such as asking students to repeat what they have learned.
- *Frameworks – Show participants a selection of frameworks that could be used to classify active learning strategies (ICAP, KIE, Webb's DOK, Bloom's)*
  - *Justify session use of Bloom's because of goal to align with learning outcomes, which are most frequently associated with Bloom's (or to a lesser degree, Webb's).*
- Pose task – use Bloom's taxonomy as a framework, common to course design, to classify active learning strategies.
  - Provide participants with a large list or set of active learning cards with descriptions of popular active learning strategies.
  - Model process of charting active learning strategy on the graph, along with group discussion of where it might belong and why.

Charting Active Learning with Bloom's Group Task: 20 min.
- Group work:
  - Split participants into groups (3–5 participants ea.)
  - Provide participants with graph outline. X axis = Bloom's taxonomy levels. Y axis = instructional time commitment.
  - *Have groups work collaboratively to choose 10–15 strategies, mix of ones they are familiar with or use plus some new ones, and have them do an alignment against Bloom's taxonomy on charts in the middle of their table (or on a wall board/poster). Expect some disagreement with eventual conclusion that strategies may span multiple taxonomy levels, but exercise still discriminates among strategies in a manner useful for alignment with LOs.*
  - *Do a gallery walk, where groups visit other tables – discuss similarities and differences among alignment.*
  - Participants return to individual seats/working designations

Using Charts to Help Select Active Learning Tasks that Align with LOs: 25 min.
- Learning Outcomes & Alignment:
  - Participants (individually) given a handout for writing SMART learning outcomes along with 2–4 minute overview.
  - Participants are then asked to individually write down a target learning outcome (on an alignment handout) from one of their courses or another learning experience, using Bloom's language.

       ○ Ask participants to think about and record the activities they are already using/or will use to achieve that LO. Do any of the activities match the active learning strategies that have been mapped by any of the groups?
- If yes, do the LO and the active learning strategies align?
- If no, challenge them to find an active learning strategy that they would like to try that is appropriately aligned with the LO.
- Have participants mini-plan the active learning strategy for use in a course.
- Have participants think about what to do *after* they've done the strategy. What is its value? How should they respond?

Summary and Feedback: 5 min.
- Summarize and make sure participants have an implementation plan to move forward with.
- Gather workshop feedback from participants using a Gots and Needs format. Likely sticky notes on chart paper.

Time slot:
We would prefer a 90 minute session. If reduced to 60 minutes, we would shorten the "Frameworks" item in the outline above, reduce the number of strategies that groups select and work to align, and cut the gallery walk. The segments that would be modified are italicized in the outline.

RMS ASEE TARGET AUDIENCE

Anyone attending the meeting who is interested in exploring a tool/framework to help them incorporate active learning strategies into their learning experience design. Session participants will leave with a renewed appreciation for using principles of course design to achieve learning outcomes, an expanded set of active learning strategies, practice aligning active learning strategies with learning outcomes, and a plan to implement an active learning strategy to achieve a learning experience goal. We expect the learning outcomes for this session can be applied to most learning experience designs, including classroom experiences, online courses, presentations, and informal learning contexts.

PRESENTER CREDENTIALS

Sarah Bodbyl Roels, Ph.D.
Sarah is a faculty developer in the Trefny Center at the Colorado School of Mines. Her role includes assisting faculty to achieve classroom and student-centered learning goals. She earned her Ph.D. in Ecology and Evolutionary Biology from the University of Kansas where she studied plant mating system evolution. She has extensive experience managing science communication and education research projects and specializes in facilitating evidence-based training and professional development for K–advanced degree educators.

Amy Hermundstad Nave, Ph.D.
Amy is a faculty developer in the Trefny Center at the Colorado School of Mines. Originally from Colorado, she earned a BS in Mechanical Engineering from Colorado State before going on

to earn her Ph.D. in Engineering Education and MEng in Mechanical Engineering from Virginia Tech. Amy's research interests include engineering students' professional development and efforts to support underrepresented students within engineering, primarily using qualitative research methods to investigate a variety of perspectives on these topics. She has also done research on conceptual understanding in engineering courses and studied the variation in cultures between engineering departments and disciplines. In addition, while at Virginia Tech, Amy taught first-year engineering courses, worked in the Center for the Enhancement of Engineering Diversity, and worked with graduate students to incorporate contemporary pedagogical practices in a variety of fields.

Deb Jordan, M.A.
Deb is a Research Associate working on an NSF-funded grant, *Carbon Transformations in Matter and Energy* (*Carbon TIME*) as well as working with the Trefny Center as a Faculty Developer. Prior to joining Mines, Deb served as a Senior Fellow on the Disciplinary Literacy in Science Team at the Institute for Learning (IFL) at the University of Pittsburgh. She previously served as a Science Educator at Biological Sciences Curriculum Study (BSCS) and as a Senior Consultant at McREL International. Her extensive background in science education includes K-12 Science Coordinator as well as years as a science teacher.

Megan Sanders, Ph.D.
Megan is the Senior Assessment Associate. Before coming to Mines, Megan worked at the Eberly Center for Teaching Excellence and Instructional Innovation at Carnegie Mellon University, where her role focused on supporting instructors in conducting research about student outcomes in their courses. Megan's disciplinary background is in educational psychology. She earned her doctorate from the Ohio State University, and her research focused on the idea of relevance in higher education—how we define it, how students perceive it, and how to measure it—an interest that continues to inform her work.

Sam Spiegel, Ph.D.
Sam leads the Trefny Innovative Instruction Center at the Colorado School of Mines in proactively supporting faculty to advance the quality of students' learning experiences, advance campus discussions on pedagogy and innovative teaching, and advocate for and support faculty in their use of empirically proven innovative teaching approaches.
Prior to joining Mines, Sam served as Chair of the Disciplinary Literacy in Science Team at the Institute for Learning (IFL) and the Associate Director for the Swanson School of Engineering's Engineering Education Research Center at the University of Pittsburgh. He previously served as a science educator at Biological Sciences Curriculum Study (BSCS); as Director of Research & Development for a multimedia development company; and as founding Director of the Center for Integrating Research & Learning (CIRL) at the National High Magnetic Field Laboratory, Florida State University. Under Dr. Spiegel's leadership, CIRL matured into a thriving Center recognized as one of the leading National Science Foundation Laboratories for activities to promote science, mathematics, and technology (STEM) education. While at Florida State University, Dr. Spiegel also directed an award winning teacher enhancement program for middle grades science teachers entitled Science For Early Adolescence Teachers (Science FEAT).

His extensive background in science education includes experiences as both a middle school and high school science teacher, teaching university-level biology and science education courses, working with high-risk youth in alternative education centers, working in science museums, designing and facilitating online courses, multimedia curriculum development, and leading and researching professional learning for educators. The Association for the Education of Teachers of Science (AETS) honored Dr. Spiegel for his efforts in teacher education with the Innovation in Teaching Science Teachers award (1997). Dr. Spiegel's current efforts focus on educational reform and in the innovation of teaching and learning resources and practices.

REQUIREMENTS

What materials/handouts will you bring?
- We will provide handouts, chart paper, markers/pens.

Do participants need to bring anything? e.g. laptop
- No

What are your intended (ideal) and max participant counts?
- Ideal count: 30
- Max count: 70

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