The ICAP framework: Linking cognitive engagement to active learning outcomes

Michelene (Micki) Chi's research at Arizona State University (ASU) defines **interactive engagement** in wider contexts than physics, and for K-12. She has evidence that it is the **most effective methodology**. Very exciting research!

At the CAST conference at ASU in October 2016, I heard Micki give a great talk on ICAP, her theoretical framework for cognition in instruction. It aligns with Modeling Instruction -- it tells why Modeling Instruction is effective. (CAST is the acronym for Center for the Art & Science of Teaching. Its founder is Mari Koerner, former ASU Dean of Education.)

(By the way, I don't think Micki has ever visited a Modeling Workshop, so her research is entirly independent of Modeling Instruction.)

Micki Chi has done research on cognition in science education for many years. She was formerly in Pittsburgh, PA at the Learning Research and Development Center. We are lucky to have her, at ASU!

Below is an overview of the first part of her CAST talk. Most is in her words, from her 2014 paper, which you can FREELY download (the URL is below). I strongly encourage you to download it. In her talk, she gave MUCH confirmatory evidence in K-12, across the curriculum.

-- Jane Jackson, ASU (Feb. 2017)

Cognitive engagement behaviors can be categorized and differentiated into one of four modes: **Interactive, Constructive, Active, and Passive**. **The ICAP hypothesis predicts that as students become more engaged with the learning materials, from passive to active to constructive to interactive, their learning will increase.**

In other words**, "the Interactive mode of engagement achieves the greatest level of learning, greater than the Constructive mode, which is greater than the Active mode, which in turn is greater than the Passive mode (I>C>A>P).** Thus, the ICAP hypothesis predicts different levels of learning for different modes of overt behaviors. Higher levels imply learning with deeper understanding."

Passive mode of engagement (receiving) "In our taxonomy we define a passive mode of engagement as learners being oriented toward and receiving information from the instructional materials without overtly doing anything else related to learning. For example, paying attention and listening to a lecture without overtly doing anything else (i.e., listening without taking notes) is a passive engagement behavior.

Active mode of engagement (manipulating) ... "In the context of learning measures, undertaking active activities have also been shown to exceed passive activities, such as when students

manipulate some parts of the learning materials, by pointing to or gesturing at what they are reading or solving, pausing and rewinding parts of a video tape (in order to review certain selected parts of the tape), underlining certain text sentences that they think are important, copying some of the problem solution steps, mixing certain chemical amounts in a hands-on laboratory, choosing a justification from a menu of options, and so forth."

Constructive mode of engagement (generating) "Our taxonomy defines constructive behaviors as those in which learners generate or produce additional externalized outputs or products beyond what was provided in the learning materials. Thus, a characteristic descriptor of the constructive mode is generative. To meet the criteria for constructive, the outputs of generative behaviors should contain new ideas that go beyond the information given; otherwise such behaviors are merely active/manipulative. For example, in a constructive behavior such as self-explaining, learners are articulating what a text sentence or a solution step means to them, by generating inferences that are not explicitly stated in the text sentence, or providing justification for the step. Both the inferences and the justification go beyond the provided information. " ...
Constructive activities include activities such as drawing a concept map; taking notes in one's own words; asking questions; posing problems; comparing and contrasting cases ...

Interactive mode of engagement (dialoging; co-creating) ... "we operationalize interactive behaviors to dialogues that meet two criteria: **(a) both partners' utterances must be primarily constructive, and (b) a sufficient degree of turn taking must occur.** ... "dialogues are truly interactive only if each speaker's utterances generate some knowledge beyond what was presented in the original learning materials and beyond what the partner has said; thus, both partners need to be constructive. It is in this sense that interactive subsumes constructive.... Such mutual exchanges of ideas imply that both partners make substantive contributions to the topic under discussion, such as defending and arguing a position, criticizing each other by requesting justification, asking and answering each other's questions, explaining to each other, and elaborating on each other's contributions (such as clarifying, building upon, correcting, etc.). ...

In addition to being constructive**,** a dialogue must have a sufficient frequency of turn taking to meet our definition of interactive. Two students who take turns giving mini-lectures to each other, even if they are being constructive, will likely not reap the same benefits as two students who frequently interject to ask each other questions, make clarifications, and so forth. We hypothesize that by frequently taking turns, it will be easier for students to incorporate their partners' understanding of the domain and to make adjustments to their own mental model...."

You can download the article at Micki's website:
chilab.asu.edu/publish.html
Chi, M. T. H., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes. Educational Psychologist, 49, 219-243 (lead article)
http://chilab.asu.edu/papers/ChiWylie2014ICAP.pdf