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WIP: Instructors' Framing of their Instructional Practice

Prof. Milo David Koretsky, Tufts University

Milo Koretsky is the McDonnell Family Bridge Professor in the Department of Chemical and Biological Engineering and in the Department of Education at Tufts University. He is co-Director of the Institute for Research on Learning and Instruction (IRLI). He received his B.S. and M.S. degrees from UC San Diego and his Ph.D. from UC Berkeley, all in chemical engineering.

Dr. Amanda Clara Emberley, California Polytechnic State University, San Luis Obispo

Dr. Emberley is an Assistant Professor in Mechanical Engineering at California Polytechnic State University, San Luis Obispo

John Galisky, University of California, Santa Barbara
Dr. Brian P. Self, California Polytechnic State University, San Luis Obispo

Brian Self obtained his B.S. and M.S. degrees in Engineering Mechanics from Virginia Tech, and his Ph.D. in Bioengineering from the University of Utah. He worked in the Air Force Research Laboratories before teaching at the U.S. Air Force Academy for sev

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Introduction
This WIP study stems from a larger project focused on the propagation of educational technology in diverse instructional settings [1, 2]. During that study, 24 faculty from 9 institutions were interviewed several times about a range of aspects of their instruction [3]. We identified how each instructor's application of the educational tool interacted uniquely with their instructional ecosystem in ways that we termed their *trajectory of practice*. The study reported here extends that work by exploring ways to conceptualize how instructors frame their teaching. For this case study, we contrasted two instructor's framings in an attempt to establish the viability of applying this analytical lens to the whole data set.

Theoretical Framework
We used the lens of resources and framing as an analytical tool to understand differences in how instructors approach their courses. Instructors' beliefs are known to play a key role in their instructional practices [4-7]. Historically, resources and framing have been used to understand cognitive processes of learners solving disciplinary problems [8] and to understand students' personal epistemologies as they approach that work [9]. Few, however, have taken the lens of resources and frames to understand instructional practice [10].

A person's framing is the set of expectations that they bring to a social situation (such as teaching) or, more simply, their view of "what is going on here?" [11, 12] Such framing influences how instructors make sense of in-the-moment decisions of teaching, how they design course activities, and what they chose to change. Resources are fine-grained knowledge elements, often subconscious, which can be learned (e.g., in teaching workshops) or can arise from lived experience [8, 9]. Different resources are activated in different situations. Resources are interconnected, and the activation of one resource may promote or inhibit the activation of others. When activated together, sets of resources can coalesce into a frame.

In this study, we ask the following research question: In comparing two instructors from different contexts, what resources do they identify when discussing their teaching practice? Ultimately, we are interested in connecting these identified resources to the framing that instructors bring to their courses.

Methods
This comparative case study focused on two instructors, Avery and Blair, from the set of 24 instructors in the larger study [3]. We use gender neutral names to provide anonymity. The interview protocol and previous coding scheme and analysis are described in [3]. Building on two previously coded interviews (the initial interview from each instructor), the four authors collaboratively re-coded the transcript, identifying resources with emergent codes. The first author initially coded Blair, then the four authors met and refined codes adding new ones until consensus was reached. The first and second authors then independently coded Avery, using this set of codes, but adding additional codes as they emerged. We then grouped those resources into themes, and both resources and themes are reported here. The ultimate goal is to connect instructor resources to the different ways they framed instruction, and from that analysis to identify ways that uses of educational technology fit within those frames.

Findings

We present the findings in terms of the four themes into which we grouped the resources: how the instructors positioned students for learning, instructor practices, instructional activities, and goals for instruction. For each theme, we present the corresponding resources, and identify the instructor who expressed them. We also provide a description of some salient aspects, attending to the ways the resources connect with one another.

How the instructors positioned students for learning

The resources for this theme are shown in Table 1. Both instructors identified **learning from peers** most commonly of the resources for how they positioned students for learning; however, Blair much more frequently than Avery.

Avery viewed small group work in terms of how changes in positionality and authority led to different forms of engagement:

> *Avery: When they get it from a classmate, they have to listen to that and think critically. When they're getting information from the teacher, they don't have to think critically about it because the teacher said it. It must be right, you know.*

To operationalize this resource, Avery provided class time for students "to set up the question." Coupling it with the resource **more problems are better**, she described encouraging students to complete homework in groups since "there's no substitute for doing problems. If you want to learn how to do problems, you got to do a lot of problems."

Table 1. Position students for learning codes

	Avery	Blair
Common language		X
Connect to prior knowledge		X
Connect to real life		X
Exams as growth opportunity		X
Extend examples to new problems	X	X
Having students take roles		X
Learning from peers	X	X
More problems are better	X	X
More time on topic = more learning	X	
Negotiate confusion		X
Reflective thinking of students	X	X
Student contributes to whole class discussion		X
Student reasoning		X
Students are motivated by points	X	X

Avery also connected this resource to the **material tool** resource by using Piazza as a technology tool to support asynchronous discussions.

Blair also connected **learning from peers** and **material tool** resources using hands-on activities to position students to "explore" statics concepts while Blair circulated around the classroom asking "probing questions."

> *Blair: like a lot of the pedagogy that'd be developed around the kit is designed for students to engage with each other with this kit as a communication aid and work through concepts.*

Blair also described "listening to student conversations" about concept questions as an important mechanism for formative assessment.

Both also frequently identified the **reflective thinking of students** resource to position students to learn. Avery engaged students in reflective practice to provide information about Avery's own teaching, asking them, "What was the most useful thing that I did in this class to help you understand the concepts?" or asking those who participated in office hours about a specific

classroom practice. Blair tied his use of this resource more directly to giving students authorship for their own learning. He described the rationale for his reading reflections as "not (to) have me dictate so much what they get out of the class (but to) have them articulate what they're getting out of the class." Blair connected this resource to the **connect to prior knowledge** and **connect to real life** resources, asking them to "summarize the main points of the reading and put it in the context and make an effort to relate that to their prior knowledge, what they learned in physics or what they've seen in math or what they know from real life, from their life experience." Later in the interview, Blair connects these resources to the **negotiate confusion** resource:

> *Blair Another prompt is what is surprising. Again, I'm looking for that same thing, for them to make an effort at connecting that to like, how does what they're reading conflict with their understanding of the way the world works?*

While both instructors referred to the **students are motivated by points** resource, it appeared much more prominent in Avery's framing of instruction, as they connect it to the cultural practices of schooling:

> *Avery: But I think the students have changed as well since I started. The internet has really come in and everything's on the internet. Like I said, the points thing just drives me nuts. It's like, "How much is this worth?" Like, "Is this worth me doing it depending on how many points it is?" I'm looking for a different way of dealing with that… I know, in order to get to good college you've got to get A's in high school. In order to get A's in high school you got to, "How many points am I getting for this?" That's how it's run in high school. The students are so used to that. That's their motivation.*

Instructor practices

The resources for this theme are shown in Table 2. Avery discussed only two instructor practices while Blair identified several more. Avery discussed the use of the **scaffolding problem solving** and **timing of complex material** resources while the latter was the only instructor practice resource that was not identified in Blair's interview. Blair's most commonly discussed resource, **responsive teaching**, was overlapped with **responding to instructional constraints**, **scaffolding problem solving**, and **assessing students' state of mind** resources.

Though they both discussed **scaffolding problem solving**, Blair's use of **responsive teaching** in combination with the scaffolding resource demonstrated a marked difference.

Table 2. Instructor practices codes

	Avery	Blair
Adapting practices from colleagues		X
Changing practice over the term		X
Prioritizing problem solving over content coverage		X
Responding to instructional constraints		X
Responsive teaching		X
Scaffolding problem solving	X	X
Assessing student state of mind		X
Timing of complex material	X	
Participation NOT correctness		X

Avery described how they would frontload useful information for problem solving by asking questions: "'What diagrams do you think you're going to need? How are we going to approach this? What equations? What does it bring in?' [I would] try and get them to think ahead in the problem, what they'll need, and have a discussion on that in class." Though this scaffolded the solving of a particular problem, they appeared to be framing their instruction in terms of a predetermined instructional pathway. Blair, however, would scaffold their instruction using a set

of increasingly complex questions, expecting that students would be able to solve the first based on prior knowledge but would eventually reach a point of uncertainty. In terms of their use of the Concept Warehouse tool [13] in assessing student understanding, combining it with the **negotiate confusion** resource:

> Blair: *What I found to be the most effective is I'll have a series of questions that increase in difficulty and/or nuance, and we'll kind of go through those until we get to that point, like, 'Okay, here's what we need to talk about, because this is where like more than half the class is not getting there' ... Then, without even discussing it as a class, I have them discuss as a group at their table and talk about it and try and convince their neighbors that they're correct. And then they answer again after that discussion. And then based on that answer, I decide whether or not we're going to talk more about it as a class ... It all depends on how confused people are.*

Blair appeared to be prepared for their instruction to proceed in a number of possible directions. They recognized that with each question, students may either be ready to proceed with a more complex version or may demonstrate a need for further explanation or instruction.

Instructional Activities

The resources for this theme are shown in Table 3. Both instructors most commonly discussed using the **material tools** resource as part of their instructional activities with Blair centering instruction around three-dimensional models.

> Blair: *it kind of looks a little bit like a lab, where groups of students are sitting around a table, exploring static concepts with these hands on models, and they're working through a worksheet, and I'm coming around asking probing questions.*

Table 3. Instructor activities codes

	Avery	Blair
Conventional HW	X	X
Material tools	X	X
Traditional lecture		X
Short quizzes	X	

Averys mention of hands-on activities was not as prevalent, mentioning "they have spools and they pull the string on the spool and see which way it goes." In addition to hands-on activities, this resource also contained technology tools (e.g., Concept Warehouse, Piazza) and pedagogical tools (e.g., whiteboards for small group collaborative learning).

The other resources in this theme appeared in the context of their role in pedagogical practice. For example, Blair used the **traditional lecture** resource at the beginning of the term, progressing to more active learning later.

> Blair: *Early in the quarter, I might do a little bit more demonstrating kind of more lecture, didactic style teaching on that front. Later in the quarter, it's much more groups of students standing around a table, working on a whiteboard.*

Avery found the use of **short quizzes** to be a particularly effective instructional activity for formative assessment:

> Avery: *I also do a lot of quizzes, like really quick five minutes quizzes. Like, "Here's a concept." You know like, "Here's a question. Just draw the diagrams." Or, "Here's a worked out problem. Point out the mistakes.*

Goal of instruction
The resources for this theme are shown in Table 4. The goal of instruction theme provided the most direct evidence of how these instructors framed their instruction. The goals for their students varied. Avery's goals were focused on preparing students for the final exam and for the following classes, with the concepts they needed from their current class:

> *Avery: I would say almost everybody else does friction last but I move it up into the middle. I push frames and machines and trusses back. I find that works pretty well [...] Friction is, it's really hard and then they have to know it going into dynamics. They've got to understand friction. The trusses and frames and machines are something very specific to statics, and still equilibrium stuff that they've kind of got. So, it makes a lot more sense to me to move friction up.*

Table 4. Goals of instruction codes

	Avery	Blair
Development of engineering identity		X
Growth in confidence		X
Learning how to learn		X
Learning concepts	X	X
Preparing students for professional practice		X
Preparing students for the following classes	X	X
Preparing students to pass the final	X	X

This quote illustrated their goal of teaching specific topics that students would use in subsequent classes.

Blair had a different approach to the goals of their class activities. They said:

> *Blair: I would say the thing that's most important to me is what they take away in their approach to learning and their approach to problem-solving. I hope that they are developing as a student and developing a better self-regulation. I really want them to learn how to learn. I'm a believer that the most important thing that... We can talk all we want about content and technical stuff in engineering, but really, what we're doing is we're putting students through the ringer, really intense material for four years and training them how to learn complex material efficiently. And that's what makes a successful engineer. Because you're not going to go graduate and get a job doing what you learn, solving textbook problems. Right?*

Here, Blair described their goal of helping students develop the skills they would need to be successful engineers, including self-confidence, taking responsibility for their learning, and growing as students. They did not list specific technical topics that they hoped to teach the students, but rather using those topics to teach the broader skills.

Discussion
One instructor framed their instruction as working to get students to solve the specific types of challenging problems in their mechanics course, viewing that as paramount to succeeding in future courses in the curriculum as well as on a common final exam. The other instructor framed instruction more expansively, stating that students were "only going to apply a small fraction of the technical content that [they] learned as an undergrad [in professional practice]," but would need the ways of thinking that these problems afforded. Hence, rather than focusing on the future courses in the curriculum, their stated goal was to develop successful engineers. This study potentially contributes theoretical understanding to approaching professional learning by considering not only about where someone is on their trajectory of practice but also how they are framing their practice and what resources they are activating.

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