Northeastern
Center for Advancing Teaching and Learning Through Research

The Scholarship of Teaching and Learning

Essays by the 2018-19 Faculty Scholars

About the Scholars Program

The Scholars program supports faculty as they engage in deep investigation of their students' learning experiences, the concepts and assumptions of their disciplines, and the body of scholarly work that is relevant to their teaching practice. Scholars meet as a cohort every other week throughout the academic year to surface and refine their questions about teaching and learning. As a community, they also share ideas and receive feedback on plans for improving and systematically investigating learning.

All of this work culminates in a Scholarship of Teaching and Learning (SoTL) project, which is a systematic, evidence-based investigation related to student learning. This project could be a close examination of a specific aspect of a course, a structured investigation of a particular teaching approach, or experimentation with new methods.

For most faculty, involvement in scholarly teaching begins long before their application to the Faculty Scholars program. Most have participated in the year-long Teaching Inquiry Fellows program prior to applying to become a Scholar, a sequence which CATLR recommends.

For more information on the Teaching Inquiry Fellows program or the Faculty Scholars program, contact CATLR at catlr@northeastern.edu.

2018-19 Scholars and program facilitators

INTRODUCTION

Gail Matthews-DeNatale, Ph.D.
Senior Associate Director
Center for Advancing Teaching and Learning Through Research

The essays in this booklet provide a glimpse into the experiences of the 2018-19 Faculty Scholars. Faculty Scholars is an intense yet rewarding journey. In these essays, we asked the authors to strike a balance between the informality of a first-person narrative and the formality of a referenced project write-up, because Scholars is as much about process as it is about product.

During our last get-together in December 2019 we shared a good meal, including celebratory cake, and warm conversation. The Scholars also completed a survey in which they shared both observations about the program and advice. According to one participant "[the program] allowed me to rediscover the pleasure of doing research, while deeply involved in teaching. It has allowed me to appreciate the feedback from colleagues with a similar interest in teaching and learning and very different experiences and backgrounds. I have loved the camaraderie, the laughs, the hard work."

In her study of class debates, Katy Shorey learned that students perceived the discussion which followed the debate to be the most valuable part of the activity, leading her to conclude that the "debrief is the main event." Perhaps this is also true of the Scholars experience? Michelle Laboy advises, "You will probably leave with more questions than you had when the program began. Due to this I think it is important to focus on starting and 'finishing the starting.' Realize that this work is likely multiple years in duration, but this program can kick-start that process."

We hope you enjoy the following essays, which as Michelle has observed are as much about beginnings as they are about findings!

ALESSANDRA DI CREDICO, PH.D.
Physics

Is less more?

As I enter my classroom, the usual buzz welcomes me. The students are taking their seats, chatting with their neighbors and getting ready for class. The lecture proceeds at its own pace, a short explanation of a new concept, some basic examples, a few interactive questions, a problem solved on the board, and repeat. Students seem very comfortable with the material. It is Mechanics, after all, the basic force of Nature at work, and examples are drawn from the everyday experience of each of us. They make sense, they feel familiar. Until, sitting at home in front of the homework, or in class in front of the test, every concept becomes blurry and confusing and solving a physics problem becomes a daunting task.

Being able to solve physics problems is a fundamental part of learning physics.

As an instructor, I have often wondered how to best approach the disconnect between perceived conceptual understanding and successful problem-solving. I have struggled to find the combination of approaches that would be beneficial for most of my students and felt that I was failing in helping my students develop this essential skill. After many attempts, guided by the existing work done on the subject (Renkl, 2014), I finally decided to consider the point of view of the student as my point of reference.

I started observing my students while solving problems in office hours and during group work, and I noticed that several of them found it difficult to generalize the concepts that had been introduced in class to the different situations presented in their problems. Research shows that students approach physics problem-solving as “novices” (Chi, 1981). A novice focuses on the minute details of the problem and often fails to see the big picture, underlying principles, or assumptions (e.g., Newton’s 2nd law, or conservation of energy). A novice may also fail to notice similarities between different situations. The expert is able to recognize the underlying physics principle even when the details of two problems are different. As novice students practice and learn they gain the expertise to consider

the big picture before they focus on the details of the problem. In order to grow from novice to expert, students need to practice encountering and interpreting different representations of the same problem so that underlying principles become more and more immediately evident to them. Aware of this research, I had my students work on several problems that share a similar underlying principle, then sat back and waited for the evolution from novice to expert to happen naturally. While some students gained expertise using this method, this evolution did not happen for others or happened very slowly, leading to frustration (for me) and overall confusion (for the students).

Why do some students gain expertise through problem-solving practice and others do not? In examining the problems I assigned more closely, I wondered if one source of confusion could be the way problems were presented (choice of words, adjectives used, context). Perhaps the presentation of a problem hindered a student's ability to spot underlying commonalities with other problems.

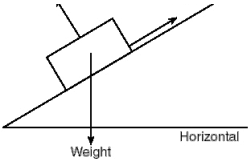
This became the focus of my research: **Does the presentation of a physics problem have an effect on the ability of the student to transfer that knowledge to a different problem?**

In particular, I wondered if elaborately detailed problems were more likely to obscure underlying principles. I looked for ways to investigate a connection between presentation style (detailed versus minimalist) and successful use of key elements (recognition of basic physics principles, assumptions, and adoption of effective strategies). What form of evidence could give me the information I needed to determine if there was a connection?

In the classes I teach, assessment of students' understanding of the material takes place through quantitative tests. The research methods of my discipline are also purely statistical and numerical in nature. Given the quantitative evaluative data available to me and the quantitative focus of my discipline, I assumed that student test grades would be the most useful form of evidence to determine if presentation style affected students' ability to progress from novice to expert pattern recognition. Quite immediately I

crashed against the reality that I could not determine such an effect through numerical data analysis alone.

A skier slides down a hill...



A block slides down an inclined plane...

I needed to find a different way to approach my question. I went back to the novice-expert research that had triggered my interest. I realized that I needed to listen to the voice of my students, one by one, to understand what they were thinking while solving their physics problems. With this new qualitative approach the number of students interviewed would be limited, due to logistics, but the thought process and perspective of the student would be much more evident.

Students are able to communicate information about their understanding of the problem they are trying to solve while commenting on what they read, what they notice (or not), what they deduce or induce from the information presented (Chi, 1981). Over the past year I have used a number of strategies for gaining insight into my students' thinking: comparing solutions and grades, comparing written explanations to conceptual questions with their grades, comparing only written explanations. None has given me the depth of information I need to establish or rule out a correlation between presentation and development of transfer skills. I trust that a purely qualitative approach drawing on educational psychology methods will be able to offer a clearer picture of what happens in the mind of a student when they look at different problems.

My next step is to record interviews with students as they think aloud and tell me about their problem-solving process. I am in the midst of arranging for these interviews.

My experience as a Faculty Scholar has allowed me to seriously consider the limitations of my own discipline while investigating a question that is essential to my discipline. Teaching students how to solve physics problems is one of the primary goals of any introductory physics course. But understanding how to do it in a way that optimizes student learning (transforming them from novice to expert-like thinkers) requires methods that are closer to psychology than physics. I am very excited to continue along this path, with the guidance of my mentors and peers.

References

Chi, M., Feltovich, P., & Glaser, R. (1981). Categorization and representation of physics problems by experts and novices. *Cognitive Science,* 5(2), 121-152.

Chi, M., Bassok, M., Lewis, M.. Reimann, P., & Glaser, R. (1989). Self-explanations: How students study and use examples in learning to solve problems. *Cognitive Science, 13*(2), 145-182.

Renkl, A. (2014). Learning from worked examples: How to prepare students for meaningful problem solving. In V. A. Benassi, C. E. Overson, & C. M. Hakala (Eds.), *Applying science of learning in education: Infusing psychological science into the curriculum* (pp. 118-130). Society for the Teaching of Psychology.

MARY LYNN FAHEY, DNP
Nursing

Clinical decision-making among nurse practitioner students

My SoTL experience began with a puzzle. How can I teach students to think like practicing clinicians while interacting with them only in a class setting? I teach within the Family Nurse Practitioner Hybrid Program. Our goal is to prepare students to become independent advanced practice clinicians. This is a demanding role with expectations for a high level of independence, including the ability to apply decision-making skills across a variety of clinical scenarios.

As I reflected on the challenge of teaching my students how to think like clinicians, I realized that I did not have a clear understanding of how my students view the process of clinical decision-making. In my class many skills are presented, practiced, and measured. These skills are taught through in-class activities and through modeling of skills in the clinical practicum. When asked, students could not describe their decision-making process. Some recalled acting only as instructed by the preceptor. Some provided textbook-like responses without tailoring their responses to the unique clinical situation.

I considered options for helping students practice clinical decision-making in the mentored setting of my classroom. I decided to introduce case-based discussions into the class. During case study discussions, students had an opportunity to apply clinical decision-making to hypothetical situations.

Students' case study participation was encouraging. Their responses were well thought out and reflected current evidence-based practice. The students were producing the information needed to effectively address the needs raised in the case study. But when I reviewed the clinical preceptors' evaluations of students and students' clinical notes, it became clear that students were inconsistent in applying the skills modeled and discussed in the cases in their clinical practicum work. This observation raised several questions for me:

- What classroom-based processes enhance students' clinical decision-making skills?
- Are the students using skills taught through in-class activities in the clinical practicum? If so, how?
- Do the students identify these skills as important to clinical decision-making?

These questions became the focus of my SoTL inquiry.

Around this time I also began to consult the literature on experiential learning, which helped me to refocus my SoTL inquiry. I realized that I had been approaching my investigation from the standpoint of the teacher and not the learner. I was deeply concerned with the student's ability to transfer what was taught and modeled in the classroom to the real-world, experiential learning setting of the practicum site. When considering Kolb (1984), I began to shift my attention to how I could turn my class into a real-world "workshop" that engaged students in decision-making, connecting classroom and practicum learning, going beyond the discussion of hypothetical case studies.

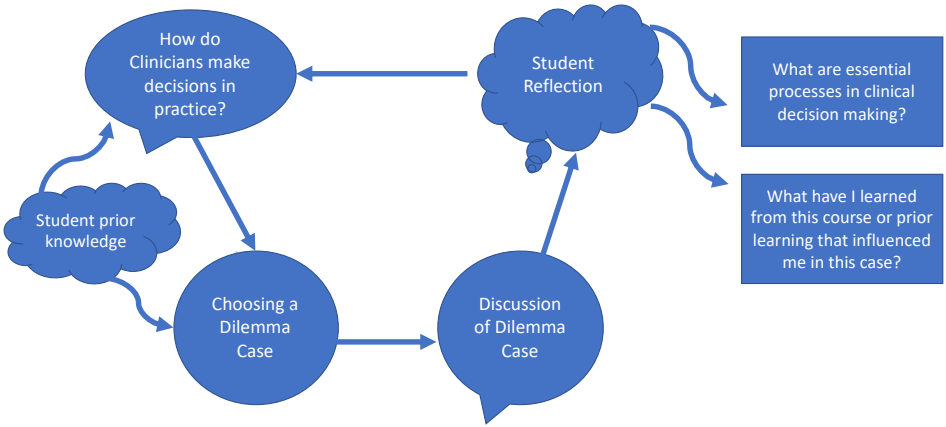
Experiential learning, such as clinical rotation, is where the need for skills becomes apparent, making students more attuned to the modeling and authentic practice that lead to skill development. Kolb and Kolb (2018) stressed the importance of learners naming their own experience in dialogue with others. This dialogue should emphasize praxis, the transformative dialect between reflection and action. This is the foundational concept that informs the Dilemma Case, which is the classroom practice I initiated and studied for my Faculty Scholars project.

The Dilemma Case is grounded in the clinical practicum. The students attend clinical practicum in the community where they observe skills being performed. They capture "moments," short notes to self that they enter into the SAIL app while on site. These observations serve as the basis for future reflection, leading to formal write-ups of how decisions are made and communicated. I provided students with a graphic organizer that helped scaffold and focus their attention on data (e.g., vital signs, observed body language in patient or family), information (connections made across

data), knowledge (insights gleaned from information), and action-oriented decisions that are based on knowledge.

For the Dilemma Case students select one observation, something they perceived to be challenging, and present it to the class with two student peers. They discuss the case from the standpoint of their dilemma, challenges, and perceived gaps in skills. The peers then reflect on the dilemma case and complete their own reflection. The students then contemplate future action based on the shared experience and reflections.

The model below is a representation of the reflective process within the Dilemma Case activity. The student presenting the case is asked to reflect on the influence of prior knowledge and newly acquired knowledge. Additionally, the student is asked to consider which essential processes in clinical decision-making influenced the situation. This consideration includes those actions and behaviors observed in action during the clinical experience. These may include their own actions and behaviors as well as those modelled by the clinical preceptor.



The Dilemma Case assignment helps students draw from their own challenging clinical experiences. The challenge may be related to a new situation that they had not yet encountered in their clinical practice, an interpersonal interaction or negotiation, or a complex situation requiring identification of resources. This exercise allowed students to think more

critically about their practice and clinical decision-making. They were encouraged to "think out loud" with peers and discuss how their prior learning informed their clinical decision-making. Class discussion assisted the student in identifying strengths and challenges in clinical practice.

Kolb and Kolb (2018) discussed the Educator Role Profile in their framework. I found this helpful in bringing myself as educator back into the process. The framework provides some direction on where and how to support the learner in the process of learning through experience and reflection. In the framework the role of the educator is described as flowing between a learner-centered and a subject-centered focus. The educator takes on the roles of facilitator, subject expert, standard setter/evaluator, and coach. The Dilemma Case activity allows the educator to take on a more learner-centered approach focusing on facilitation and coaching.

"What should my students know?" can only be appropriately addressed in conjunction with the learner-centered question: "How can I help my students learn skills and knowledge and be able to transfer what they have learned in a real-life context?"

The answer seems to be the link between experience and reflection. My SoTL investigation is well underway. Data collection is taking place across several semesters in order to allow time for the students to collect "moments" and identify Dilemma Cases. Initial coding of data has begun. It is my hope that the process of reflection and discussion will allow the student to identify steps to clinical decision-making and transfer these skills to actual practice.

References

Kolb, A., & Kolb, D. (2018). Eight important things to know about the experiential learning cycle. *Australian Educational Leader, 40*(3), 8-14.

Kolb, D. (1984). *Experiential learning: Experience as the source of learning and development.* Prentice Hall.

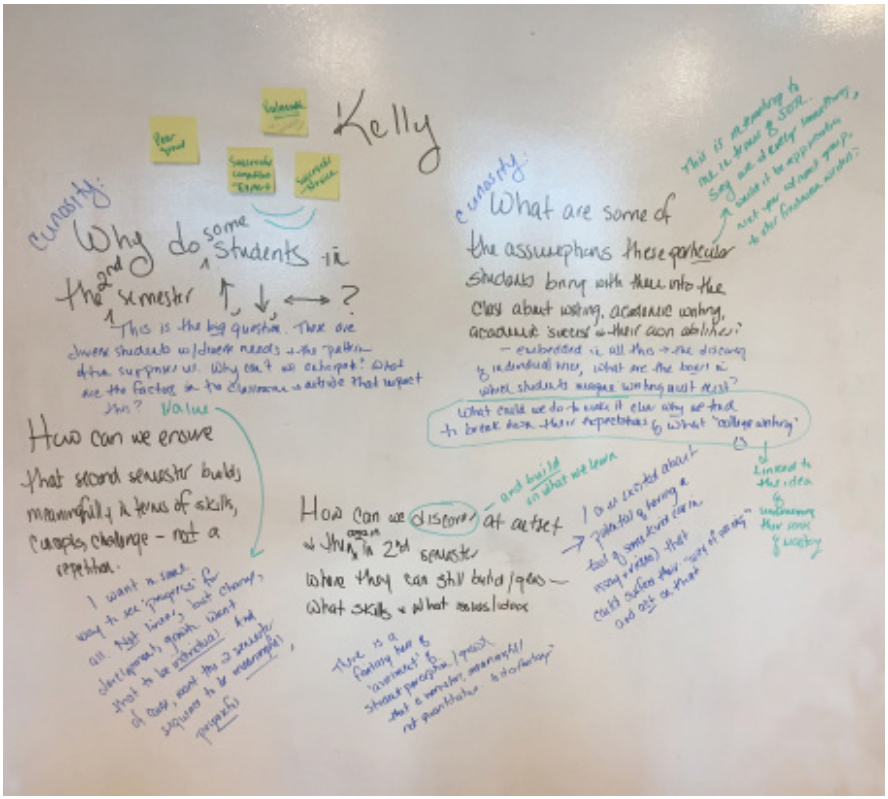
KELLY GARNEAU, PH.D.
English

Writing with a net: Exploring strategies to encourage risk-taking in First-Year Writing

As I walk around our First-Year Writing classroom, students chat easily about their work, ask questions, express frustration, point to where they are stuck in their writing and where they have made changes. One group is deep in conversation, carefully working out one writer's innovative take on the essay prompt. Another group is quiet, slowly putting commas where they think they belong and "fixing things up" without much attention to what they are actually reading. This is our second semester together, so as I wander I'm both pleased and frustrated. Pleased to see a student who used to avoid taking any risks in her work, now really making the assignment her own. Frustrated to see several students who have been quite strong just barely engaging. I want to know what they are thinking; I want to know why things clicked for one student, and another has checked out. Basically, I want to be a mind reader.

This is the start of my research project—the desire to understand why, in a two-semester First-Year Writing sequence, some students who were doing well at the end of the first semester continue on an upward trajectory, while others stall. Some who struggled in the first semester suddenly buy in, and their writing deepens and improves. I had already spent a lot of time on course delivery and assignment design, the things that I could "do" to engage my students. I now wanted a clearer understanding of their experience of the course, and what their motivation was to stay connected, or to check out.

I began with a mess and a tangle of inquiry, a set of interconnected questions that looked like this:



The author explores the roots of her curiosity through a Scholars brainstorming process

Fairly terrifying. I wanted to know everything. I narrowed my focus to two related areas: student motivation and fear of failure. Being open to not knowing, and even to failure, is essential to taking risks, being curious, and producing writing that generates knowledge rather than filling in a formula. As Carr frames it, failure is essential to the iterative process of writing, but "the discourse around failure... induces anxiety, loss of confidence, fears that we are inadequate" (2013, p. 4). What if we could reduce the anxiety? Create room for risk-taking and failure, or at least failure as my students perceive it? I narrowed my question: "How do teaching strategies that encourage rhetorical risk-taking affect students' engagement with assignments across two terms, and impact their identities as writers?"

To get answers, I started flying the plane while I was building it. I drew on the expertise of colleagues and relevant research to develop a grading contract. There are many ways a grading contract may be integrated into a course. In my class, the contract is an agreement the students and I develop together that emphasizes the writers' labor, their process developing a project, and *then* variations in quality. This shift, I hoped, would allow students to take risks in their writing without fear of failing, as long as they participated fully in each project. I hoped contract grading would "give all students a space that invites internal motivation, not just externally imposed motivation" (Danielewicz & Elbow, 2009, p. 257).

To gauge if this and other strategies were effective, I implemented a series of surveys over the course of two semesters. Those surveys show that students did make a connection between risk-taking, confidence, and their identity as a writer. In the second-semester final course survey, one student identified what was most effective about the course as "having the opportunity to really write how I wanted to without being nervous/scared to fail or make a mistake." Another wrote: "I've been able to develop into a confident and convincing writer able to take risks."

In addition to the surveys, I required process reflections at the end of each project, and course reflections periodically throughout both terms. While reflection has long been part of my practice, I centered it more consciously in each writing project, responding to Belanoff's call "for another place of sanctuary... that we as teachers can create for our students by valuing reflection and by creating reflective time and space in our classrooms and in our own students' writing" (2001, p. 410). Through reflection students synthesize their writing experience, their choices regarding form and audience, the places where they were able to take risks and where they chose not to. In the survey I ask: "When you are asked to reflect on your work as a writer, what are you being asked to do? Is it helpful/useful?" In response, students often note a moment of "stepping back," "adjusting," "seeing where you struggled and succeeded." While for some it remains a process of "correcting," for most it is more complex: "Reflecting to me is looking at your words from a new perspective. If you can break down the barriers of your own biases while staying true to yourself, it's easier to improve."

I also have discovered that some of my assumptions about my students' experience of my course were just wrong. While I worried that students were simply not confident enough to take risks, the initial survey showed that 75% identified themselves as good writers. I became more curious, then, about how they actually do see themselves as writers, so I added the question: "How would you describe your identity as a writer?" to the surveys at the end of Semester 1 and Semester 2. The responses indicate that this identity does evolve. A student who in December answered by acknowledging "I really had no idea what I was writing," in April identified as "a storyteller." Another who identified as "a much better writer than people think" in December, saw themselves as just "different" in April: "...the way I look at assignments and approach them is just way different than others and I am proud of that." This suggests that the classroom interventions to encourage both reflection and risk-taking do impact writerly identity. This matters because if students see themselves "as writers" they can engage with ideas, develop knowledge, and reach their chosen audiences, within and beyond my classroom. As one student wrote: "I've been able to acknowledge the writer I am."

I continue to gather surveys and reflections with a second group of students, and will be coding and analyzing responses to see if there are consistent patterns or significant variation based on different class cohorts. While this work will not guarantee that all students are engaged all the time, or that they will progress in a predictable way, it provides a window on why they do engage/disengage, and I am an active investigator—if not, as I'd hoped, a mind reader.

References

Allison, C. (2013). In support of failure. *Composition Forum, 27.* Retrieved from https://compositionforum.com/issue/27/failure.php

Belanoff, P. (2001). Reflection, literacy, learning, and teaching. *College Composition and Communication, 52*(3), 399-428.

Danielewicz, J., & Elbow, P. (2009). A unilateral grading contract to improve teaching and learning. *College Composition and Communication, 61*(2), 244-268.

DAVID HAGEN, J.D.

Criminal Justice, Intelligence, and Homeland Security

Does prior knowledge affect objectivity?

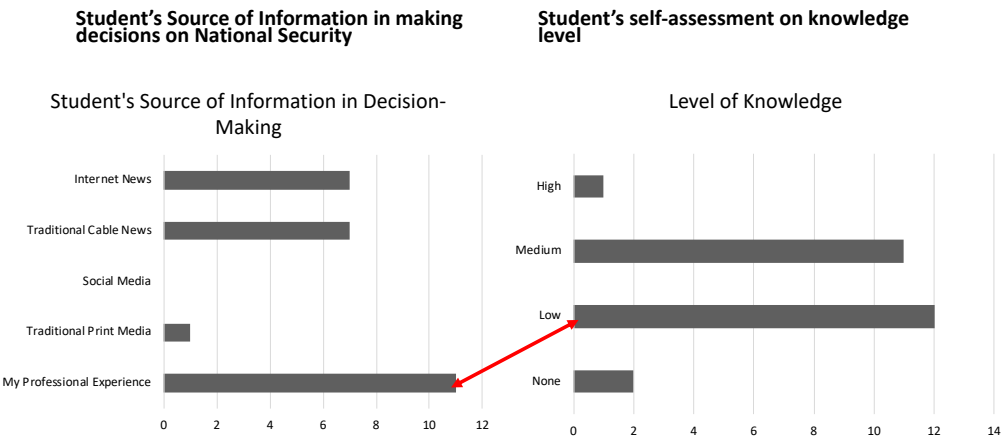
"The government can search anything I have, if you're not doing anything wrong, why should you have anything to hide?" The student's comment led me to consider how prior knowledge and experiences may influence objectivity. The concern that emotions informed by prior experience may overshadow evidence and research has driven my Scholarship of Teaching and Learning as it conflicts with my own education as an attorney and experience in intelligence analysis.

I teach graduate students in the Strategic Intelligence Analysis and Criminal Justice programs in the College of Professional Studies. While objectivity is vital in all disciplines, the prolific media coverage and often skewed public commentary surrounding contemporary issues of national intelligence and criminal justice can impede students' decision-making skills. To that end, I crafted pre-course questionnaires from which to gather evidence in support of my research question, "How does prior knowledge affect student decision-making in Criminal Justice and Strategic Intelligence Analysis education?"

The surveys I administered underwent several revisions as I attempted to isolate certain variables related to prior knowledge. I decided to focus on the primary sources of students' knowledge about national security and their self-assessed level of knowledge in the area. Where did students get their information from? What information sources did they rely on most in making decisions?

Our class sizes are small, so in the time period from June 2018 to May 2019, there were 24 students in courses related to this study. In a course on national security (Figure 1), 85% of students responding assessed their level of knowledge as low or medium, with 50% using professional experience as the primary source in knowledge they used in making decisions related to national security.

Does Prior Knowledge affect decision-making in students in National Security courses?



Student's Source of Information in making decisions on National Security

Student's self-assessment on knowledge level

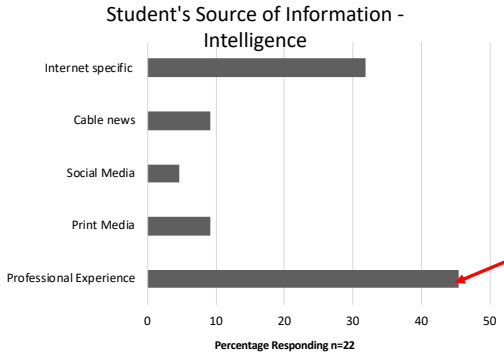
Fig 1. Sources of and self-assessment of knowledge in National Security, 6/2018 through 5/2019.

I then examined if these results changed depending upon the course area. In a Fall 2019 Intelligence & Policy Course (Figure 2), results showed a higher level of self-assessed professional knowledge (22.72% self-assessing as high), yet the same percentage assessed as low, with 45.45% reporting the most significant influence on their decision-making is personal knowledge. In this course, 77.26% of responding students assessed their knowledge as low or medium, and still, 45.45% relied upon personal knowledge as their primary source of influence in decision-making. In summary, half of the students with a low or medium level of self-assessed knowledge rely upon that personal knowledge when making subject matter specific decisions.

According to Cooper, Ralphs, and Harris, "increasingly complex and specialized forms of experiential knowledge are being produced, circulated and acquired outside of the academy in spheres of work, civil society, politics, community and family life" (2017, p. 200), but such forms of knowledge may not be explicit to learners themselves. The possibility exists that, given all these potential sources of learning, students may have an actual higher level of knowledge then was self-assessed. In adult learners, the life skills of problem-solving and workplace analytical skills carry such significance that students may confuse personal growth and development with narrowly focused professional proficiency.

Does Prior Knowledge affect decision-making in students in Intelligence courses?

Source of Information



Level of Knowledge

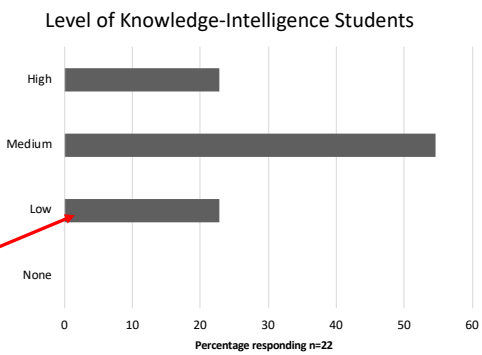


Figure 2. Sources and self-assessment of knowledge in Intelligence & Policy, September 2019.

Snyman and van den Berg (2017) found that the "learner profile" can influence individuals' recognition of prior learning: The learner profile "consists of four main dimensions, the personal attributes, and characteristics, the multiple learning contexts, the knowledge, skills, and experiences gained through a journey of life and career development and the process of growth and development as an adult learner" (p. 32). They concluded that these processes do not occur in isolation, "justifying a holistic and eclectic" approach.

This broader approach may infuse adult learners with problem-solving skills, which elevate professional competencies. What we may mistakenly label as a low to moderate level of expertise may as a product of "multiple learning contexts" be at a higher level. This "true" level could then justify why students report a low/moderate level still overly rely upon this knowledge.

Cooper and Harris (2013) looked at the distinction between the broader experiential knowledge gained through adult learning and the discrete analytical skills necessary for complex problem-solving. They argued "that while knowledge gained from life and work experience may be as valuable

as formal, academic knowledge, these two forms of knowledge are not the same" (p. 448). Their research distinguishes between the technical and structured disciplines (such as intelligence analysis) and the more nuanced social science areas, which have wider applicability of work and life experience. It may be that in the courses considered in the combination of learning sources, the knowledge and skills adult learners acquire is higher than that which they may actually assess themselves as possessing. This recognition of a broader base of skills that may be under-recognized by students in this assessment has resulted in my attempt at a higher degree of granularity in the survey questions. This may develop into assessment of specific skill sets developed in a holistic, experiential manner.

I have developed an appreciation in the distinction between discipline-specific skill sets, which require a quantifiable level of proficiency, and those acquired through life experiences, which may amplify the professional skills. The challenge is to identify essential life experiences and incorporate this into a broader understanding of their applicability in making objective decisions in the intelligence and national security arenas. My next steps need to identify specific skill sets that are necessary for analytical work and attempt to quantify those in the survey. This would support efforts to frame the problem of identifying levels of knowledge.

References

Cooper, L., & Harris, J. (2013). Recognition of prior learning: exploring the "knowledge question." *International Journal of Lifelong Education, 32*(4), 447-463.

Cooper, L., Ralphs, A., & Harris, J. (2017). Recognition of prior learning: The tensions between its inclusive intentions and constraints on its implementation. *Studies in Continuing Education, 39*(2), 197-213.

Snyman, M., & van den Berg, G. (2018). The significance of the learner profile in recognition of prior learning. *Adult Education Quarterly, 68*(1), 24-40.

MICHELLE LABOY, MUP, M.ARCH

Architecture

Learning technical concepts by design: Insights from reflecting-in-action

As a designer teaching both design and technical courses to Architecture students, I understand the value of active learning experiences that more closely resemble the creative and integrative nature of the design process in professional practice. Learning to design is hard and exciting but often marginalizes the technical side of architecture despite the student's initial desire to learn it because, as the leading architecture educator Ed Allen described, we educate the desire out of them (Allen, 2006). I had a hunch that experimenting with and applying technical concepts in a design project would be a better way to learn than the lecture-exam model. After a few years of experimenting and making informal observations, I wanted to move past intuition and anecdote towards a more systematic understanding of the student's learning experience, and to closely examine the barriers to engage science in the generative design process.

My initial inquiry sought to determine if design projects are a better context in which to teach architecture students technical concepts and tools that they can later apply to many different situations as professionals. I observed that in lecture courses students expect to learn step-by-step processes that can be repeated in similar problems, but when problems are not similar enough they often fail to see connections between concepts. On the other hand, in design courses the same students expect to deal with uncertainty, complexity and abstraction through multiple cycles of iteration, feedback and reflection that may stem from precedent but will result in different and unexpected solutions. Teaching design as a reflective-practice better resembles—and prepares students for—a complex and uncertain world (Schön, 1987). Unfortunately, even though project-based learning in technical courses is becoming integral to many design fields, it often models rational problem-solving rather than reflective practices (Currano & Steinert, 2012). This can reinforce the contrast between creativity in the design curriculum of architecture and the "medicine" of its technical curriculum. I wanted to examine the effectiveness of a model of project-based learning that avoids elevating technical tools as the end in themselves or relegating

them to solve problems created by design. If successful, my hypothesis was that a design project should help students connect those concepts and tools with the creative process of form-making and space organization to be applied in future situations.

The starting point of my inquiry was an existing design project within the course called Structural Systems. Limiting the size and scope within technical constraints that resembled reality focused the project on the structure, while rewarding conceptual, formal and aesthetic ambition made for an open-ended problem with many possible solutions: ideally an intentionally "ill-structured" or "messy problem" (Schön, 1987). While multiple phases allowed for increased complexity, iteration and feedback, the project lacked opportunities for critical reflection. I was missing the opportunity to look more closely at the design process as it unfolds, and to expand my inquiry beyond the effectiveness of project-based learning of this technical knowledge, towards a deeper understanding of the learning process: what helps students learn, when and why. Reflection-in-action (during the process) rather than reflection-on-action (after the fact) can bring new insights about the design process to the student's next experience (Tracey & Baaki, 2014). Similarly, these reflections could bring valuable insights about the learning process to my future teaching. Fortuitously, the method of gathering data is also a vehicle for more effective learning.

Pilot data from the reflections I collected during the first year of my study provided evidence of what other scholars discovered: students need to be taught the tools for critical reflection (Currano & Steinert, 2012). For example, despite being urged within the assignment prompt, students rarely used diagrams (schematic representations of complex ideas) in their reflections. This was surprising considering how central diagramming is to design education, and how essential it is to describing structural concepts and relationships. The pilot data also revealed that physical model making in the last phase of the project proved to be the most transformational to students' learning. I realized it was necessary to not only refine and improve the prompt for reflection, but also to teach students how to use these diagramming tools within their process of reflection. During the second year I used case studies and readings to explicitly teach the role of diagramming and model making, traditional design tools, within the creative process of

ideating, testing, and reflecting on structural concepts. As shown in Figure 1, I reorganized the course content around three phases of the design project to examine one reflective practice at a time: diagramming, modeling, and finally the dreaded calculations. Each phase was scaffolded with prompts for reflection, and I added surveys at entry and exit points to better understand student assumptions, expectations, and changing perceptions before and after the design project experience. My assumption was that by equating the calculations to the other two design tools, the calculations would become more clearly part of a design process of refinement and iteration.

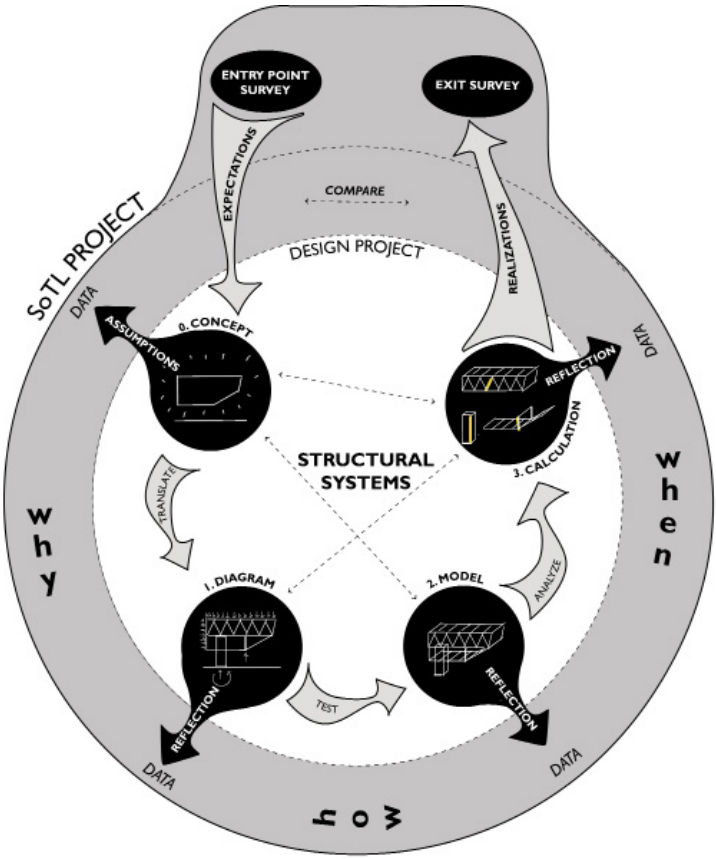


Figure 1: Diagram of the research project surrounding the course design project.

The results have been both expected and surprising. The entry survey confirmed the problem: before taking the class, less than half of students thought that technical knowledge (e.g., calculations) would be extremely or somewhat important for them. Many more thought it would be applied in professional life than thought it would be important in design studio courses. Even for their professional life, students perceived this knowledge to have more utility for their once-in-a-lifetime license exam than for design practice, evidence of a disconnect between creative and technical aspects of architectural education. This perception may have been reinforced by the majority's belief that math and analytical skills are slightly more important for this course than traditional creative skills of precedent study, diagramming, drawing, model-making, and especially design. After the design project, the exit survey revealed an increase in the perceived importance of all of these design-related skills, except design when listed by itself, which remained low. To my surprise, diagramming and model making saw the most significant increases in perceived importance, while math and analysis remained nearly unchanged or dropped in perceived importance.

The reflections, which I am still mining, have proven to be a rich source of data about the struggles, realizations, discoveries, and frustrations in the learning process. Most students seemed to immediately recognize the value of quick and less precious physical models for testing and developing a more intuitive understanding of their ideas, perhaps because of the tangible truth of their overt physicality. During the last phase of calculations, while still considered the most difficult and frustrating, students demonstrated significantly more confidence in their adaption of the analytical process to a new situation, despite their strong belief that the numbers themselves may have included mistakes. It wasn't until this last phase that their reflections explicitly and nearly consistently expressed that the early diagramming was an essential tool to achieve clarity and confidence, and that this mattered more to them than getting the exact numbers right. These reflections explain the shift in the perceived value of reflective design skills and the increased confidence of students in their conceptual understanding of and ability to apply this technical knowledge to future work. While searching for ways to more effectively bring science into design practice, the findings of this research shed light on what scholars consider the matters of significance: the value of the reflective process in turning idiosyncratic design practices into a more productive science (Buchanan, 2013).

References

Allen, E. (2006). The essence of building technology. Retrieved from http://btes.org/pdf/Edward%20Allen%20BTES%202006%20Keynote%20Speech.pdf

Buchanan, K. (2013). Creative practice and critical reflection: Productive science in design research. *Design Issues, 29*(4), 17-30.

Currano, R., & Steinert, M. (2012). A framework for reflective practice in innovative design. *International Journal of Engineering Education, 28*(2), 270-274.

Schön, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions.* Jossey-Bass.

ANDREW MACKIE, MPAS, PA-C
Physician Assistant Program

The impact of worked examples on acquisition of ECG interpretation skills

As a professor in the Physician Assistant program, one of the subjects I teach is electrocardiography (ECG), which examines the electrical patterns produced by the heart to diagnose a variety of cardiac conditions. Because they are often used to detect urgent problems, and because expert-level interpretation is rarely immediately available, being able to read ECGs is an important skill for any clinician. However, the complexity of learning how to see the patterns in those "squiggly lines" makes this a challenging topic to teach and learn. While a variety of studies have looked at various approaches, no clear method has been found to be superior (Fent, Gosai, & Purva, 2015).

Prior to entering the Faculty Scholars program, I was a participant in both the Teaching Inquiry Fellows and the Evidence-Based Teaching Fellows programs. In these programs, I had the opportunity to explore the educational literature and reflect on which principles might apply to my teaching. In the course of these experiences, it became clear to me that existing studies about teaching ECG focused primarily on conceptual knowledge and less on "strategic knowledge," which emphasizes the application of concepts. The importance of both practice in interpreting ECGs and of feedback to support student learning became evident. After students were instructed in the conceptual portion of the knowledge in the first semester, the addition of practice sessions through the assignment of weekly ECG interpretation in the next semester was relatively straightforward.

In *How Learning Works*, Ambrose et al. (2010) define feedback (Figure 1) as "information given to students about their performance that guides future behavior" (p. 125). They further suggest it must be coordinated with timely opportunities for practice to be effective. As I considered how to best provide that feedback I realized the time required to hand-grade 10 weeks of assignments for 44 students was prohibitive, leading to my initial approach of providing a written answer key after submission of the assignment to allow students to compare their responses with the correct interpretation.

While this seemed adequate, it was not as timely as would be optimal, so I turned to the literature to explore whether more effective approaches were available.

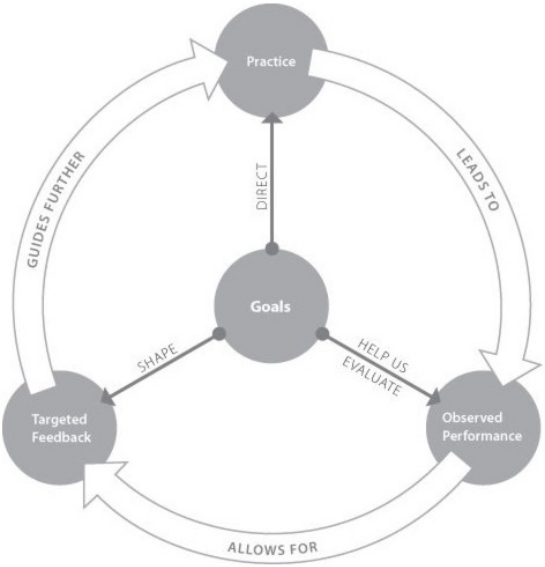


Figure 1. Cycle of Practice and Feedback (Ambrose et al., 2010).

This led me to the concept of "worked examples" (Kopp, Stark, Kühne-Eversmann, & Fischer, 2009). Instead of being left on their own with a problem-solving assignment, novices who had acquired basic conceptual information and were ready to practice its application could be more effectively supported by the use of worked examples where learners would benefit from attempting the exercise on their own, then be walked through the example by an instructor. The reduced cognitive load with this approach would allow them to focus more on the strategies involved in solving a problem and better learn how to apply the learned material.

For my class this took the form of using a "video key" during which students could hear me "think out loud" as I went through each step of interpreting that week's assignment. The videos are in the format of a voice-over animated PowerPoint and are specific to that week's assignment, allowing the students see the particular elements of the ECG on the video as I

discussed them. This "worked example" approach seemed a better solution, but how could I be sure it was actually more effective than simply providing the written key immediately after submitting the assignment?

After reading an article describing educational study structures (Windish & Diener-West, 2006), I decided to randomize my students into two different groups. During the first semester they each completed the same course in which they learned the fundamental concepts of ECG interpretation and during the second semester they received the same weekly practice ECG assignments. One group then had access to the video key and the other the written key. Immediately after submitting the assignment each week, students would get access to their designated key, which they would then review.

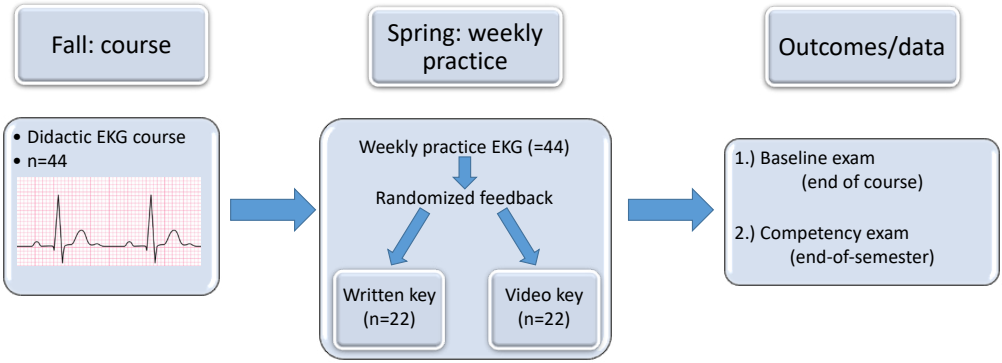


Figure 2. Study design.

Quantitative data was collected that consisted of grades in the introductory first-semester didactic course, providing a baseline to compare the two groups. At the end of the second semester a more rigorous competency exam was administered. Rather than simply demonstrate they understood the basic concepts of the elements involved in ECG interpretation, they were required to fully interpret five 12-lead ECGs of increasing complexity. Differences between the results of this exam reflected any change that could be attributed to the intervention of video vs. written key. P-values

comparing the groups at baseline and after the intervention were calculated using a two-sided Student's t-test.

At baseline, grades from the initial didactic ECG module were not significantly different (92.41% vs. 90.83%, absolute Δ 1.58%, p = 0.2071). After a semester of ten weekly 12-lead ECG practice assignments, the group which had feedback via a video key explaining the correct interpretation had a performance that was educationally superior, but only trended toward statistical significance (72.52% vs. 66.53%, absolute Δ 5.99%, p = 0.0538) on the 5-ECG competency exam.

Semester	Assessment (by intervention group)	n	Mean score	Δ	p-value
1	Baseline ECG didactic module grade (pre-video key group)	22	92.41%	1.58%	0.2071
	Baseline ECG didactic module grade (pre-written key group)	22	90.83%		
2	Competency exam grade (video key)	22	72.52%	5.99%	0.0538
	Competency exam grade (written key)	22	66.53%		

Table 1: Results.

These results suggest that feedback with a video key may be superior to that of a written key on weekly assignments intended to develop competency to interpret 12-lead ECGs. Failure to reach a definitive level of statistical significance was likely due to the small sample size (n=44); however, the nearly 6% difference in scores on a rigorous competency exam indicate the magnitude of effect was likely sufficient to be of educational benefit. Limitations include the small sample size and that findings are based on data from a single program.

Being a member of the Faculty Scholar cohort helped me identify a conundrum particular to my teaching context, explore the educational literature, develop a way to assess different strategies to solve the challenge, and collect and compare data to determine if one method tested was superior. This experience has helped me take a more scholarly approach to teaching and educationally benefit my students, as well as become a member of a community of like-minded professors seeking to participate in educational scholarship.

References

Ambrose, S. A., Bridges, M. W., DiPietro, M., Lovett, M. C., & Norman, M. K. (2010). *How learning works: Seven research-based principles for smart teaching.* John Wiley & Sons.

Fent, G., Gosai, J., & Purva, M. (2015). Teaching the interpretation of electrocardiograms: Which method is best? *Journal of Electrocardiology, 48*(2), 190-193. doi: 10.1016/j.jelectrocard.2014.12.014

Kopp, V., Stark, R., Kühne-Eversmann, L., & Fischer, M. R. (2009). Do worked examples foster medical students' diagnostic knowledge of hyperthyroidism? *Medical Education, 43*(12), 1210-1217. doi: 10.1111/j.1365-2923.2009.03531.x

Windish, D. M., & Diener-West, M. (2006). A clinician-educator's roadmap to choosing and interpreting statistical tests. *Journal of General Internal Medicine, 21*(6), 656-660.

LAURIE NARDONE, PH.D.
English

Owning their writing: An investigation of students in a year-long, first-year writing class

In an annual teaching reflection for the Writing Program, I wrote about my desire to be "patient with my own learning." This was harder than I thought. As a classroom teacher, when there is a problem, my impulse is to fix it immediately, rather than observe, explore, and study it. But what might happen if I held it in my hands for a bit, if I turned it over, looked at it from different angles, in a different light?

I teach a two-semester, required first-year writing course in Northeastern's General Studies program. This program supports a population of about 100 students: athletes, city scholarship students, TORCH (first-generation) scholars, international students, and students from the general population who may benefit from extra support in their first year. It's an enrichment program that offers a transitional year for students whose admissions statistics may not match those of the incoming class, but whose "potential for success" with extra support is high. Many of these students, however, *appear* to lack both confidence and preparation, manifesting itself in students seeming uninterested or inconsistent in their writing projects. I realize my consideration of inconsistence is based on a linear notion of progress, but with carefully scaffolded assignments, I do expect students to move forward with certain skills and confidences.

Here, I turn to Yancey and her colleagues who discuss "signature pedagogies" in the context of First-Year Composition (FYC) classes; they ask, "How we might help students *think like* writers?" (Yancey, Robertson, & Taczak, 2014, p. 4). My impression is that students arrive in my class *without* conscious writerly identities; instead, they arrive with rules about writing that seem separate from themselves, and they see writing projects as tasks or barriers—a hoop to jump through, something isolated and in a vacuum. And so each project or assignment becomes a completely new and separate opportunity. This makes me wonder: How might they understand or recognize their identities as writers? How might they see writing not in

isolation, but as something on a continuum, as something they process and perform in their identities as writers?

To gather more information, I collected student reflections, exit cards, and surveys throughout both semesters. The surveys, especially, indicate the most valuable information for my inquiry. In them, I ask students to describe what makes them feel successful and what makes them lose confidence as writers; among other things, I also ask them to describe what they consider to be good writing. I administered this survey three times over the course of the year: on day 1, at the end of the first semester, and at the end of the second semester. Comparing shifts in the answers to these questions of success, loss of confidence, and good writing have given me a lot to be curious about.

Data collected from first-day student understanding of writing success is illustrated in the following figure:

First-Day Survey: What specific experiences have made you feel successful as a writer?

On our first day, students identify their writing successes via external markers like grades and teachers, while they see their writing challenges as inherent personal flaws—as identities (*I am bad at grammar, I don't read enough, I have never been a good writer*).

Most students come to this class with insufficient or limiting prior knowledge; for instance, many have been taught formulas for writing (the five-paragraph or compare/contrast essay), or they have been discouraged from using personal experiences or pronouns. This limiting or insufficient prior knowledge almost always calls attention to a lack of students' sense of self-efficacy. In "Notes toward a Theory of Prior Knowledge and Its Role in College Composers' Transfer of Knowledge and Practice," Robertson, Taczak, and Yancey (2014) highlight one of the ways that "students actively make use of prior knowledge and practice." This method of "drawing on both knowledge and practice and employing it in ways almost identical to the ways they have used it in the past" resonates with my experience as students relied on duplicating previous practices, at least in our initial weeks together.

By the end of our year together, I want students to be able to assess rhetorical situations and have the confidence to complete *any* writing assignment. So how do I help them get from point a to point b? By looking at the exit surveys, I see that students shift from identifying "good" or successful writing *outside* of themselves (i.e., grades, grammar, rules, organization) to seeing "good" or successful writing as *self-awareness* of personal writing processes (*I need two drafts, freewriting is crucial to my process, I have to find a personal connection to the assignment so I can foreground my voice, I need to connect with the audience*)

Last-Day Survey: What specific experiences have made you feel successful as a writer?

As you can see above in a word cloud created from our final survey, students move *away* from talking about grades and teachers when asked about their writing successes, and the corpus analysis shows a shift from first-day responses. What strikes me especially is the prominence of words like *helped, voice, explore,* and *difference*. These markers highlight writing as a community- and process-based endeavor. But how does it happen? Can it be fostered? Quantified? Mapped out? These, perhaps, are questions for future research.

As Jones notes in his discussion of student performance and self-belief, college writing instructors "should focus on helping them become more internally oriented and become more aware of productive and counterproductive academic behaviors." He continues, "It may also be that students need help recognizing the ways in which their behavior (not luck or chance or the teacher's attitude) and their writing strategies have resulted in improved writing performance" (2008, pp. 233-34). Indeed, helping students create, recognize, and practice a writing process as personally valuable seems to set the stage for acknowledging and internalizing a writerly identity, one that encourages writing ownership and process.

References

Jones, E. (2008). Predicting performance in first-semester college basic writers: Revisiting the role of self-beliefs. *Contemporary Educational Psychology, 33*(2), 209-238.

Robertson, L., Taczak, K., & Yancey, K. (2012). Notes toward a theory of prior knowledge and its role in college composers' transfer of knowledge and practice. *Composition Forum, 26*.

Yancey, K., Robertson, L., & Taczak, K. (2014). *Writing across contexts: Transfer, composition, and sites of writing*. Utah State University Press.

DESISLAVA RAYTCHEVA, PH.D.
Biology

Inquiries into student assumptions about the scientific process

I teach an inquiry-based research class, Biology Project Lab, in the Biology Department at the College of Science. Usually students take this class during their sophomore year and we recommend that they take it before their first co-op experience. In the class, students work in groups to design and execute their own research projects.

Understandably, from the student's point of view the main objective of the class is to prepare them for their first co-op experience in a laboratory research setting. While taking the class, they are often already applying to co-op positions and reading job descriptions that contain lists of techniques the students need in order to be considered for the position. At the beginning of the semester, students will sometimes ask for an exhaustive list of the laboratory techniques they will learn in the class. On occasion, they will specifically select a project that will expose them to the coveted technical skills.

Although proficiency in lab techniques is important in bench research, it is simply a basic skill in the scientific process. A very important objective of the course, and for any scientist in training, is to develop higher-level skills, including organization, designing and planning an experiment, analyzing data, troubleshooting and planning the next steps, writing, and oral communication skills. Students often ask questions related to *technical skills*, but I have never been asked by a student what higher-level skills they will learn in the course. All along, I have had concerns that they may be preoccupied and overly focused on technical lab skills, and possibly failing to recognize the importance of developing more overarching scientific competencies and an understanding of the complexity of the scientific process.

I always assumed that the focus on co-op preparation was the only factor prompting my students to focus on technical skills. Studies have shown that in high school students are taught how to do science but often

without the conceptual skills to understand the process of science (Lederman et al., 2013). Students often view replication of experiments as "busy work," especially if the experiment yields expected results, and often fail to grasp the critical importance of iteration in research (Corwin et al., 2015). In the context of inquiry-based projects where students work in groups, each group needs to independently organize and execute their work. This makes it especially important for the educator to gauge whether the students are prepared to manage an independent inquiry project (Kuhn et al., 2000).

In general, I think I have a good idea of the background knowledge my students have acquired in prerequisite classes. But as I was researching the literature, I realized that I did not really know what assumptions my students hold about the nature of the scientific process. I decided to investigate this research question by conducting interviews with students. I aimed to recruit students from three different groups. I wanted to also test whether the students' views shift as they move through the curriculum:

Group 1: Students who have not taken the class yet.
Group 2: Students who have taken the class but had not completed a co-op yet.
Group 3: Students who have taken the class and completed a co-op.

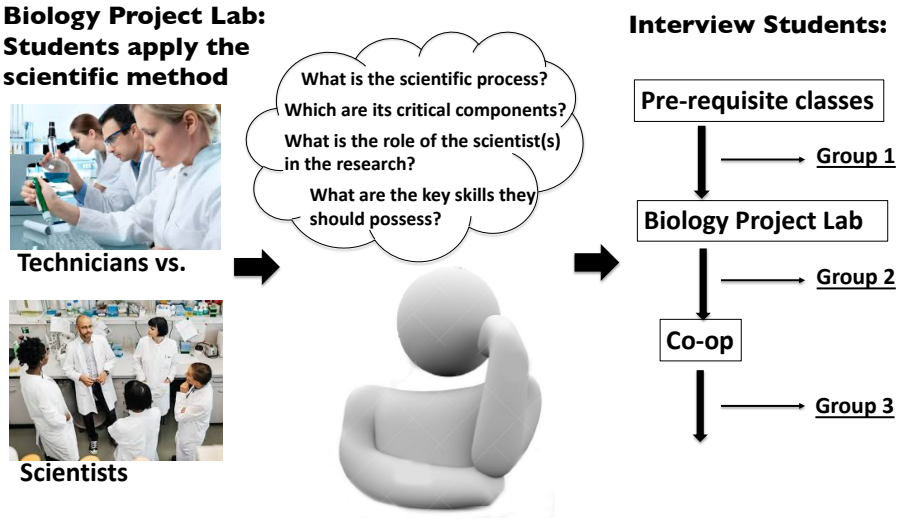


Figure 1. Visualization of project questions and methods.

The interview prompts were focused on students' understanding of the scientific process (see Figure 1).

In total, eight students were recruited—one for Group 1, three each in Groups 2 and 3, and one student with a slightly unusual path since they had already completed a co-op but had not taken the class yet. I am currently analyzing the data from the interviews. The preliminary analysis shows that students believe that the impression they get in high school about the scientific profess is somewhat simplified. They begin to grasp the complexity and "messiness" of the scientific process while doing research in an academic or industrial lab. In these experiences, they also realize that technical skills are a necessity, but they are not at the core of the scientific process.

The analysis needs to be completed before final conclusions can be drawn, but I view these interviews as the beginning of an extended line of research. I am considering conducting a longitudinal study in which students are periodically interviewed as they move through the curriculum. Additionally, I hope the interviews will help me identify key points I can use to encourage students to be more aware of the important higher-level competencies that any scientist needs to demonstrate.

References:

Corwin, L., Runyon, C., Robinson, A., & Dolan, E. (2015). The laboratory course assessment survey: A tool to measure three dimensions of research-course design. *CBE—Life Sciences Education, 14*(4), ar37.

Kuhn, D., Black, J., Keselman, A., & Kaplan, D. (2000). The development of cognitive skills to support inquiry learning. *Cognition and Instruction, 18*(4), 495-523.

Lederman, J., Lederman, N., Bartos, S., Bartels, S., Meyer, A., & Schwartz, R. (2014). Meaningful assessment of learners' understandings about scientific inquiry—The views about scientific inquiry (VASI) questionnaire. *Journal of Research in Science Teaching, 51*(1), 65-83.

KATY SHOREY, PH.D.

Philosophy and Religion

Redesigning class debate

Class debates are a controversial learning tool, and for good reason. Debate can introduce the wrong kind of incentives. Debate can reward the loudest, rather than most thoughtful, students. It can reward gamesmanship rather than good argumentation. It can reward oversimplification of complex issues and disagreement without a problem-solving goal. I think these are serious objections. Class debates can do more harm than good. And they are risky activities to implement (for instructors and students). This is because debates are unpredictable, and their success depends on students collaborating and adapting under time pressure. Class debates also present assessment challenges, especially when it comes to assigning individual grades that reflect the appropriate criteria.

On the other hand, my experience with several debate structures (Lincoln-Douglas, Parliamentary, Ethics Bowl, and others) makes me wonder if debate offers unique educational advantages that may be difficult to replicate in other assignments. At its best, class debate introduces constructive controversy channeled toward critical reflection (Mezirow, 2002). I also wonder if the activity's success depends on how involved students are in designing solutions to the challenges mentioned above. If student involvement can help overcome these challenges, how valuable is a class debate in comparison to other assignments also designed to create critical reflection?

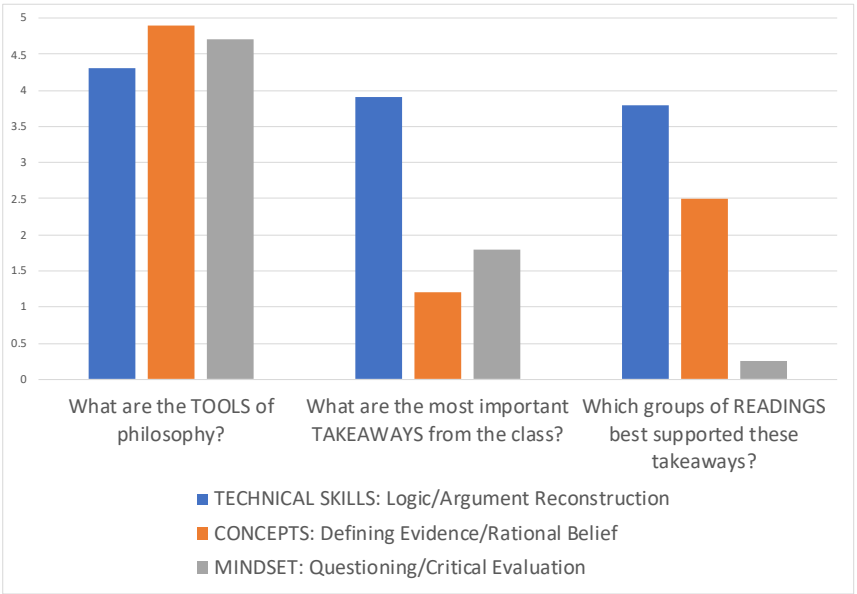
This question motivated my Scholarship of Teaching and Learning project. To gather evidence, I focused on two philosophy courses: Introduction to Contemporary Moral Issues and Debating Ethical Controversies. As a first step, I re-designed the classes to rely on student choice in ways that could allow me to test different kinds of assignments and activities. What I first noticed is that students were eager to play a role in selecting class content and assignments, and eager to help me assess whether their assignments were meeting the outcomes we set.

This was great news for me. As instructors, we want to know whether our assignments are helping students develop certain skills; we want to know what's working and what's not working. We also want students to be invested in the learning process and invested in the class as a learning community. To meet these goals, I offer choices for content and choices for how students demonstrate their progress. To some extent, students choose their own work product and how they are evaluated. Then, I ask students to help debrief on whether these assignments/assessments met the right outcomes. My hope is that this helps students take ownership of their education, gives me data on student experience, and helps me improve my courses each semester.

During the Faculty Scholars program, my research question changed several times. First, I asked, "Which assignments do students value most, and are their reasons tracking course objectives?" Then, more narrowly, I began investigating the question "Do *collaborative* final assessments (structured team debates, student interviews, team reports, and co-authored papers) give students the right kinds of opportunities to engage, invest, and partner in creating new understanding and new solutions to the problems raised in class?" After a semester of data collection, I narrowed the research question to focus on collaborative debate: "How do students *explain* the learning outcomes of collaborative debate?" I looked to data collected from reflective writing and class debrief conversations to help me evaluate whether debate activities were meeting the goals we set as a class. Going forward, this will give me a basis to begin investigating how valuable debate activities are in comparison to other assignments also designed to create critical reflection.

My project relies on literature showing the value of giving students opportunities to partner in assignment design and assessment design (Fink, 2013). When I began working with students to design a variety of debate structures, I wanted to keep the objections to debate in view. For example, there is good reason to think that debate tends to reward showmanship and rewards oversimplification of complex issues and caricatures of arguments (Nebel et al., 2013). I began to research ways to change debate structures and add features that prioritized reflection, debrief, and feedback.

The findings from my class and from the literature were encouraging. For example, my students noted that scaffolding the debates with basic logic and argument reconstruction assignments was a key part of changing the nature of the debates. One student reported, "I think the greatest takeaway from this class has been creating logical arguments. Debating has always been something that I had issues with due to how little ground is often made, so being able to break down arguments to find exactly what premise the disagreement lies with is useful." Another student commented that class debates helped put logic into practice: "Since the class is focused on this idea of argument reconstruction, having more debates really has the students put those skills into a real situation." Finally, many students emphasized the importance of slowing the pace of the debate and building in time for debrief and feedback at the end of each round. Debrief was, from my perspective, what made the rounds most educational and actually helped create a collaborative environment rather than a divisive environment. Debrief gives us time to examine and reflect on what happened during the round, and this is the space where critical reflection can fuel learning: "Reflection enables us to correct distortions in our beliefs and errors in problem solving. Critical reflection involves a critique of the presuppositions on which our beliefs have been built" (Mezirow, 1990, p. 1)



Student Survey Responses, April 2019.

Next semester, I look forward to building on the changes we tested. I plan to experiment with new ways to structure team debates, drawing from literature on how to leverage cooperation and conflict (Johnson, Johnson, & Tjosvold, 2012). My students and I will also design our debate rubric together. This change reflects one of the most significant discoveries I made during the Faculty Scholars program: students are your most valuable partners in improving pedagogy. It may seem strange to bring your teaching puzzles and problems to your students, but this is one of the great privileges of working with Northeastern students. They are excellent problem solvers. They are insightful. And they are as eager as we are to experiment, re-imagine, and improve learning.

References:

Fink, L. D. (2003). *Creating significant learning experiences*. Jossey-Bass.

Johnson, D. W., Johnson, R. T., & Tjosvold, D. (2000). Constructive controversy: The value of intellectual opposition. In M. Deutsch & P. T. Coleman (Eds.), *The handbook of conflict resolution: Theory and practice* (pp. 65-85). Jossey-Bass.

Mezirow, J. (1990). How critical reflection triggers transformative learning. In J. Mezirow (Ed.), *Fostering critical reflection in adulthood* (pp. 1-20). Jossey-Bass.

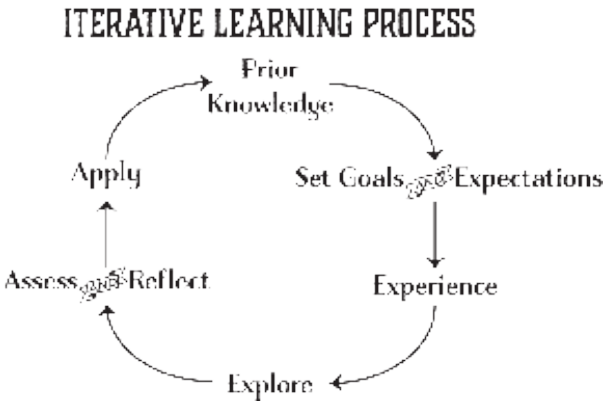
Nebel, J., Davis, R., van Elswyk, P., & Holguin, B. (2013). Teaching philosophy through Lincoln-Douglas debate. *Teaching Philosophy, 36*(3), 271-289.

MARK SIVAK, PH.D.

Art + Design and Engineering

Loop-de-loop: Using knowledge of iterative design to improve iterative learning

I teach in two different colleges, the College of Engineering and the College of Art, Media and Design. The foundational element to many of the courses that I teach is an iterative design process. Students learn and apply this process in many courses throughout their programs. The names of the steps for this process vary but the order and purpose of each step is similar across disciplines: gather, define, make, test, learn, and implement (IDEO, 2015). Students seem to understand this process easily and intuitively and can apply it to projects and challenges they encounter. For many students the iterative process through which they learn is opaque, if they have thought about it at all. Students have shown they want to improve their learning process and have some level of metacognition about how best they personally learn (Tuncer & Kaysi, 2013), but lack a formal framework about how to apply this information to improve their learning (Fan, Yu, & Lou, 2018). The question I have sought to answer is "How can I make an iterative learning process as easy and intuitive to understand and apply as an iterative design process?



To address this, I have created an introduction lecture and survey, in addition to a series of reflective prompts and slides that tie iterative learning to iterative design. The process for iterative learning that matches

iterative design is this: identify and activate prior knowledge, set goals and expectations, experience/explore, reflect, assess, apply. I hope that by being explicit in the connections between these steps that I can help students bring their iterative learning process into clarity and allow them to apply it intentionally.

To gather data, I looked at three different courses that I teach: Programming Basics, Iterative Product Prototyping, and Prototyping for Experience Design. I chose these courses because they have important differences and similarities. Programming Basics is an introductory course and is the most technical of the three. Iterative Product Prototyping is in the College of Engineering and is firmly rooted in an iterative design process. Prototyping for Experience Design is a graduate course and also relies on an iterative design process.

Early in my exploration of this topic I implemented surveys in these courses before the semester, at the midpoint in the semester, and at the end of the semester. The purpose of the surveys was to gather information about my students' prior knowledge as well as the depth to which they reflected on how they learn best. My findings from the pre-survey included what the students viewed as the most effective learning methods: short lectures, in-class discussions, in-class activities, and individual projects. Learning methods that the students found least effective included long lectures and team projects. Methods that were moderately effective included reading outside of class, critiquing others' work, watching videos or listening to podcasts, and studying as a group. I also found that the vast majority of students were interested in improving their learning skills and rated their current learning skills between not effective and moderately effective.

Using the survey data, I created an iterative learning process lecture and a series of reflections that I would implement into these courses to try to measure student learning. I gave this lecture in the first week of class both in Spring 2019 and Summer 1 2019. I then collected student reflections and survey data. One of the major findings is that, while I was presenting an interdisciplinary topic that is understood across the two colleges and three courses, the student populations for each course are very different. Students all reacted differently to the reflections, treating them with different levels

of specificity and even differences in the topics. While it seems obvious that these differences would exist, I had anticipated that by presenting the information in a discipline-agnostic manner that the students would react to it in similar ways. To act upon my findings, I plan to implement more prior knowledge questions into my pre-course survey, such as asking students about design in their co-op experiences, to understand the nature of their different responses. I also plan to be more specific about my expectations and definitions for the reflections.

The next finding was that the higher-performing students found it easy to understand and implement an iterative learning process. Another finding was that students did believe that the lectures and reflections helped them learn, as evidenced by students' rating of their learning skills as higher in the post-course survey than in the pre-course survey. Students still wanted to improve their learning skills, so I believe an intervention like this could be expanded to more courses to also reinforce the learning process.

References

Fan, S. C., Yu, K. C., & Lou, S. J. (2018). Why do students present different design objectives in engineering design projects? *International Journal of Technology and Design Education, 28*(4), 1039-1060.

IDEO. (2015). *The field guide to human-centered design: Design kit* (1st ed.). IDEO.

Tuncer, M., & Kaysi, F. (2013). The development of the metacognitive thinking skills scale. *International Journal of Learning and Development, 3*(2), 70-76.

2019-2020 COHORT

Bret Keeling
College of Social Sciences and Humanities

John Sangster
College of Engineering

David Tamés
College of Arts, Media and Design

Anne van De Ven-Moloney
College of Science

Elizabeth Zulick
College of Professional Studies

Northeastern
Center for Advancing Teaching and Learning Through Research

215 Snell Library
360 Huntington Ave
Boston, MA 02115

t: 617-373-3157
f: 617-373-7779

learning.northeastern.edu
CATLR@northeastern.edu