Introduction

Pedagogy, the art and science of teaching, provides the foundation for deep and meaningful student learning. Across the Virginia Tech campus, faculty members are engaging in an array of instructional approaches designed to foster pedagogical excellence. This proactive development of learner-centered instructional environments results from a conscientious commitment to the needs of a diverse student body, dedication to an intellectually honest approach to disciplinary and interdisciplinary education, and a passion for engaging students in critical thinking, self-awareness, and global citizenry.

During the past seven years, the Center for Instructional Development and Educational Research (CIDER) has been working with and supporting numerous individuals and groups across campus to augment their pedagogy, resulting in increased student learning and growth. These efforts have ranged from integrating multiple forms of media into courses, to focusing on formative assessments as learning opportunities, to instigating problem-based and case-based approaches to learning. Some of these efforts might be categorized as “cutting edge,” while others may be more subdued, yet they all have one central focus: the enhancement of student learning.

This Pedagogy in Practice publication provides an avenue to share the stories of several Virginia Tech faculty members who are engaging students in “holistic and transformative educational experiences” through the creation of effectual pedagogy. It is with gratitude that I extend my thanks to those willing to share their stories of pedagogical challenge and change, as well as those engaged in similar ventures whose stories are yet to be told.

Peter Doolittle
Director, Virginia Tech Center for Instructional Development and Educational Research

Creative and energetic faculty members are at the core of educational excellence. This fourth edition of Pedagogy in Practice highlights several noteworthy efforts designed by faculty members who are deeply committed to Virginia Tech’s teaching mission. The range of disciplines represented in this issue reflects the breadth of impact of the Center for Instructional Development and Educational Research (CIDER). In this issue are articles that describe how student-centered pedagogy inspires learners to excel in traditional classroom settings and in environments beyond campus. Faculty members advance excellence by creating new ways to use writing, online technologies, research opportunities, and colloquia. Excellent teachers also reflect on their pedagogical practice and share their ideas with colleagues. Peer review can be an effective process for students, who learn from evaluating other students’ scholarly work and also learn a skill that can be useful in their careers. Virginia Tech remains committed to its instructional mission and CIDER is a valuable faculty development resource for skill-building and for advancing the scholarship, art, and practice of teaching excellence.

Jack W. Finney
Vice Provost for Faculty Affairs
Mission
The Center for Instructional Development and Educational Research (CIDER) works with Virginia Tech faculty, administrators, and graduate students to design, develop, and implement disciplinary and interdisciplinary learner-centered instruction; promote and recognize excellence in higher education instruction; support and conduct cutting-edge research on the scholarship of teaching and learning; and collaboratively advocate for a campus climate that values educating the whole student through effective, innovative, and transformative instruction.

Staff
Peter E. Doolittle
Director
pdoo@vt.edu

Danielle L Lusk
Associate Director for Professional Development
dlusk@vt.edu

Tiffany Shoop
Assistant Director for Special Programs
tshoop@vt.edu

Patricia Sandler
Senior Associate
psandler@vt.edu

Jacquelyn Woodyard
Faculty Development Fellow
jcmccart@vt.edu

Stephan Munz
Faculty Development Fellow
munzst@vt.edu

Bonnie Alberts
Administrative Assistant
balberts@vt.edu

CIDER
111 Hillcrest Hall
Blacksburg, VA 24061-0453
United States
cider@vt.edu
540-231-5212

Graphic Design
Tiffany Pruden, University Relations

Photography
Christina O’Connor, Department of Student Affairs, Aki Ishida, Jim Stroup, Thomas Tucker, Mitzi Vernon, and the FORM exhibition team

Contents
2 Motivate the Future
Timothy D. Baird

5 Combining Passion with Educational Innovation at the Click of a Button: Clickers as a Potential High-Impact Pedagogical Practice
John Chermak

8 Visualization as a Tool to Support the Inquiry Arc
Thomas Tucker, Todd Ogle, David Hicks, Doug Bowman, David Cline, Aaron Johnson, Gurjot Singh, and Rosemary Zlokas

12 Media and Contexts in Teaching Building Materials
Aki Ishida

16 Technology Enhanced Pedagogy in Engineering Instruction
Vinod K. Lohani

22 Beyond the Books: Meaningful Activities that Motivate Learners to Develop Information Skills
Rebecca K. Miller

27 Unlocking the Potential for Learning
Martha Glass, Frances Keene, Patty Perillo, and Frank Shushok

30 Form and its Selfless Partner, Function
Mitzi R. Vernon

Virginia Tech does not discriminate against employees, students, or applicants on the basis of age, color, disability, gender, gender identity, gender expression, national origin, political affiliation, race, religion, sexual orientation, genetic information, veteran status, or any other basis protected by law. For inquiries regarding nondiscrimination policies, contact the executive director for Equity and Access at 540-231-8771 or Virginia Tech, North End Center, Suite 2300 (0318), 300 Turner St. NW, Blacksburg, VA 24061.

Printed by University Printing Services
VT/15/10461/16.5K/0415/UR2015-0285/TP
I've never really been a morning person. When I was a kid, my dad always had to wrangle me out of bed. He'd come into my room every morning and drone out the same tiring line: “Time ta get up.” This routine drove me nuts. I remember asking him to change the line once in a while—to spice it up, add some variety—but we never really got there. In college, I droved my roommates nuts with the snooze bar on my alarm clock. After college, things didn't change much. Mostly, I drove myself nuts. Only recently have I overcome this, and I think it has something to do with going to bed at night rather than in the morning. But something else may be at play here.


The alarm is a signal that something needs to happen, but generally it does not motivate us. This may be why the alarms didn't help me to become a morning person. As a college professor, I've come to think of the classroom in these same terms. Like alarms, homework, essays, exams, and projects are signals that something needs to happen. Unfortunately, too often students hit snooze on these. Not because they're not aware of them, but because the motive for doing them, the motivation, is not strong enough—or perhaps is misguided.

When I was designing my first college class, I tried to focus on motivation. I started with a single goal: I wanted the students to get better at integrating information, thinking critically, and communicating effectively. To work toward these, I started with a discussion-based format. Classes where discussion was prominent were always my favorite when I was a student, and that is what I wanted to do in my class now that I was at the front. But, how to do this well? This seemed like a challenge I was up for, but I needed a strategy.

First, I needed content that students could get excited about. A compelling story. In this case, a story about environmental conservation. The story was clear enough in my head: Conservation is complicated. Next, I set about trying to find books and magazine articles and movies and songs and games and activities to help me tell this story. So I filled the syllabus with diverse content, including stuff that wouldn't normally belong in a class on conservation—mad libs, Frosted Flakes, Elvis—but it helped me to tell my story. Now, how to get them to read so that they can come in and discuss it? Here, I borrowed and tweaked some strategies I got from sociology classes I took in grad school. Everyday, there would be more than an hour of reading. And everyday, there would be 10 to 15 homework questions to answer. And everyday, students would get full credit for their homework if they handed it in on time. And this homework grade would be 50 percent of their final grade. Simple as that. If I want them to do a lot of reading and writing, I figured I had to provide a significant incentive, or motivation. So, I put a significant grade on it.

I'm prepared for some pushback from other educators on this. “You're just giving away grades!” I suppose so, but I'm also creating a real incentive for them to do an enormous amount of reading and writing, which, in turn, gives us a tremendous amount of fodder for class discussion. Plus, students don't feel the tyranny of the grade all semester and can take more risks on
their homework without fear of failing. This is a real benefit. With the readings and the questions, I’m also covering a great deal of material and I’m teaching them how to read, through my questions. It works well. In fact, it’s been the centerpiece of all of my classes. I call it “reading notes.”

Reading notes do a lot of the heavy lifting for me in terms of my goals to improve students’ abilities to integrate, think, and communicate. But more can be done to assess this improvement and to promote it. In my courses, I generally have two exams: a midterm and a final. My goals for these assessment tools mirror my goals for the course. I want to see that students can integrate the course material, think critically about it, and communicate effectively—typically in just a single ambitious question. Two other factors shaped my exam design: (1) I wanted the exam to function as a learning tool as well as an assessment tool; and (2) I wanted students to get better at organizing their writing. Correspondingly, my exams are open-book, open-note, multiday take-home tests where students are asked to prepare an outline, not an essay. They are instructed to make strong, clear, broad, integrative arguments that are supported by more specific sub-arguments, which, in turn, are supported by very specific material from the course. So far, this approach to exams has worked quite well. Initially, at the start of the semester, students are pretty freaked out, but generally they adjust.

Around the middle of every semester, I have the students assess the course and provide anonymous feedback. I ask them to list three things that are helping them to learn and three things they would change to better facilitate their learning. Generally, they tell me that the discussion, the readings, and even the exams are helping them to learn. So, more or less, I feel like things are going pretty well in my courses. I’m invested in my strategy for teaching; I feel like it’s thoughtful and centered on specific goals. Yay for me… right?

Hold up. There are still days—more than I’d like—where students simply aren’t fired up. I mean, some days they come in revved up. Other days, not so much (the same could be said for me). Recently, I’ve started thinking again about motivation and my approach to designing a class. I’ve been using grades to motivate. Mostly, this is what we do in higher education. If we want the students to do something, we have to put a grade on it. If I want them to read, I have to put a grade on the reading, not just the exam. If I don’t put a grade on the reading, many of them won’t do it. This way, I get the students to read my stuff, answer my questions, take my exams. We can certainly use grades in innovative ways to get our students to do things, even new exciting things. That doesn’t mean that students are going to come into class everyday with that fire in their eyes. But what if the readings, the questions, the exams were theirs?

To circle back around, I think assignments sound the alarm; they provide the signal that something needs to happen. But, it’s the grades that get them out of bed. So this is what I decided: In our system, grades are a primary motivation for learning—which ultimately kills the fire and undermines the learning. This idea started to gel for me a while ago when I started hearing about studies in social psychology and behavioral economics, initially in Drive, Daniel Pink’s book about motivation. Pink reports on the findings from numerous studies, which show that
incentives, or extrinsic motivations, often lead to diminished performance, especially for complicated tasks. This is because the task becomes about the grade and not about the task, especially in the case of complex tasks. Alfie Kohn has written extensively about the effect of grades on learning, most notably in his book *Punished by Rewards*. Empowered by these ideas, I decided to experiment in my class to see if we could move from a grade-based motivation for learning toward an intrinsic one. So, in the spring semester of 2013, I rolled out an assignment where students were instructed to skip class, do anything they want, and give themselves a grade. I called it “pink time.”

Initially, the students freaked out. I was expecting cheering, tears of joy, applause, or something, but I just got blank stares and then several “Wikipedia projects.” I started wondering if this was a good idea. But we did this three times and had a handful of heart-to-hearts. Pink time, I told them, was about pursuing your passion. And the hardest part, I followed, was having one. I told them to go learn about something that fired them up—and learn about it in the way that makes sense to you. And then tell me how well you think you learned it for that period of time. Like with the exam, they adjusted. Big time.

I’m ready for more pushback. This seems like a crazy idea, doesn’t it? I can already hear the critiques. “Skip class?! Do anything they want?! They already do this!” Precisely. “Why would we give them credit for this?!” We need to tap into this. Despite our clever readings, our engaging discussions, our grades, and our plans for their learning, something else compels our students. Something else gets them out of bed. Something intrinsic. With pink time, I’m trying to draw this out, give it life, add structure to it, and bring it into the classroom. Really, I’m trying to annex their lives.

With a great deal of help from David Kniola (Virginia Tech Office of Assessment and Evaluation), Shelli Fowler (Technology-enhanced Learning and Online Strategies), and my graduate student, Ashley Lewis, I’m collecting data on the efficacy of pink time in terms of promoting course engagement and self-regulating learning. Conclusions are still a ways off, but some things are clear. Students are pursuing a great diversity of activities that span experiential, creative, and traditional academic forms of learning. They are bringing their passions into the classroom and imbuing them with lessons from the course. They’re thinking more critically about assessment, and they’re recognizing that learning is taking place all the time, not just in the class, and that one goal of higher education is to recognize, discipline, and direct this learning.

Most importantly, they’re having fun and the fire is back—and that gets me out of bed in the morning.
Teachers, through students, can have positive impacts on the quality of life of future generations. My personal experiences have developed and shaped this philosophy over the course of my career. Purely by chance, in my first academic quarter in college, I ended up in an Introduction to Geology class with over 150 students. The course was taught by an inspirational instructor who continually challenged my thinking. I was fascinated by the material he presented and immediately knew that I had found my passion, my career, and the start of my educational journey. As my career progressed, I came to realize that my experience in that life-altering class was not unique. As the educational literature demonstrates, an inspirational and passionate teacher is important in helping students determine their field of study and career choices (Chambliss & Takacs, 2014).

One of the disheartening facts that I learned in that introductory geology class several decades ago—a discovery that has been reinforced by my research, professional experiences, and personal observations—is that humans have a substantial impact on the Earth, including its atmosphere, water systems, and biological systems, to name a few. All will have long-term consequences for future generations. In my courses, I want to make sure that every student understands and realizes this impact. The everyday choices that students make have significant effects on the long-term future and environmental health of the planet.

Today, with every new semester and every class, I try to bring my passion for teaching, learning, and science into the classroom. I have found that passion—along with real-world examples from my research and professional experiences, integrated with an active in-class learning environment—has promoted student learning and has helped students transition to a path of being a lifelong learner. There have also been a number of students who have been inspired in my classes by a particular subject (e.g., climate change and sustainability), decided to switch majors, and are now working with their degrees in those areas trying to implement change.

How do I try to make this happen? One active-learning strategy that I use in my large introductory classes is student or personal response systems—“clickers.” Clickers are a popular technological innovation found in many lecture-based college classrooms (Boyle & Nichol, 2003; Mayer et al, 2009; McConnell & Doolittle, 2012). At their most basic level, clickers represent a convenient tool for taking attendance and increasing student involvement in large classes (Kolikant, Drane, & Calkins, 2010). Clicker fans often claim that they are particularly suited for today’s student body, collectively known as Millennials, digital natives,
or the constantly texting “thumb generation” (Immerwahr, 2009). Generational myths aside (Bennett, Maton, & Kurvin, 2008), the pedagogical power of clickers to improve student learning is still an open question in the literature (Mayer et al., 2009; Martyn, 2007; McConnell & Doolittle, 2012).

For more than eight years, I have been teaching an introductory Resources and the Environment class in a traditional large-lecture format (the average class size is 200 students) and have used clickers since 2011. Clickers have given me the ability to poll student attitudes on different subjects as well as evaluate content-related comprehension using multiple choice and/or true/false questions. I am also aiming to address a range of open questions regarding the use of clickers in my class:

• How well do clickers work to keep students involved?
• Do clickers motivate students?
• Can the use of clickers be used to identify and address student misconceptions?
• Can faculty craft clicker questions that push students to think and ultimately learn more deeply?

Clickers allow for the collection of data in order to help address these questions and others and can also give insights on short- and long-term learning and assessment.

With my dataset, I have observed that students are not “blank slates” when coming to college. In certain areas, personal experiences or education may have allowed them to develop misconceptions (Libarkin et al., 2005; Svinicki, 1998; Thompson & Logue, 2006). I have spent the past few years trying to identify these misconceptions, teach supporting material around these misconceptions, change the misconceptions, and monitor students’ thoughts on these misconceptions throughout the semester.

With the use of clickers, I have started to identify student misconceptions of course material and to document student short- and long-term retention. As an example, I asked one class of 175 students, “Which metal is recycled in the largest quantities in the U.S.?” Approximately 64 percent of students answered aluminum, which is incorrect. After a long discussion of why iron is the correct response, the students were then asked to answer the same question again. Using their clickers, almost all (95 percent) of the students recorded iron as the correct answer. Two days later on their exam, I asked the same question again. More than 50 percent of the students still answered the ques-
tion incorrectly as aluminum. Once I had identified this as a continuing misconception, I revised my teaching of the material to include more depth and the continued revisiting of this and other misconceptions.

Data collected using clickers have identified other examples where there have been challenges in terms of changing students’ original misconceptions. The ability to change misconceptions might challenge students to think more critically and question how they think about information, potentially altering how students approach their lives, especially in relation to areas such as human population growth and resource use, environmental impacts associated with energy extraction and its use, and other areas. In collaboration with Kathryne McConnell in the Office of Assessment and Evaluation, I am evaluating how the findings align with educational research and cognitive psychology vis-à-vis how students learn and what we as educators need to do to help promote the ultimate goal of college teaching: long-term retention and transfer (Halpern & Hakel, 2003).

Although I still have a lot to learn about students and teaching in large classrooms, I feel that, with active-learning techniques like clickers, I am positively impacting and maybe even changing the lives of students. I am hopeful that my classes will inspire students to start their own lifetime pursuit of knowledge and that this educational journey can open for them just as many, if not more, doors as have been opened for me.

References


Gunther Kress, professor of semiotics and education at the University of London, contends that there has been a shift in the predominant form of knowledge construction, meaning-making, and dissemination from the idea of a “world told” to a “world shown,” where the concept of literacy goes beyond communicating and comprehending written texts. Media convergence in a multimodal, information-rich society has changed how we now understand what it means to be literate. Media convergence has also changed how we think about our research and teaching in our disparate fields.

Visualization means many things to many people, including, for example, graphical representations of datasets, processor usage, search terms, and mechanical stresses in structures. From the context of history education, visualization is a window into a past that no longer exists in the physical world. Augmented Reality (AR) is a tool that allows for visualization in a number of settings and contexts. AR provides users a view of both the real world and virtual augmentations. Augmentations can include text annotations, photographs, video, audio, and 3-D models, all of which can be geo-located so that they appear as part of the real-world scene when viewed through a smartphone or tablet. AR can also be brought into the classroom for visualization of places or structures that are layered upon a physical affordance, such as a printed map or physical model. This allows for the visualization of evidence that is separated from the learner either by time or place.

Over the last three years, our growing understanding of multimodal literacies led us to think about how visualization can support the teaching and learning of inquiry. Ideas emerged among a group of colleagues from the disciplines of education, history, instructional design and technology, art, and computer science that led us to focus on how we can use AR and other visualizations to support the teaching and learning of history. Along the way, we used this as an opportunity for our students to engage in the development of media and technology scaffolds as well as the design and evaluation of strategies for the use of those media and technologies in formal and informal learning environments. We trace the trajectory of our interdisciplinary collaborations and our work with students as we continue to play in the field of visualization to support the inquiry arc.

Sharing the essential understanding that “what gets processed gets learned,” our work has consistently been guided by these two overarching questions:

1) In what ways can AR be used in multiple contexts as a scaffold to facilitate information processing?
2) In what ways can AR be used to help visualize both past and present and understand the themes of time, continuity, and change?

With these questions in mind, our aim was to leverage the affordances of AR technology as scaffolding to teach students to engage in the process of inquiry. Our approach takes advantage of AR’s ability to:
• Augment real sites with information, leveraging the benefits of situational context;

• Require student reflection on sources in context, supporting the learning of complex strategy knowledge through scaffolding;

• Require social mediation, as students work together from personalized but similar points of view;

• Allow students to visualize change over time and space to support understanding of chronology.

On the ground at historic sites, learners can use AR to view and reflect on evidence in the field, leverage the benefits of context, conceptualize the past, visualize changes over time, and participate in a compelling experience that engages and motivates.

**Discovery, Development, Design, and Discussion**

Our first attempt to play with AR came in the form of a project entitled “Virtual VT.” Virginia Tech’s campus is large, and as faculty, we have very specific pathways that we take day in and day out, rarely straying from these known paths. This is a different experience than students’, whose lives revolve around campus, from dining halls to classrooms. The objective of Virtual VT was to help people discover the campus using AR. The app identified campus buildings that were in focus through the smartphone camera, providing pertinent information about each one. We had the chance to play with it via the Summer Academy, which is a program intended to help incoming freshman get a head start on their studies and learn about the campus on which they will live. As part of the session, students downloaded the app onto their smartphones and were summarily “released” onto the campus with a series of missions to be completed through Virtual VT. For example, students were asked to “find a building(s) in each category [dining halls, administrative buildings, academic buildings, etc.] that you will need to visit during your first year, and come back with two details about each building”; and “identify four academic buildings that existed in 1920. Provide an interesting fact from the history of one building.” As part of the session, students were also tasked with discussing how the use of AR could be extended into their own fields of interest and study, which led to robust discussion of visions of the possible using AR.

Our use of AR and virtual reality (VR) is not limited to exploring the present, as our area of interest lies in using AR as a portal into the past. This interest resulted in the emergence of two parallel projects that both focused on exploring the lives of local African-American communities. Both projects saw faculty working with groups of both undergraduate and graduate students to design not just curricula, but interactive media for use in formal and informal learning environments. Both projects use not only in-situ but classroom- or museum-based AR experiences. While on site, historical source material augments existing structures as well as virtual recreations (3-D
Students in the School of Education and Department of History worked to build a repository of historical resources to be used in the AR and helped to construct a place-based unit of study for elementary and middle school students. Additionally, a graduate cohort of pre-service teachers is currently conducting an evaluation of the instructional design and the user experience of the AR through the eyes of both students and teachers in order to provide feedback in a continuous improvement cycle.

We also recognize that most of this work is local history- and place-based. While these serve as a window into regional and national history, we are exploring how we can access the past and places that are geographically inaccessible to many learners. Our most recent work is in the design, development, and evaluation of online educational resources that allow learners to visualize structures, places, and terrain of the Meuse Argonne battlefield from the Western Front of World War I. Using LIDAR, which illuminates an object with a laser then analyzes the light that is reflected, our team built precise 3-D models of German trenches and associated underground galleries, structures such as bunkers, and American memorials that mark American involvement in and around the Meuse Argonne. Pre- and in-service teachers are exploring how such visualizations can support concept learning and introduce inquiry-based activities that allow for an exploration of the American experience as the soldiers entered the Meuse-Argonne region of France. Currently, these visualizations take the form of video fly-throughs, but the

“This would be useful in an engineering class if the app had the ability to display orthographic, isometric, and other types of sketches or blueprints of buildings and or objects. Also, if the app were able to display just dimensions, that might be useful as well.”

—A student, on augmented reality’s potential
“Hey, just finished tech fluency with the augmented reality and the technology was amazing! I could definitely see this software developed further to meet the needs of research for students concerning architecture and blue prints and 3-D models. That would greatly assist research projects.”

—A student, on augmented reality’s potential

work of students and faculty in the School of Visual Arts will allow the environments to be freely explorable via computers and tablets this semester.

The very fact that we are a transdisciplinary team makes it difficult to assemble students from the arts, computer science, history, and education into a single course to explore AR as a tool to support inquiry. Instead, our pedagogy in practice extends beyond the walls of the classroom/lecture hall into team meetings, field study, studio work, and research sessions. Students work side by side, collaborating with us and each other to help answer our guiding research questions, which continue to investigate the potential and provisos of AR to support the type of sophisticated and systematic literacy work required for reading the world in both its past and present forms. Our work to date has begun to illuminate AR’s capacity to be used as a learning tool in multiple contexts to support an inquiry arc. With our students, we continue to identify models of wise practice in regards to AR’s ability and affordances to visualize the themes of time, continuity, and change.

Link to Virginia Tech AR video:
http://vimeo.com/50066269
Link to ABMC Visualization:
https://www.youtube.com/watch?v=ePjq9oc4FYU
The course Building Materials is taught based on the belief that students learn best if they are introduced to major building materials through multiple media and contexts, both inside and outside the lecture hall. ARCH 2044 Building Materials, required for every student majoring in architecture, introduces sophomore students to the physical attributes of basic building materials. Knowledge that the students gain through this course is applied to their projects in design studios, a series of labs at the core of every student’s five years of education toward a professional degree in architecture.

Major materials covered in the course include concrete, stone, brick masonry, glass, steel, wood, fabric, plastic, and composite materials. For each one, I present the physical properties of the material, ways in which it came to be used for building construction historically, and current developments to enhance or vary its physical properties. I couple the lectures with a hands-on experimentation project in teams, a visit to a local production plant, and/or a presentation by an expert within the local community.

Learning through Tactility

The combination of learning both through experience and through books and lectures is not unlike the goals of the German modernist design school, Bauhaus. Johannes Itten, one of its core teachers, aimed to develop his students’ design abilities through “subjective experience and objective rationale” (Wick, 2000, p. 124). Another Bauhaus teacher and designer, Lazlo Moholy-Nagy, also advocated for educating designers about materials by means of tactile exercises. In modern times, in which vision dominates all other senses, he saw a place in education to teach through tactility, which remains a valuable means for education today.

When learning about concrete in Building Materials, students were asked to work in teams of three or four to construct a concrete wall that allows light to pass through. Some walls were monolithic with cast apertures, while others were aggregates of multiple units. Grading was based on the following elements:
1. Design: Is the wall stable while allowing light to pass? How well do the modules stack or interlock with each other? Does it challenge the properties of concrete?

2. Execution: How well are the mold and the casts made? Does the wall hold its shape without falling or breaking apart?

3. Diligence: Did the team produce multiple iterations and improve upon the weakness of the previous? Did the team allow enough time to work out the design and technical challenges?

4. Quality of photographs and drawings: How well do the photographs capture transmission of light? Did the team use the drawings not only as a representation, but also as a visualization tool?

5. Site management: How well did the team maintain the “job site” both inside and outside the building? Did the team members put names on their molds and take accountability for keeping a job site that respected their fellow teams and the facilities?

Teamwork is an essential component of this exercise. The scope of work and the allowed time were set up so that the amount of labor would necessitate teamwork and would be neither feasible nor sensible for one person to complete alone.

Each team’s work in progress was reviewed two weeks into the project. I reviewed the progress with each team, and the students were expected to make improvements for the final presentation one week later. The walls from 15 teams were presented on Burchard Plaza and were exhibited outside for another week, which gave the members of the architecture and design community an opportunity to critique their peers’ work and learn from them.

At the completion of the project, the students were asked to respond to these inquiries in a reflective worksheet: How does their wall demonstrate an understanding of concrete’s physical attributes, and what aspects of concrete were revealed to them in executing this project? Some reflected on their discovery of how fragile unreinforced concrete is and how hot concrete gets while curing, and many described the manners in which concrete took on the shape and textures of the mold, from the texture of the tape that lined the mold to the wood grain. These physical qualities of building materials are abstract when read in textbooks, but our bodies remember these qualities through our senses. From this relatively quick project, the students gained a renewed appreciation for the exquisite surfaces of concrete walls by Pritzker Prize laureate Tadao Ando or the exposed texture of rough-wood formwork in Le Corbusier’s buildings.

**Using Distance Learning Technologies**

Technology used for distance learning makes it possible for us to tap into remote, highly valuable resources that are not available to our students otherwise. When teaching about metal, I organized a video conference with TriPyramid Structures in Massachusetts. TriPyramid is a specialized metal fabrication shop with expertise in metallurgy, mechanical engineering, and digital fabrication. The shop applied its knowledge of fabricating metal fittings for racing sailboats to architecture decades ago when glass fittings for I.M. Pei’s glass pyramid at the Louvre were fabricated and, more recently, pristine metal components for Apple Stores worldwide.

During a 50-minute video conference, we passed around metal component samples from TriPyramid’s projects, while Jeff Anderson, an architect and
project manager from the shop, discussed what metals are used for which applications and why they are selected. Virginia Tech’s Video Broadcasting Services set up the interactive video conference in a classroom equipped for distance learning. Equipment was arranged so that Anderson and the class could navigate TriPyramid’s website on a large screen, he could see our classroom simultaneously, and the students could converse with him from their desks. Video conferencing technology allows us access to exceptional resources in ways that would otherwise not be possible.

**Using Local Resources to Learn about Global Context of Materials**

Facts and figures of building materials are best understood, retained, and applied if they are presented in the larger context of their production. As MIT architecture professor Sheila Kennedy says in her book *KVA: Material Misuse*, “To be interested in materials is to ask questions about the nature of the real in contemporary culture, in all its complex and contradictory dimensions” (p. X). The contexts under which building materials develop and evolve can affect physical prosperities and, as a result, spatial qualities of a building. For example, as the students saw by visiting Old Virginia Brick, bricks fired with gas have different coloration from those fired with coal. As factories switch from using coal to gas in response to environmental concerns, the difference in energy source results in changes to the color, production time, and energy consumption.

Another resource I have used every year is Virginia Tech’s own Hokie Stone quarry just behind a residential neighborhood 10 minutes from campus. Having seen Hokie Stone, a dolomite limestone, extracted from the earth, sawn with a diamond-tipped blade, cut to smaller pieces with a hydraulic cutter, and finally packaged onto wood pallets ready to be trucked to construction sites on campus, the students learn to connect the building materials they see on campus to the materials’ natural source. They try lifting blocks of stone and feel how heavy they are, and they might remember to
question whether it makes sense to import heavy, exotic stones from foreign countries the next time they have an opportunity to specify stones in an architecture office.

Such contextual information is presented in this course to give students a deeper understanding of how building materials are extracted, how they develop and change over time, and how we might make informed decisions in application of materials.

References
Technology Enhanced Pedagogy in Engineering Instruction

Vinod K. Lohani | Professor, Department of Engineering Education

The College of Engineering (COE) has always been proactive in integrating contemporary technologies into instruction. All entering engineering freshmen were required to own a desktop computer beginning in 1984 and this requirement changed to a laptop in 2002. A tablet PC computing initiative was announced in summer 2006, which made it mandatory for all engineering freshmen (about 1,600 each year) to own a tablet PC starting in the fall of that year. In fall 2007, DyKnow, a classroom-interaction software, was introduced into instruction. The COE only recommends the specifications of the tablet and students buy their machines from a number of manufacturers.

During their year-long freshman engineering program (also called the General Engineering program), freshmen are required to pass two engineering courses. The first course is called EngE 1024, Engineering Exploration. The course delivery format formerly included one 50-minute lesson that I taught in a 120- to 250-seat classroom, followed by one 110-minute workshop taught by graduate teaching assistants in a 32-seat classroom each week. This delivery format was continued until fall 2013, when in the 2013-14 academic year a new course (Foundations of Engineering I, EngE 1215) with a new delivery format involving small class sections (30 students each section) was pilot-tested; the course was implemented during the 2014-15 year. In this article, I describe my experiences during 2007-13 to implement tablet PC/DyKnow technologies into EngE 1024 to: (i) seek instant feedback from students, (ii) develop a feedback loop and establish students’ prior knowledge, (iii) conduct a metacognition experiment, (iv) promote collaborative learning, and (v) expand the learning space. Finally, I provide a summary of assessment data collected over a period of five years to demonstrate the effectiveness of these technologies.
Instant Feedback

In addition to a general introduction to the class and syllabus in the first lecture of the semester, students were shown examples of tablet PC/DyKnow applications including students’ feedback from prior years, as a way to set course expectations. Tablet PC/DyKnow-based instruction began from the second week onward. The DyKnow software allows an instructor to connect digitally with all students in the class. As a result, all annotations made by the instructor on his/her tablet get transmitted to students in real time. Typically, a set of PowerPoint slides are made ahead of time for each lecture and loaded into the DyKnow environment to begin the class. Students are asked to join the DyKnow session. DyKnow assistants, typically trained undergraduate students provided by the COE for the first few lectures, are very helpful to make sure that students are able to join the DyKnow session. One of the features of DyKnow allows the instructor to seek instant feedback from students about the ongoing activities in the class. I often use this feature, typically once or twice per lecture, to develop and implement formative assessment activities in my large lecture class. Figure 1 shows examples of feedback obtained anonymously during various weeks in the fall 2013 semester. The topics discussed during these weeks included LabVIEW programming (week 12), flowcharting concepts (week 5), development and applications of empirical functions (week 4), and a problem-solving activity involving the concepts of projectile motion (week 2). The pie charts shown at the bottom right corner display students’ understanding of various underlying concepts and are created in response to requests made by the instructor (Green: “I understand well”; Yellow: “I understand a little”; Red: “I do not understand”; White: “No response”). The boxes above the pie chart show the understanding level of various students logged into the DyKnow session. The PIDs listed have been hidden for anonymity. On average, it takes less than one minute per occasion to collect students’ instant feedback, which can be shared with them if needed. I typically use this feedback to engage students in discussion.

Feedback Loop and Prior Knowledge

Tablet PC/DyKnow technologies allow an instructor to develop a feedback loop in large classrooms and engage students’ prior knowledge in teaching and learning processes. These ideas are consistent with the recommendations made in publications such as Classroom Assessment Techniques and How People Learn. I use the panel retrieval option within the DyKnow software to collect students’ feedback and use

Figure 1: Tablet PC/DyKnow-based formative assessment, fall 2013
this feedback for instruction. As an example, the following problem-solving activity from the text was assigned to students in the second week of the course in fall 2013:

A narrow belt is used to drive a 20.00 cm diameter pulley from a 35.00 cm diameter pulley. The centers of the two pulleys are 2.000 m apart. How long must the belt be if the pulleys rotate in the same direction?

Students were instructed to sketch the diagram necessary to solve this problem on their tablets. They were allowed two minutes or so, and then a few random students’ sketches were retrieved anonymously using the panel retrieval function of the DyKnow. The retrieval process takes about 30 seconds. These sketches were then projected on the classroom projector in order to discuss students’ work. Figure 2 shows four examples of student sketches. The fifth sketch (bottom right) is the instructor’s solution that was discussed after discussing student sketches. Annotations in black ink are the instructor’s illustrations of various correct and incorrect things on various sketches. Students’ feedback (see Figure 2, with feedback from the second week) shows positive learning experiences, right from the second week of the semester. It may be pointed out that I use the classroom projector only when discussing students’ feedback with them. Also, I collect students’ feedback an average of two times in each lecture.

**Metacognition Activity**

After reading an article in *The Chronicle of the Higher Education*, I implemented a metacognition activity in my class in fall 2012 with 200-plus students. Students were introduced to the idea of metacognition and the instructor discussed the following recommendation made in the National Research Council publication *How People Learn*: “A metacognitive approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them.” In order to implement this activity, students were asked to project their test scores after completing test 1. The day the test 1 papers were returned, the students were surveyed using the survey feature of DyKnow to enter the difference between their actual and projected test scores. Figure 3(a) shows the student-entered differences between projected and actual test 1 scores in five categories. For example, category A (red color) represents a difference of eight points or higher between projected and actual test 1 scores while category
E represents (green color), a difference of minus eight points or lower between projected and actual test 1 scores. As seen, categories A and B represented 69 percent of students who over-predicted their test 1 scores by at least one point while categories D and E represented 22 percent students who under-predicted their scores by at least one point. Obviously, the majority of the class over-predicted their test scores. The results were discussed in the context of metacognition and the need to improve metacognitive skills was emphasized. Additionally, students were informed that a similar experiment would be done after test 2. Figure 3(b) shows results after test 2. As can be seen, only 53 percent of students over-predicted their test 2 scores and 27 percent students under-predicted their test 2 scores. It is interesting to note that 5 percent of students accurately projected their test 1 score and this percentage went up to 8 percent for test 2, as seen below.

**Collaborative Learning**

I have done a few collaborative learning experiments using the DyKnow/tablet PC technologies. For example, the DyKnow software allows an instructor to give control to students, which means that once this control is granted, students’ annotations on their tablets appear on other students’ screens and the classroom projector in real-time. Figure 4(a) shows two orthographic views of a 3-D object shown in an isometric view. Students were shown these views and were asked to describe the process of computing the volume of this 3-D object using simple sentences. They were given DyKnow control. Figure 4(b) shows a screen capture of the ideas shared by various students. All I did during this exercise is to comment on various ideas provided by the students and compared these ideas with how I would solve the problem. The pie chart shown in Figure 4(b) shows a good understanding of the process of computing volume of the object, after implementing this collaborative learning activity.

**Expansion of Learning Space**

The DyKnow software allows a student to attend class from a remote location and also makes it possible for the instructor to teach class from a remote location. In fall 2007, I attended the International Conference on Engineering Education in Coimbra, Portugal, and took advantage of this capability of the software, teaching an EngE1024 lesson from Coimbra. The content of the lecture consisted of an introduction to this old university in Portugal, a brief description of the conference, a brief description of the travel route I took to reach Coimbra, and the geography of the western European region. Following these descriptions, I went on to discuss the topics (introduction to graphics) assigned for the week. The setup needed webcams at each end, an audio output, and a video projector. Skype software facilitated audio/video communication at both ends, while DyKnow/tablet PC technologies provided the instructor the capability of working on engineering problems that were dynamically reflected on each student’s tablet PC. Students were asked to list three things they liked about this presentation. Selected comments included: “We learned interesting facts about Portugal,” “Consistency of the same teacher regardless of where they may have traveled,” and “Made me think about the future of school—we could be millions of miles apart.”

In May 2009, I attended a conference in Alaska and taught a 50-minute lesson from Anchorage using the tablet PC/DyKnow/Webcam/Skype technologies (see Figure 5). Since this was the last lecture of the spring 2009 semester, I also did a summative assessment by conducting a survey remotely. Students were presented with a slide con-
taining EngE 1024 course objectives and were asked to rate their satisfac-
tion using three letters: “L” for “least satisfied,” “S” for “satisfied,” and “Q” for “quite satisfied.” Figure 6 shows ex-
amples.

In a semester-end exit survey, students responded to the following statement: “I participated in EngE 1024 lecture session from a remote location with the help of DyKnow software on one or more occasions.” At least 15 percent of students attended at least one class remotely. Students were asked to explain the circumstances that led them to log into the class session remotely. A few examples are cited below.

“I was extremely sick one day and I logged on to DyKnow from my dorm room.”

“I had a doctors appt. for my broken collar bone at the time of the class and I arrived back to my dorm about 10 minutes before class was over, DyKnow allowed me to get the lecture notes with out hassling my peers for them.”

“I was home in Marshfield MA sick with mono and I was able to sign on.”

“I had to take my boyfriend to the dentist to have surgery and logged on from the waiting room.”

“One day I had just flown in from home and I logged in from the airport where I was waiting for a connecting flight.”

Assessment of Tablet PC/DyKnow Instruction

I have collected data to assess students’ learning experiences using a number of exit survey questions implemented in the entire freshman engineering course (EngE 1024) over the years.
As an example, in response to an exit survey statement “The DyKnow software has been successful in making the classroom environment interactive and conducive to learning,” about 60 percent of students “strongly agreed” or “agreed,” 13 percent “strongly disagreed” or “disagreed,” and the remaining students chose the “neutral” option consistently in fall semester surveys from 2007 through 2011. In yet another question, “Did your skill of using tablet PC in this course help you in any manner in other courses?”, more than 50 percent of students responded “yes” consistently over five years (2007-2011). While a lot of work remains to be done in terms of systematically diffusing the technology-enhanced pedagogy into upper-level courses, these data are definitely encouraging.

I have thoroughly enjoyed implementing various tablet PC/DyKnow-based teaching and learning strategies into my instruction and continue to make improvements. These technologies have huge potential to expand the learning space and generate high-quality research data on how students learn various concepts in a technology-enabled environment. Diffusion of tablet PC/DyKnow-based pedagogy at a large scale, however, remains to be a challenging mission. Availability of wireless-ready classrooms and faculty buy-in, along with incentives, are a few factors that may make the large-scale diffusion possible.

References


In a typical year, librarians at University Libraries collectively teach between 600 and 700 information literacy classes, reaching around 13,000 individual learners at Virginia Tech. Unlike most of the other instructors on campus, librarians spend most of their teaching time designing and implementing learning opportunities called “one-shot” classes. These one-shot classes are regularly integrated into all sorts of different courses with the goal of helping students develop and enhance their research and information skills.

Librarians who work with faculty colleagues to promote students’ ability to successfully navigate an increasingly complex information landscape often encounter challenges unlike those encountered by faculty who teach more traditional, semester-long courses. Motivating students to engage with the ideas presented in information literacy one-shot sessions is one of the most serious challenges that librarians must work to overcome since librarians often do not have the benefit of building relationships with students or being the individual who evaluates student work. Therefore, it is critical that librarians think carefully about how to construct their learning opportunities on a solid foundation of learner motivation and work with their faculty colleagues to effectively do so. But what, exactly, does that motivation look like? Research on learner motivation makes it clear that there are specific elements and strategies that can deeply impact instructional opportunities, and the examples that I explore here provide illustrations of and best practices for creating meaningful learning experiences that ultimately help students gain the skills they will need to thrive in global, connected world.

**Integrating Information Skills**

For more than 25 years, educators and information professionals have used the term “information literacy” to describe the specific set of skills that enables an individual to recognize and resolve an information need (Association of College & Research Libraries, 2000). As information and communication technologies have grown in both popularity and functionality, it is no longer enough for university students to graduate with a passing knowledge of how to Google an answer, find a library book, or search a scholarly database. Rather, stu-
students entering the workforce need to be equipped with a multifaceted skill set that will allow them to both consume and produce information in an agile, flexible manner (Head, 2012).

Like mathematics or history, information literacy represents a specific discipline and a way of thinking that provides Virginia Tech students with a well-rounded method of approaching the world and growing into a knowledgeable and effective global citizen (University Libraries, 2012). However, the challenge remains: How can librarians most effectively work with faculty and instructors to motivate students to begin to engage in thinking in any sort of real way about finding, using, and creating information?

**Motivation Models**

When I began researching frameworks for thinking about motivating students, two models of motivation were particularly helpful: John Keller’s ARCS Model of Motivational Design and Brett Jones’ MUSIC Model of Academic Motivation. Both models emphasize the importance of understanding the learner’s perspective and orienting instructional material in a way that makes clear what is in it for the learner. Keller’s ARCS model urges instructors to gain the learners’ attention and underscore how a learning opportunity may be relevant to a particular group of learners (Dick, Carey, & Carey, 2009). Similarly, Jones’s MUSIC model identifies learner interest and perception of the usefulness of the learning opportunity as significant factors in motivation (Jones, n.d.).

Both models include many other valuable components, but these elements of student interest or attention and the relevance or usefulness of the learning opportunity are particularly appropriate and feasible for librarians to consider as we collaborate with faculty to integrate information skills into courses. Specifically, lessons and workshops on information literacy topics need to be both interesting and directly relevant to the work that students are doing for their classes or will be doing in their future professional lives.

**Strategies for Motivating Students**

Again, most librarians work directly with faculty members to identify courses that are particularly appropriate for pairing with information literacy sessions. Colleges and departments on campus work with library liaisons who have expertise in specific disciplines (University Libraries, 2014). As the library liaison for a number of departments in the sciences and life sciences, I have worked especially closely with students and faculty in the departments of Computer Science (CS) and Human Nutrition, Foods, and Exercise (HNFE). The examples described here utilize strategies developed for the unique groups of learners in these contexts.

**Example 1: Developing Authentic Activities**

Since 2011, I have worked closely with Advanced Instructor Heather Cox in the Department of Human Nutrition, Foods, and Exercise to enhance the information literacy component in her course HNFE 3224: Communicating with Food. The description of this course indicates that learners will “develop oral and written communication skills” in order to communicate “food and nutrition information to diverse populations” (Office of the University Registrar, 2014). This course is ideal for integrating information skills since its entire goal is to evaluate various types of food and nutrition information in order to share them with a wide variety of groups and individuals.

Many students in the Department of Human Nutrition, Foods, and Exercise graduate from Virginia Tech and become leading nutrition and health care practitioners; accordingly, HNFE students need to be able to use both traditional and emerging technology tools to gather and disseminate health and food information. Once they join the professional workforce, they will be communicating with their colleagues and clients through social media and other less tradi-
tional types of digital publishing. They will need to be able to use these tools effectively if they want to succeed in the health care world.

With this understanding of how HNFE students will need to communicate in their professional lives, Heather Cox and I developed a lesson and activity that directly incorporated these elements. Instead of asking students to research a topic and write a paper, we ask them to consider the world of social media and use the format of a blog post to condense complicated nutrition research into information geared toward a more general audience. Many classes are now incorporating blogs and other Web-authoring tools into their courses, but the twist in this assignment is that students are actually authoring blog posts that are incorporated on a national blogroll for National Nutrition Month, sponsored by the Academy of Nutrition and Dietetics. A spring course, HNFE 3224 coincides with National Nutrition Month, always in March, which offers students the opportunity to create an authentic artifact that will be read by future colleagues in the field of nutrition and dietetics, as well as anyone else on the Web who may subscribe to the National Nutrition Month content.

The in-class workshop related to this assignment, which I, as the librarian, facilitate, includes a nontraditional view of searching for and evaluating sources. Rather than focusing on traditional, scholarly research resources, we evaluate blog posts and items of information communicated via social media, and consider the quality and reliability of these sources. Students’ interest and attention are engendered when I select fun items to evaluate in class, and they are motivated to engage with the lesson when we discuss the blog post that they will be writing for a real audience that includes, but is not limited to, their instructor and me.

Many educational researchers have highlighted the importance of authentic activities, or activities that are similar to those that students will encounter in the world outside of the educational context; and the HNFE 3224 blog assignment has been successful because it prepares students for the type of work that they will be doing in their professional lives (Land, Hannafin, & Oliver, 2012). Student blog posts from 2011, 2012, 2013, and 2014 can be read here: http://hnfelibrarian.blogspot.com/

Example 2: Using Case Studies

Another HNFE course, HNFE 4004: Seminar in HNFE, focuses on helping students navigate the scholarly world of literature related to food, nutrition, and exercise (Office of the University Registrar, 2014). Multiple sections of this course are taught each semester by a variety of HNFE faculty, but most sections of the course schedule one or two workshops with me in order to help students identify the most appropriate databases and other research tools in their discipline. The information literacy workshops that I develop for this course focus on more-traditional information literacy topics: developing a research question, using scholarly databases, and evaluating peer-reviewed articles. Although this workshop should be relevant to the learners since they will need the skills that we work on in order to successfully write their paper for the course,
these students do not always immediately grasp the relevance.

Similar to my approach with the HNFE 3224 students, I began using an activity that would immediately grab their attention and also help them connect what they are doing in the workshop with what they will be doing in their real-world, professional lives. I begin the workshops by distributing a very brief summary of a real-life situation that hinged on a researcher’s ability to find and evaluate research information: the 2001 death of a healthy subject in an experiment at Johns Hopkins (Perkins, 2001; Suber, 2001). The case study contains some shock value since the case involves a death and the surprising inability of a doctor and researcher to conduct research, and immediately gains student attention. Discussion of the case allows students to connect their training at Virginia Tech with their future responsibilities as health care practitioners, establishing the relevance of the rest of the information literacy workshop.

Using case studies to connect classroom work to real-world situations is fairly common, but especially valuable in information literacy workshops. Students often fail to perceive the relevance of what they do in the library, or as they research a term paper, and are unable to connect the work with the real world. Case studies dealing with situations in which individuals need to or fail to think critically about information can help make these connections explicit, especially for students in disciplines that may not use traditional information resources, such as books or journal articles, as their mode of sharing, communication, or work.

**Example 3: Writing Six-Word Research Memoirs**

Often dealing with code, user-experience data, and other nontraditional resources, computer science students can definitely fall into the category of students in disciplines that use resources besides books and journal articles. However, these students still have a real need for understanding best practices for interacting with the information environment around them.

CS 3604: Professionalism in Computing represents a computer science course that is appropriate for introducing a number of important information literacy skills into the computer science student’s skill set. Focusing on communication and ethical responsibilities, CS 3604 is often taught by multiple instructors in multiple sections each year (Department of Computer Science, 2014). I have worked particularly closely with Instructor Dan Dunlap to develop activities that will motivate students to participate more meaningfully in an information literacy workshop focused on helping students identify different formats of resources and the ethical use information.

With computer science students, I discovered that it was important to gain their attention and interest immediately. The most effective activity for doing that is called the “Six-Word Research Memoir.” Librarians at other universities have used the activity with success, and it is a motivating strategy that comes with a number of additional benefits (Miller, 2011). The six-word memoir originated from a project developed in 2006 by SMIHTH Magazine that encouraged people to write very short stories of only six words. I then ask them to share their past research experiences in six words. I then ask them to share their memoir via PollEverywhere, a free audience-polling system. When students submit their memoirs to PollEverywhere, the entire class can view the submissions. The research memoirs are often funny, self-deprecating, and deeply revealing of students’ attitudes toward and understanding of scholarly information and research. A few of my favorites include:

- Start, try not to cry, cry
- Procrastinate … then use ALL the resources!
- Spent all night in the library
- Tombstone will read death by APA

These “memoirs” never fail to generate discussion and often humanize me and the entire workshop. While the memoirs certainly help motivate students by gaining their interest and attention, they can also be instrumental in structuring discussion that will help students connect their work in CS 3604 and the information literacy session with the work that they will be doing as computer and information professionals.

**Final Thoughts**

It is our goal as librarians to motivate each of the 13,000 individual students whom we come into contact with each year. The three examples described here are only a handful of the creative ways that we use to try to reach students and collaborate with faculty in order to meet our goal of “exposing students to the practical skills, theory, and experiences resulting in competitive advantages in the job market, greater civic engagement, and cultural enrichment” (University Libraries, 2012). The information skills and knowledge that students will need to succeed in the future is constantly evolving and changing, and we feel a deep responsi-
bility for maintaining a dynamic and impactful information literacy and instruction program that will support both students and faculty.

To get in touch with a liaison librarian who can work with you and motivate your students to think critically about the world of information surrounding them, visit the University Libraries liaison librarians webpage: www.lib.vt.edu/instruct/clprg.html.

References


The Division of Student Affairs mission is to promote students’ learning, life skills, and personal growth through a strong focus on holistic student development and collaborative partnerships that deliver superior service to, and care for, students in the spirit of Ut Prosim (That I May Serve). We believe this mission calls us to support and sustain the culture of learning present on our campus. We, along with academic partners, strive to offer and connect students to the profound opportunities open to them while enrolled. Also inherent in our mission is the desire to help students to develop habits of interpersonal awareness, intentional actions, and self-reflection to complete and complement academic and professional education.

We are committed to discerning and designing the learning opportunities available in student environments, creating new and innovative practices for student learning, and assessing the extent to which students are able to apply knowledge to solve problems. Our hope is that our students will connect knowledge to the possibilities, creating a legacy now and in the future. In 2010, the Division of Student Affairs adopted five aspirations for student learning in an effort to build a framework to guide our collective efforts as we work with students during their time at Virginia Tech.
5 aspirations for student learning

• Commit to unwavering curiosity: Virginia Tech students will be inspired to lead lives of curiosity, embracing a lifelong commitment to intellectual development.

• Pursue self-understanding and integrity: Virginia Tech students will form a set of affirmative values and develop the self-understanding to integrate these values into their decision-making.

• Practice civility: Virginia Tech students will understand and commit to civility as a way of life in their interactions with others.

• Prepare for a life of courageous leadership: Virginia Tech students will be courageous leaders who serve as change agents and make the world more humane and just.

• Embrace *Ut Prosim* as a way of life: Virginia Tech students will enrich their lives through service to others.

The outcomes listed in each of the frameworks identify what we want students to know or be able to do as a result of participating in programs, services, and activities. These outcomes reflect the expectations we have for students and represent the breadth of learning opportunities the division makes available to students. The outcomes in each framework are based on the broad, shared understanding of each aspiration. Each learning framework has a theoretical foundation that reflects the spirit of the aspiration, but it is not comprehensive. For example, the learning outcomes for the practice civility aspiration are influenced by Kohlberg’s stages of moral development. However, a multitude of theoretical frameworks could be used to understand the aspirations, so the learning outcome frameworks will continue to be refined as we further explore and deepen our understanding of the aspirations.

Our aspirations and learning-outcome frameworks are the foundation for our division to ensure that in all of the ways we interact and learn with students, we are creating integrated, learning-centered environments that engage our students with each of the aspirations in a variety of contexts. This has been particularly important as we embrace a collective identity where every faculty or staff member is viewed and valued as an educator. This shared vision is the basis to build a network of opportunities in and among the educators inside the Division of Student Affairs as well as with other campus and community educators so that all students have the opportunity to engage in dynamic learning environments. We have fully embraced Dungy’s call in *Learning Reconsidered* that “the integration of learning must embrace out-of-classroom experiences as well as all aspects of the formal academic curriculum.” Truly, the learning opportunities on our campus are unlimited when the entire campus community is considered a learning environment.

After the creation of the aspirations for student learning, small committees of faculty, staff, and student members formed around each aspiration. The committees each developed learning outcomes for their aspiration that provide educators in the Division of Student Affairs a roadmap for creating learning environments and experiences. A hallmark of the learning environments and experiences is the emphasis on reflection and meaning making, allowing for enriched learning and relationship-building. The learning-outcome frameworks are both a planning tool and an assessment tool; they guide planning as departments use them to create intentional learning environments and experiences. Our hope is to convert each framework into a rubric that can be used to guide the assessment and evaluation of those environments and experiences. Each framework is organized into three broad areas. A “learn” level connects students to the content of the aspiration and how that aspiration may hold meaning for them. Next, at the “practice” level, students engage in practical hands-on activities that allow for opportunities to exercise skills and explore their attitudes and beliefs about that aspiration. Finally, at the “model” level, students exhibit habits that exemplify how that aspiration informs their life.
We are hopeful as we seek to integrate theory, practice, and our aspirations into holistic experiences for students that interrupt their activities to infuse reflection through artful questioning and long-lasting relationships. This interruption—or reflection—can be overlooked as our bright and enthusiastic students seek experiences rapidly as their curiosity and interests expand. To that end, as we walk along with students on their journeys while enrolled at Virginia Tech, we embrace a holistic philosophy of student development, where cognitive, interpersonal, and intrapersonal development are all equally necessary to promote student learning. Thus, we hope to create environments and contexts that advance the development of self-authorship for our students.

We also hope that our work can strengthen education and learning on our campus and beyond. To that end, in November 2014, in partnership with the Center for Instructional Development and Educational Research, we hosted our first Aspirations for Student Learning Symposium. We were thrilled to structure our two-day symposium around dialogues on each of the five aspirations through moderated paper presentations and discussions by higher-education professionals inside and outside our campus community. We believe that the expertise and passion from the authors along with the dialogue at the symposium added to the understanding, scholarship, science, and pedagogy associated with our aspirations for student learning. We invite you to join us in this dialogue as we dream about the possibilities of capturing our entire campus as a learning environment.

References

This is a short story about two parallel projects. A team of 20 industrial design students decided to design and build a traveling exhibition about form. Industrial designers design exhibits, but they usually design products and are the ultimate form-givers of those artifacts. The exhibition, FORM: Line-Plane-Solid, features the design work of 90 students and three years of projects from the form studio in the second year of the industrial design program at Virginia Tech. The team of 20 had also participated in the form studio at some point between 2011 and 2014. So, their own form work is present among the 220 exhibits. The exhibition opened at Perspective Gallery on the Virginia Tech campus on April 4, 2014.
structural integration. It is the most important component of the architecture, but it is a selfless worker, hiding in plain sight.” The connector is to the exhibit architecture as the architecture is to the form exhibits.

With few exceptions, everything visible and invisible in the exhibition—the exhibits and the exhibition architecture—was designed and built in-house at Virginia Tech by students in industrial design, through our design studios and workshops. The team as a whole wrestled with myriad concepts for several months before converging on a basic architectural element (after an all-day charrette), which we call the “tower”—an aluminum structural concept. With that decision, we were free to experiment with the 1-inch aluminum tubular components, which enabled us to transform a standard tower, as needed, to accommodate different types of exhibit pieces and any venue particularities. The overall architecture consists of one tower with three adaptations. To connect the tubular units, the team pursued multiple and nuanced iterations of the connector concept, prototyping in hardwood first, then drawing again, then considering sand casting, then resolving to mill from aluminum solid stock. The tower angle (approximately 6 degrees) and the use of the lightweight tubing prescribed the intricacies of the connector design, leading to seven slightly distinct joints, derivatives of the initial concept.

Team Structure

Education, curation, photography, graphic collateral, infrastructure, fabrication—these were the subgroups of the overall team. Somehow we survived despite a large and teeming group, routine debate, and the stress of time, money, and ideology. The most beautiful feature of this team is how deftly they translated from one subgroup to another in scaffolding each other.

The education team was tasked with the daunting mission of explaining form to anyone and everyone. Attempting a definition of form is pure folly. It is foremost a plastic word that is everywhere and without singular definition. The curation group had the unenviable assignment of collecting, selecting, organizing, and labeling the 200-plus projects, not to mention the responsibility of prodding 90-plus students to finish their projects ... well. They never—not once—missed a deadline. Similarly, the photography troupe had to photograph all of the projects, often many times, and they were on constant notice for seven months to document shop work, studio discussion, and the exhibit team. The graphics group, by some means, survived the worst fate of trying to satisfy 21 people with exhibit title, color palette, and not one but nine different icons. Untold hours were spent in graphics purgatory. And then there was the exhibit catalog, which chronicles the exhibition process and encompasses every exhibited project. Through a legion of hours, a two-student subgroup designed the catalog from inception to publication. Another two-student team produced a 20-minute video for the exhibit, which involved days of student interviews, videotaping, and editing. The work of the infrastructure and fabrication groups was unending, start to finish, and everyone participated in some aspect in order to meet the installation deadline. More than 1,100 units of aluminum tubing were cut, degreased, filed, deburred, and brushed. More than 600 joints were milled by our metal shop craftsmen, Jeff Snider and Matt Tolbert—two extended and honorary members of the exhibit team.

Pedagogy

The exhibition responds to a need for new discussion about form within industrial design education. We attempt to renew the concept of form-giving through an iterative and rigorous pro-
cess of making. We use the term “form-matrix” as a pedagogical prompt, a start, to talk about primitive form in the design studio. The matrix is a construct of various divisions of form, though not exhaustive, and how they overlap and inform each other. Think of Line, Plane, and Solid as modes of form, while Flow, Tecto, and Roto are genres, a more specialized classification having to do with behavior: fluid, tectonic, or rotational.

The work emerges from a triangulation of courses in the sophomore year of industrial design at Virginia Tech: analog and digital visualization, hand and digital craft, and the studio—the hub of our curriculum. We have reshaped our course of study to address the qualitative nature of form-giving, while building on the existing “Bauhausian” workshops within our school. This pedagogical paradigm focuses our studio on “search,” rather than “solution,” through making. The projects are exercises (concept-to-form) and products (form-to-product), organized in three subsections—Line, Plane, and Solid: form projects (linear flowform, planar flowform, solid flow-form, solid rotoform, planar tectoform, and solid tectoform) and form products (platter, handtool, vessel, and citrus juicer).

The objective is to facilitate a transfer of understanding from the exercises to product design. For example, how is a platter informed by planar flowform? Students take forward lessons from their study of planar form—fluid flow, contrast, a suggestion of volume—to the utility of a plane, as a platter, by adding the concept of serving, offering, and containing. Further, a drawing workshop introduces the properties of the hand and how human anatomy extends form behavior. Students move forward immediately from the solid flowform exercise to the utility of a simple handtool. The requirements of the tool are limited to scooping, scraping, cutting, or grooming. The form should embody the semantics of one of these activities and the relationship to the human hand. Emphasis is on the form doing the work; in other words, not relying exclusively on material properties. The handtool, vessel, and citrus juicer are all results of this initiation into ergonomics, and these products take lessons from each of the solid flowform, tectoform, and rotoform exercises in addition to a fusion of all.

In an era of fast and furious digitalization, the form studio likewise incorporates CAD (computer-aided design) conceptualization, 3-D printing, and CNC (computer-numerically controlled) milling and turning. However, there is an inherent emphasis on form first, separating the study of form from any tool used to express it. Two questions initiate the form studio: What makes anything worth making? What causes us to notice form in the first place?

---

Extra material:

The exhibition website includes work from the form studio, the exhibition, and the catalog, which may be viewed and purchased at: www.industrialdesign.arch.vt.edu/program/2ndyear/perspectivegallery.htm

The team behind the exhibition:

Alex Barrette, Claire Butterfield, Alex Chiles, Chris Crowley, Campbell Efird, Lina Garada, Jonathan Kim, Chris Kitchen, Aleyse McNealy, Hannah Minnix, Linnea Morgan, Chelsey Pon, Amanda Phung, Brian Pughe, Sarah Qureshi, Tomon Sasaki, Scott Shumaker, Meredith Walker, and Emma Weaver, along with Lauren Walkup (who produced the exhibit video), graduate teaching assistant Chris Taylor, and Professor Mitzi Vernon.