Putting Learning First: How Students Learn and How Technology Can Help
April 2013

“We need to consider how students learn... and how [we] can encourage these learning experiences with online technologies.” —E. Baran et al.¹

This year’s series of reports on teaching and technology has compared face-to-face, hybrid, and online learning formats and the pros and cons of each. The March 2013 report, “Innovators Among Us,” featured faculty experimenting with teaching techniques that employ technology to support student learning. Those 16 faculty members, as well as a number of those who responded to the reports through edtrends@uw.edu, stressed that technology is a tool for teaching, not an end in itself.

“I have to figure out what is best to do via video and what is best to do face-to-face. The answer depends on the goals of the class,” says Doug Wills, Associate Professor at the UW Tacoma Milgard School of Business. Even though students expect technology in the classroom, skilled instructors don’t select a tool and then decide how to use it. Instead, they focus on learning goals and then choose the best tool or technique for a specific situation, regardless of whether they teach fully online, without technology, or somewhere in between.

This final report focuses on research-based principles of how people learn and how technology can help. UW faculty, students, librarians, and academic technology experts recommend ways technology can support pedagogy-based teaching choices, and share resources that can help instructors select techniques and tools for face-to-face, hybrid, and online courses.

Research on how people learn and which conditions lead to deep understanding can help faculty choose the best tools, techniques, and approaches for teaching. This research has resulted in a number of ways to frame learning principles that, while different, share common elements. For this report, the UW Center for Teaching and Learning staff suggest using the following research-based principles adapted from How Learning Works: Seven Research-Based Principles for Smart Teaching (Ambrose et al. 2010) and How People Learn (Bransford et al. 2000).²

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**Getting started**

As any instructor will tell you, trying a new tool, technique, or approach requires up-front preparation. Instructors consider not only how their students learn, but how they as faculty can most easily and most successfully incorporate new teaching practices. When polled, UW faculty provided the following suggestions to peers interested in trying something new:

**Start small.** Rather than overhauling an entire course, many instructors experiment with redesigning one unit at a time. Rather than trying multiple new techniques and tools, they choose just one or two to implement.

**Find support.** Peers and staff can encourage reflection and provide constructive feedback, motivation, and inspiration. Faculty suggest:

- **Joining a Faculty and Professional Learning Community (FPLC):** “Joining a Center for Teaching and Learning FPLC is the most inspiring thing I’ve done.” — Emily M. Bender, Associate Professor, Linguistics, UW Seattle

- **Finding or creating informal groups to share information:** “Creating an online network of peers who are deeply engaged in thinking about teaching has been key for me—that’s where I learn almost everything that I do with technology in my courses. I’m sometimes amazed at the generosity and honesty of peers who ‘think out loud’ about their own pedagogy in these networks.” — Jane Van Galen, Professor, Education, UW Bothell

- **Observing others’ techniques:** “I sit in on colleagues’ classes and have them sit in on mine. That way I can observe things I may want to try myself.” — Heidi Stahl, UW-IT Web Information Specialist, who has taught in various settings, including Tufts University

**Practice, and expect imperfection.** Rarely do new things go smoothly from the start, and students may need time to adjust to changes. Plan ahead of time how you might respond to setbacks and build in multiple opportunities to get it right.

**Use technology glitches as teachable moments.** “Embrace the fact that technology will let you down. Incorporate this into the culture of your class, teaching your students that we are all in this together and digital literacy means knowing how to cope.” — Colleen Carmean, Assistant Chancellor for Instructional Technologies, UW Tacoma

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**Instructors can improve learning when they:**

**Make thinking visible** because…

- Prior knowledge affects learning.
- How people organize their knowledge affects learning.

**Motivate students** because…

- Students need to be engaged in the subject to learn.
- Metacognition deepens learning and cultivates self-directed, lifelong learning.

**Design the learning experience thoughtfully** because…

- Students need scaffolding and deliberate practice to develop mastery.
- Students need a climate that fosters learning and inquiry.
- Feedback from instructors to students and students to instructors can enhance and support learning.

While these principles are familiar to experienced instructors and people interested in the scholarship of teaching and learning, applying these principles well within the context of emerging technologies, tools, and techniques is the work of a lifetime. There are always new ideas to discover and new techniques or technologies to try. As highlighted in the last report, UW faculty are continually experimenting to improve their teaching and student learning. Some faculty may focus on trying a single technique while others may choose an “informed eclectic” approach, incorporating a variety of methods in their teaching. Some experiment with a small change while others revamp an entire course. Regardless, these instructors have a common goal: to use research-based approaches to make thinking visible and motivate students through thoughtfully designed instruction.
Making thinking visible
Evidence-based teaching involves making students’ thinking visible to the instructor and to the students themselves, uncovering students’ prior knowledge and assumptions in order to build on them. It also involves making the instructor’s thought process visible to students, modeling how an expert in the discipline thinks through issues and solves problems.

Helping students understand and organize their ideas
“Understanding what students know—or think they know—coming into our courses can help us design our instruction more appropriately. It allows us not only to leverage their accurate knowledge more effectively to promote learning, but also to identify and fill gaps, recognize when students are applying what they know inappropriately, and actively work to correct misconceptions,” write the authors of How Learning Works. They add that activating students’ prior knowledge can help them learn and retain more: “In essence, new knowledge ‘sticks’ better when it has prior knowledge to stick to,” and students may need help to “bring their prior knowledge to bear on new learning situations.”

A wide range of approaches can help students reveal and organize knowledge and apply it in new contexts, such as concept mapping, digital storytelling, and “thinking out loud” in discussions and brainstorming sessions held in either face-to-face or online spaces.

UW instructors share some of the ways they help students uncover their prior knowledge and build their understanding of content, concepts, and connections between ideas.

- Concept mapping: “I have had good luck breaking students into groups and having them create concept maps, using the central theme of the course or a research assignment as the central concept for the maps. Then students trade concept maps and add any missing issues, events, scholars, or theoretical perspectives.” — Amanda Hornby, Undergraduate Instruction Coordinator, Odegaard Undergraduate Library, UW Seattle

- Free writing to build on prior knowledge: “I assign low-stakes, ungraded writing in all my courses, whether undergraduate or graduate. As many writers have commented, writing a draft tells you what
you think. Low-stakes writing gives students the opportunity to discover what they think, what they know, and what they don’t know. It also gives them practice writing the way professionals and scholars write.” — Beth Kalikoff, Director, Center for Teaching and Learning, UW Seattle; Associate Professor, Interdisciplinary Arts and Sciences, UW Tacoma

Creating digital spaces for thinking out loud: “I’ve evolved from using discussion boards on a Learning Management System, like Canvas or Blackboard, to having students create their own digital spaces for ‘thinking out loud’: blogs, Twitter, and annotated shared bookmarking of resources that students bring to the course. I also create a Google Doc with ‘opening questions’ on the first day of class. Students all add their thoughts and ideas to this while it’s projected, so we can watch their combined ‘prior thinking and experiences’ on the screen as the document grows, and then talk about these together. — Jane Van Galen, Professor, Education, UW Bothell

Modeling expert thinking

Uncovering student thinking is important, but making thinking visible also includes sharing the instructor’s thinking process with students. Research shows that novices and experts in a discipline approach problems quite differently. Novices, such as undergraduates, tend to focus on discrete and tangible labels, formulas, and terminology, while experts focus on transferable and generalizable patterns. “One big difference between novices and experts is that novices only see the superficial details of a problem while experts see the underlying foundational concept or pattern,” says Mary Pat Wenderoth, Principal Lecturer of Biology at UW Seattle.

To develop their critical thinking skills, students need exposure to the ways experts think. They benefit from observing how scholars organize knowledge, both in general and within their discipline. Instructors can help by describing their own problem-solving processes and explicitly revealing the norms and knowledge structures of their field.

Modeling expert thinking can be as straightforward as working through a problem out loud in front of students.

Narrating the expert’s thinking process: Assistant Professor A.J. Boydston models his thinking process for students by thinking out loud when working through chemistry problems, both in class and via video answer keys he posts for students to watch as they correct their work at home. He says, “I try to get the students in the mindset of assessing the problem, rather than trying to immediately fit the problem into some memory bank and regurgitate semi-related information as an answer. I sometimes deliberately comment on some possible red herrings and how I snuff those out to get to the best answer. They’ve loved it.” — A.J. Boydston, Assistant Professor, Chemistry, UW Seattle

This approach can be especially powerful when the instructor walks through a novel challenge, one he or she is truly grappling with in real-time, such as in research settings where students observe faculty solving problems first-hand.

Demonstrating expert thinking. Assistant Professor A.J. Boydston uses a tablet and Canvas’ shared whiteboard feature to illustrate chemistry concepts for students during online office hours. He says, “I narrate as I go and explain exactly what cues I’m seeing in the problem. I try to have students make the decision at each fork in the road. I ask them, ‘What do you think this problem is asking? What do you think I’m trying to test with this question?’"
In other cases, instructors build development of expert thinking into the whole curriculum, with science instructors repeatedly asking students to connect content to “big ideas,” and history instructors reminding students what counts as evidence in historical analysis. Across disciplines, instructors find it valuable to clearly and regularly identify themes, highlight discipline-specific language, and connect disparate information.

- **Analyzing clues in historical artifacts:** “I use a lot of artifacts, like images of paintings and architecture. First, I introduce the historical context of the artifact, then ask students to think like detectives and historians. For example, in court portraiture from the Mughal Empire, I ask students to look at how social hierarchy appears in this art and how that reflects the way the emperor wanted to be perceived by his subjects.” — *Purnima Dhavan, Associate Professor, History, UW Seattle*

- **Making explicit the expectations of the field:** Associate Professor Arnie Berger holds students to professional standards. “I try to set expectations for what is expected of an electrical engineering professional. I also drum into them that anything that they hand in is considered work product and is their intellectual property, and that it should be professionally prepared, because an engineer would never submit a piece of work to their boss that was written in pencil and torn from a notebook. I also teach them how to ask questions in a professional manner. This is tough to do because they are naturally fearful of appearing ignorant.”

  Berger says students’ ability to think like a professional often crystallizes during capstone courses. “For the first month or so they just tread water; they are still thinking like students, which means that they look at the assignments or exams due that week and make value judgments about how to partition their time so that they can maximize their grade. By the end of the six-month capstone, the students are able to discuss schedules, task specifications, and test plans as if they were engineers doing the same work. They have ‘bought into’ their projects and have a personal stake in their success.” — *Arnie Berger, Associate Professor, Chair, Engineering and Mathematics, School of Science, Technology Engineering, and Mathematics, UW Bothell*

Making thinking visible uncovers students’ prior knowledge, helps them build on that knowledge, and shows them how to think like a professional or expert in their field. Keeping students motivated throughout this learning process is key to its success.
Motivating students to learn

Engaging students

Students are more invested in the learning process when they have some sense of control, and when they see ways they can directly apply what they learn to their daily lives or career goals. According to the authors of a literature review in the journal *Computers & Education*, research demonstrates the “need to offer complex and authentic activities that engage the learner in decision-making and problem solving that is relevant to their real world situations.”

UW faculty use a variety of methods to cultivate buy-in and motivate students, and often employ technologies to help.

- **Using examples from current news:** “I use a lot of economics examples straight from the news in *The Wall Street Journal* or *The New York Times*, and ask students to use classroom concepts in analyzing the articles.” — Haideh Salehi-Esfahani, Senior Lecturer, Economics, UW Seattle

- **Linking course content to online videos:** “I like the ability of Canvas and Blackboard to link students instantly to short audiovisual texts (many on YouTube) that become part of course materials. I have given assignments involving academic writing and popular cultural texts; working with both, the students are enthusiastic.” — Claudia Gorbman, Professor, Interdisciplinary Arts and Sciences, UW Tacoma

- **Asking students to create exam questions and answer keys:** “Allowing students to learn from each other is essential to the learning process. It takes work to set this up, but once it happens students are engaged and it saves time. One example is having students come up with exam questions and create an answer key. They can post these online to help others study, and online discussions can emerge.” — Hedwig Lee, Assistant Professor, Sociology, UW Seattle

- **Students turning science into stories for the public:** “I ask students to develop a case study on some conservation issue, which includes a literature review of the dimensions of the problem and attempts to solve the problem. Then I ask them to develop a 300-word ‘story’ about their case, to link that story to images in a compelling way, and then publish their ‘conservation story’ in any of a number of outlets, often a class website or blog, but many also choose YouTube. (student project on YouTube). What I like about this assignment is that students have to think about how to make a compelling story that inspires other people, drawing from a strong foundation of good research. We are so in need of good conservation stories!” — Martha Groom, Professor, Interdisciplinary Arts and Sciences, UW Bothell; Adjunct Professor, Biology, UW Seattle

- **Live polling using clickers:** “There are lots of interesting things that you can do with clickers that go beyond just multiple choice answers. Using the feature ‘moment.”

Tools for engaging students

- **Social media tools** such as Tumblr and Twitter can encourage students and instructors to share supplemental resources, news items, images, and events.

- **Portfolios** allow students to curate evidence of learning and mastery, justify their learning, and develop commentary on the artifacts they choose. Portfolios provide instructors with a means for substantive assessment of student learning. There are a variety of ways to create electronic portfolios; for example, students can use Catalyst CommonView, Google Sites, or WordPress.

Using costumes and props to jazz up class videos. Cheryl Greengrove, Associate Professor in Environmental Science (left), and Julie Masura, Lecturer in Environmental Science (right), used costumes and props to liven up the introductory video for the hybrid course TESC 337: Environmental Geology. They designed the course with two other UW Tacoma faculty members as part of the 2012 iTechnology Fellows Initiative in Innovative Course Redesign. The course includes online videos and assignments, and face-to-face lab work.
to moment 1 to 5’ in TurningPoint clicker software, I poll students while they watch public service announcements created by NGOs. They judge where the announcement falls on a 1 to 5 scale ranging from pure scientific fact to pure rhetoric. The end product is a line graph of all the students’ responses. We then compare the peaks and valleys to the corresponding points in the video and discuss how a consumer of information can discern the difference between fact and rhetoric and how these judgments affect the way people make decisions.” — Lekelia (Kiki) Jenkins, Assistant Professor, School of Marine and Environmental Affairs, UW Seattle

UW students respond well to efforts to keep them engaged with the material and with each other. “Having clicker questions is engaging. It keeps me more attentive,” says Xinia Ebbay, a junior in Pre-Nursing. Brian Perez, a senior in Pre-Nursing, agrees, “It’s like a mini-quiz every day; you’re more motivated to keep up with the class reading.”

**Encouraging metacognition to deepen learning**

Reflection is another way to motivate students. Research shows that when students reflect on their learning—that is, engage in metacognition—their learning deepens and their thinking becomes more sophisticated. Instructors who engage students in complex and authentic activities can also “enable them to reflect deeply on both their learning processes and outcomes, which subsequently drive them towards metacognitive thinking and self-learning,” according to authors of an article in *Computers & Education*, who add that metacognitive thinking is associated with enhanced ability to transfer knowledge to new situations. Others note that metacognition is a key component of critical thinking. The authors of an article in *Internet and Higher Education* argue, “Metacognition must go beyond simply thinking about thinking…[to] include self-corrective strategies.”

Guiding reflection and metacognition means asking students to consider questions such as: How did they arrive at an idea? How has their thinking changed? What has been their learning process, and what might they do next time? Not all students do this or know how. Instructors can help by providing opportunities for self-reflection and clear prompts, such as those Principal Lecturer Mary Pat Wenderoth uses when she asks biology students to write learning paragraphs (shown below and in a video produced by the Office of the Provost’s [2y2d Initiative](#)).

**Writing assignments can help biology students integrate and retain class material.** Principal Lecturer Mary Pat Wenderoth (right) uses a variety of techniques to help her biology students reflect on class material and their understanding of it. These include writing paragraphs, as shown in a video produced by the Office of the Provost’s [2y2d Initiative](#). Wenderoth says the assignments give her students “an opportunity to write, an opportunity to reflect, and then it gives me an opportunity to see what they are actually thinking.”

Students agree. One wrote in a class assignment, “Reflecting has given me a minute to sit back and look at the ‘bigger picture.’ It can be really hard to do that in many classes because it’s easy to get so engrossed in just studying for an exam, or just trying to pass that test, or just having something ready to turn in. The whole reflection process instead lets me sit back and think ‘so what can I do with all that I have learned?’”
Many UW instructors use a variety of tasks and technologies to create opportunities for students, individually or in groups, to reflect at the assignment or course level.

- **Including reflection as part of the assignment:**
  “When students write papers, I have them answer a series of questions that have them reflect on what they learned and the challenges they encountered in writing the paper.” — Heidi Stahl, UW-IT Web Information Specialist, who has taught in various settings, including Tufts University

- **Creating ePortfolios to reflect on course learning:**
  “All of my courses include an ePortfolio, in which students write a reflective, framing essay about their learning, citing evidence in their artifacts.” — David Goldstein, Director, UW Bothell Teaching and Learning Center; Senior Lecturer, Interdisciplinary Arts and Sciences, UW Bothell

- **Brainstorming as a group, on (virtual) whiteboards:**
  “At a couple of points in the course, and especially at the end, I have the students brainstorm what they have learned about several big picture topics. My goal is partially to help them connect the very technical, detail-oriented work we’ve been doing with larger pedagogical objectives, and partially to have them reflect on what they have learned. When I do this in a blended in-person/online course, I have a virtual whiteboard open and use it to write down the brainstormed ideas.” — Emily M. Bender, Associate Professor, Linguistics, UW Seattle

- **Building different levels of reflection into the course design:**
  “I support reflection on three levels. In my most recent class, I termed these micro-reflection, meso-reflection, and macro-reflection. For micro-reflection, I had students fill out a feedback form at the end of the class session that asked them to either (a) describe rewarding, frustrating, surprising, and ‘aha’ moments during the class session or (b) draw a picture of their learning during the class session. I turned these forms over to a student in the class who reviewed them and brought themes back to the class during the next session. For meso-reflection, I invited students to create ‘reflection boundary objects,’ which I defined as text, graphics, sound, art, etc., that provided (a) evidence of the students’ personal reflection and (b) had the capacity to entice the other students in the class to reflect as well. For macro-reflection, I had students complete a final reflective activity at the end of the term—they had to create a pre-recorded presentation in which they made an argument for how their class experiences had prepared them for their future.” — Jennifer Turnes, Professor, Human Centered Design & Engineering, UW Seattle

By focusing on motivation, engagement, and reflective metacognitive skills, faculty can help gradually build student understanding and teach students to become increasingly autonomous, self-directed, lifelong learners.
Designing the learning experience

Scaffolding instruction and guiding deliberate practice

Research shows that students will reveal more of their thinking and advance further in their learning when questions and tasks are scaffolded. Scaffolding can take a variety of forms, but generally means breaking a complex assignment into smaller steps, or giving students other structures or resources that help them produce better quality work. Closely linked is the design of deliberate practice for skills students need to succeed in a course or discipline. According to the authors of *How Learning Works*, “Research has shown that learning and performance are best fostered when students engage in practice that (a) focuses on a specific goal or criterion for performance, (b) targets an appropriate level of challenge, and (c) is of sufficient quantity and frequency to meet the performance criteria.”

UW instructors build such opportunities into course design, scaffolding tasks in a variety of ways.

- **Breaking up complex tasks into small steps:**
  “I use multi-part assignments in which students are required to reach and try something new. Because they often fall short on part of the assignment, there is room to make it up later on and to reach an acceptable level of competency.” — Ingrid Walker, Associate Professor, Interdisciplinary Arts and Sciences, UW Tacoma

Laboratory exercises and essay questions can be scaffolded as well, by providing elements such as vocabulary or concept “banks,” checklists, sub-questions, or tutorials that help the student build towards a result, argument, or conclusion.

- **Step-by-step video tutorials:** Undergraduate Instruction Coordinator Amanda Hornby recommends that faculty post links to “How Do I...?” tutorials created by the UW Libraries. These short videos introduce students to topics such as “How do I find background information on my topic?” and “What is a scholarly journal article?” Students watch the videos before class and are then more prepared to discuss scholarly or research processes and to effectively use scholarly research tools for their coursework and research projects.” — Amanda Hornby, Undergraduate Instruction Coordinator, Odegaard Undergraduate Library, UW Seattle

Designing a course to include deliberate practice means ensuring that there are smaller-scale, low-stakes, often self-directed assignments that effectively simulate the skills needed to show mastery and pass a final assessment. Creating sufficient opportunities for deliberate practice is a task often made easier by technology tools such as Canvas. In Canvas, faculty can create question banks students can use to quiz themselves on their own time, helping students identify and fill gaps in their understanding of the material.

- **Creating self-study quiz banks:** “Canvas allows the instructor to set a quiz for multiple attempts and shuffle answers on each attempt. The learner uses self-assessment to discover what they don’t know and to go back and spend time studying the very things they didn’t know.” — Colleen Carmean, Assistant Chancellor for Instructional Technologies, UW Tacoma

In courses where learning goals include strengthening critical thinking, students will need multiple opportunities—with constructive feedback—to practice critical thinking during the term. Many UW instructors design the learning experience to include this practice.

- **Creating opportunities to practice critical-thinking problems:** “In my undergraduate economics classes, I’m very deliberate in creating ample opportunities to practice thinking critically and applying concepts. Students must attend lectures and quiz sections, of course, and I build group practice into class. Students are also instructed to spend 70% of their out-of-class time doing practice problems that I provide. Questions and answers are kept up-to-date on the course website.” — Haideh Salehi-Esfahani, Senior Lecturer, Economics, UW Seattle

Tools for deliberate practice

Students are motivated by evidence of increasing skill, many small challenges instead of a few large ones, and immediate feedback. Instructors can build such assignments using a variety of tools. For example:

- **Canvas modules** allow instructors to require students to complete a set of tasks before advancing to the next “level.”

Discipline-based tools are becoming increasingly available. For example:

- **ALEKS** software helps math and chemistry students practice basic skills; it automatically adapts questions and problem sets as students progress through the course. (Colleen Craig describes how she has used ALEKS with her classes in a UW-IT Ignite! video.)

- **Duolingo.com** is a free website for practicing basic foreign language skills, and has recently published evidence of its effectiveness.
Cultivating a supportive climate to promote learning

Practice alone doesn’t maximize learning. “Recent research...has converged on the notion of classrooms as communities,” according to an article in Studies in Philosophy and Education. Students need a positive environment in which to learn—one that is supportive and inclusive. Instructors can cultivate this climate of inquiry and equity and set norms for interpersonal behavior. In a forthcoming book chapter, UW professor Mark Windschitl asserts, “Over the past 20 years, this idea of teachers making clear, in talk and in practice, what everyone’s role is in the production of knowledge, and whose knowledge will be valued, shows up consistently in classrooms where widespread student participation and learning are evident.” UW instructors seek to establish such norms and expectations to foster a more supportive learning environment.

- **Having students negotiate norms for behavior:** “I ask students in their small groups to negotiate their own rules and expectations of one another, such as interim deadlines for group assignments, and I ask the class as a whole, on the first day, to negotiate class rules and expectations for themselves, such as under what circumstances laptop and smart phone usage are permitted.” — David Goldstein, Director, UW Bothell Teaching and Learning Center; Senior Lecturer, Interdisciplinary Arts and Sciences, UW Bothell

- **Meeting students where they are:** “Choosing to conference with students on platforms such as Skype eliminates the perceived power an instructor’s office carries with it. Once removed from these sanctioned spaces of authority, I have found that students are better situated to become active learners and collaborators in a course.” — Brian R. Gutierrez, Teaching Assistant and Graduate Student, English, UW Seattle

Instructors also work to cultivate a climate that supports learning by preparing for differences in linguistic and cultural backgrounds, disabilities, and attitudes and motivations towards schooling, classroom roles, and ways of learning. For example, accommodations for persons with disabilities need to be available in online contexts, as well as in face-to-face classrooms.

- **Understanding accessibility:** “We are still dealing with the issues that arise in providing individual accommodations and removing barriers in face-to-face classrooms, but if the technology that is used is also not fully accessible, then we must also provide accommodations for any barriers that technology may create. As a university, we should strive to create classes with technology that is universally accessible.” — Amanda Paye, Title IX / ADA Coordinator, UW Office of Risk Management

Technologies can also provide accommodations that are not available in face-to-face classrooms. One example is the opportunity for self-paced learning offered by lecture capture tools like Tegrity.

- **Helping English language learners:** “Putting video explanations online allows English language learners, students with disabilities, or students who are simply less familiar with the content or conventions to proceed at their own pace.” — Kevin Mihata, Associate Dean for Educational Programs, College of Arts and Sciences, UW Seattle

- **Letting struggling students rewind:** “For the mathematically challenged students, my lectures were far too fast. With online videos, students can work through them at their own pace. The videos solved what was previously a problem without a solution.” — Doug Wills, Associate Professor, Milgard School of Business, UW Tacoma
Providing feedback to support learning

Most of all, research indicates that students need regular and constructive feedback that they can directly and immediately apply. Authors of an article in the *Review of Educational Research* found that “A detailed synthesis of 74 meta-analyses...demonstrated that the most effective forms of feedback provide cues or reinforcement to learners; are in the form of video-, audio-, or computer-assisted instructional feedback; and/or relate to goals.” Furthermore, online settings offer tools that can enhance immediacy and clarity of feedback, such as posting and reviewing rubrics, while helping faculty balance the desire to give rich feedback with other demands on their time.

At the UW, faculty provide meaningful feedback in many ways, such as peer-review, descriptive commentary on problem-solving, and online quizzes that provide correct/incorrect answers—with explanations—immediately after students answer each question.

- Providing feedback on language students’ audio files: “In my hybrid introductory French classes, my students can submit audio files. This allows me to listen to each student and give them individual feedback, which you cannot do in a regular class.”
  — Hedwige Meyer, Senior Lecturer, French and Italian Studies, UW Seattle

Tools for assessing understanding

- **Shared online documents** can be used synchronously (during class) by multiple students to take notes, post questions, and provide information, resulting in a single, comprehensive and complex artifact. Shared documents can be particularly valuable when made public (projected on a screen in a classroom, or displayed side-by-side with media online), or when they incorporate instructor comments. One tool easily available to UW students and faculty is Google Docs, which can be integrated into Canvas course sites.

- **Online surveys, in-class clicker questions, “exit tickets,” and quick writes** can be used for low-stakes assessment of student understanding, enabling instructors to quickly identify trouble-spots and adjust their subsequent instruction.

- **Rubrics** can provide instructors with structured and efficient ways to give richer, more meaningful feedback to students. The Canvas SpeedGrader tools are one example.
Using rubrics and peer review: “I use detailed rubrics to provide online feedback and guide course discussion about an assignment. Students also present work in class in front of their peers and some of their work is available online for peer review.” — Hedwig Lee, Assistant Professor, Sociology, UW Seattle

Like many UW instructors, Assistant Professor Riki Thompson provides feedback while modeling expert thinking. She leads and records workshops where students discuss anonymous student papers.

Recording writing workshops for students to review at home: “I project a sample assignment on the screen and as a class we assess the strengths and weaknesses, talking through possible revision suggestions together. Using my stylus, I write on the assignment as if I were marking it up on paper, which students see projected on the screen. I am currently using an iPad to project the annotations I am making and record the discussion using an interactive whiteboard program, screencast recorder, and remote desktop program for iPad that can project through any PC. I currently save workshop recordings to YouTube and post them on the class website so everyone can review them later, but will experiment with the Tegrity tool for lecture capture next quarter” (sample workshop video). — Riki Thompson, Assistant Professor, Interdisciplinary Arts and Sciences, UW Tacoma

Designing a learning experience where students can learn and thrive is an area where technology can be particularly helpful by supporting scaffolding, practice, and rubrics for constructive feedback. Technologies can also make it easier to gather real-time feedback that helps faculty gauge understanding and adapt accordingly, a practice called formative assessment. Formative assessment is a particularly powerful tool to provide information to students about their progress and inform the instructor's choices about the next lesson, or even the next few moments in a class discussion. According to the authors of an article in Educational Assessment, Evaluation and Accountability, “Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited.”

Formative assessment, when done well, is both adaptive and iterative.

Adjusting teaching in real time, based on in-class assessment: Biology Senior Lecturer Scott Freeman notes an example when he used formative assessment during a discussion of experimental design. A clicker question asked students to evaluate experimental designs for testing how cedar trees would respond to different mulching treatments in reforestation. “The vast majority of students picked an answer saying that you could only do an experiment like this in a greenhouse or garden, where you can control conditions tightly, when, in fact, the whole point is to expose the trees to field conditions. Very few people picked the answer proposing a large randomized trial in a normal replanting area. So I discovered that the way I was teaching was breeding a misconception.” Freeman was able to correct the students' misconception by adjusting his teaching in the moment and in future classes “to introduce the idea of designing experiments so conditions don’t differ between treatments on average.” — Scott Freeman, Senior Lecturer, Biology, UW Seattle

Shelly Rasmussen, a junior physiology major, thinks it is especially important for instructors to check student understanding during class, as some of her professors do using clickers. “The professor can manage class time better. If a large number of students don’t understand a question, the professor can address it.”
Putting it all together

Learning together

Some instructional approaches, when implemented effectively, can incorporate several learning principles simultaneously to foster student learning. For example, activities that include a structured discussion can make thinking visible by eliciting ideas, give students practice in expert problem-solving by having them reason and respond to ideas in a group, and engage them in creating a community of learning and scholarship.

Not surprisingly, research shows that “Individuals are likely to learn more when they learn with others than when they learn alone,” according to a review in *Advances in Physiology Education*. Discussion is a great way to facilitate such group learning. As UW faculty know, cultivating productive discussion requires forethought and guidance, whether the conversations happen face-to-face or online.

Inspiring and managing discussion: “To spark lively class discussion online, I provide students with prompts seeded with links, YouTube videos, images, etc., that illustrate a concept or theme. Nearly all the work that students do in my classes is posted publicly on our course online discussion boards, and students are graded both on the caliber of their work and the quality of their engagement with the work of their peers.” — Natalie Jolly, Lecturer, Interdisciplinary Arts and Sciences, UW Tacoma

Acting as a provocateur to fuel discussion: “I throw out an open-ended question (like a piece of raw meat) onto the table and let them argue. If they refuse to debate, I make a clearly preposterous statement, and let the eruption occur.” — Jeff Dean, Lecturer, Milgard School of Business, UW Tacoma

Planning for effective conversations: “I think of teaching in terms of task, talk, and tools. In active, collaborative classrooms and especially when trying something new, we tend to focus most on tasks and tools—either high-tech or low-tech. It’s important, though, to pay attention to talk as well. Certain forms of classroom talk stimulate student thinking. Planning for productive discourse in real and virtual classrooms can boost opportunities for students to learn. In my work with TAs and K-12 teachers, we use a ‘discourse primer’ to practice successful classroom conversations, questioning techniques, getting students to talk, and managing silence. They find it’s extremely helpful and really improves classroom interaction.” — Mark Windschitl, Professor, Curriculum and Instruction, UW Seattle

Research-based complete approaches

A number of approaches synthesize the principles of how learning works in a holistic way and can employ technology to help. For example, team-based learning and problem- or case-based learning are multi-phase, structured techniques for engaging students in authentic and complex work. “All these approaches have something in common; they are student centered to varying extents, encourage students to seek, synthesize, and integrate information from a variety of sources, and assess performance in diverse ways,” according to the author of an article in *Advances in Physiology Education*. Active learning can be fostered in a variety of settings ranging from small to large groups and in face-to-face settings as well as online, through the use of wikis and other tools. Groups and departments throughout the three UW campuses implement these approaches successfully.

Tools for online discussion

- **Online discussion boards** (synchronous or asynchronous) can be valuable for creating a place for students to share their questions and ideas, and can help an instructor manage and guide voluminous communication. Using Canvas tools is one way to facilitate this.

- **Synchronous online “chat”** during face-to-face class, or when students are online and concurrently viewing media, can be a way to capture questions and comments as they arise. It may encourage or allow more students to “speak up” during class. Tools include Backchannel Chat and Twitter.

- **Reading Response 12**

  Feb 25 at 12:00pm

  
  Read Murthy, “Theorizing Twitter” and one of the two (Sullian, “A tale of two microblogs in China” or Stepanova, “The Role of Information Communication Technologies in the Arab Spring”). Write a free-styled reading response to share your thoughts about the role of microblogging technology for social change.

  
  Reply

  1 2 3 >>

  — In the article “The tale of two microblogs in China” I found it interesting that the user...

  — I really enjoyed the article “Theorizing Twitter” because it explained the many step...

  — In Murthy’s “Theorizing Twitter” one section that stood out to me was the I tweet...

Encouraging thoughtful discussion through online tools. As shown in this screenshot from a course at UW Tacoma, Canvas can provide a forum for online discussion. “Knowing that their work will not only be read by me, but will also be discussed by their peers in an open forum, leads to writing and thinking that is more carefully substantiated and more clearly articulated,” says Natalie Jolley, Lecturer in Interdisciplinary Arts and Sciences at UW Tacoma.
Preparing medical students for team-based patient care: “Team-based learning (TBL) is all about peer-teaching, coupled with guided feedback from an expert instructor. Modern medicine requires teams of doctors and staff to sort through reams of data and make judgments about how to use information to benefit patients—having enough information is only the first step. In TBL, medical students come to class having prepared themselves in advance by reading and watching pre-recorded videos. In class, guided by experienced instructors, students work in teams, pool their knowledge, consult outside sources, and learn to develop strategic approaches to solve clinical problems—problems just like those they will soon encounter as attending physicians. The social philosopher, Eric Hoffer, got it right when he said: ‘In times of change, learners inherit the earth, while the learned find themselves beautifully equipped to deal with a world that no longer exists.’” — Robert A. Steiner, Professor, Obstetrics & Gynecology, Physiology and Biophysics, UW Seattle

“Flipping” the classroom: Nursing student Pamella Guntram appreciates learning in a flipped classroom, in which she “attends” lectures online and spends class time on case studies, group projects, complex problem sets, and other collaborative work. “The ability for us to come together on campus is an opportunity to be taken, and having the course recorded enables us to use precious class time most effectively.” — Pamella Guntram, Graduate Student, Nursing, UW Seattle; Program Manager, Clinical Development and Patient Education, Clinical Care Systems, Harborview Medical Center

Learning collaboratively: “In our argumentative writing and research class, Professor [Riki] Thompson has us work on something overnight so the next day we can post it on Canvas to see everyone’s different point of view, and then we get to collaborate to see where everyone’s coming from. I really believe this is making our learning experience better, because you get to collaborate with fellow students and it’s a really hands-on approach.” — Morgan Hughes, Junior, Communications, UW Tacoma

Continuing the conversation
Instructors across the three UW campuses work to make thinking visible and motivate students. They thoughtfully design instruction and learning environments using tools ranging from the low-tech, such as whiteboards, to the high-tech, such as concept-mapping software.

While the plethora of research-based approaches and technologies can offer tremendous potential benefits, the variety of options can be overwhelming. Instructors can take comfort from the authors of How Learning Works, who write, “the number of strategies we must master to be effective teachers is not infinite.” The same can be said for tools. The UW instructors profiled in this report have found that the best standard for selecting and retaining tools and techniques is finding which best serve their students’ needs. They are putting learning first.

We welcome your comments, questions and suggestions. Please email edtrends@uw.edu.
Resources

Campus resources

- The Center for Teaching and Learning helps with the pedagogy of incorporating low-tech and high-tech approaches to teaching. CTL offers workshops, symposia, individual consultations, and learning communities and provides a variety of web resources.

- UW-IT’s Learning Technologies group can help identify and implement various tools that support teaching and learning. They offer numerous workshops to get instructors up and running.

- Teaching & Learning at the UW Libraries provides teaching tools and services, including examples of successful faculty-librarian partnerships.

- Classroom Support Services offers comprehensive media support and services to students, faculty, and staff. They offer a full range of in-classroom audio and video expertise, including help with classroom computers, equipment rental and repair, technical services, and access to an educational media collection.

- UW Bothell Learning Technologies provides support for the integration of technology in teaching and learning. Their website includes how-to guides, instructional resources, and a blog. They also offer a Hybrid Course Development Institute for UW Bothell faculty looking to replace some face-to-face instruction with increased online teaching.

- UW Tacoma Academic Technologies works in collaboration with faculty, UW Tacoma Libraries, Information Technology, and the UW Tacoma Teaching and Learning Center. They sponsor events and workshops, and offer one-on-one consultations. Among their offerings is the iTechnology Fellows Initiative in Innovative Course Redesign.

Blogs

- UW Bothell Learning Technologies
- Teaching Forum: Talking Teaching at UW Tacoma
- GridKnowledge, UW Tacoma’s Assistant Chancellor for Instructional Technologies
- Wired Campus, The Chronicle of Higher Education
- Prof Hacker, The Chronicle of Higher Education
- Agile Learning, Director of Vanderbilt’s Center for Teaching
- Faculty Focus, Higher Ed Teaching Strategies From Magna Publications

Online publications and virtual communities

- Campus Technology
- EDUCAUSE, an online research community
- EdTech: Focus on Higher Education
- eLearn Magazine
- Learning Through Digital Media
- HASTAC: Humanities, Arts, Science, and Technology Advanced Collaboratory

Other university teaching and learning centers

- Technology, Center for Teaching and Learning, University of Texas at Austin
- Technology in the Classroom, Center for Research on Learning and Teaching, University of Michigan
- Educational Technologies, Center for Teaching, Learning and Technology, University of British Columbia
Notes


6. Digital storytelling revolves “around the idea of combining the art of telling stories with a variety of multimedia, including graphics, audio, video, and Web publishing... As with traditional storytelling, most digital stories focus on a specific topic and contain a particular point of view.” They “can vary in length, but most of the stories used in education typically last between 2 and 10 minutes,” according to Educational Uses of Digital Storytelling, the University of Houston’s comprehensive guide and collection of examples and resources.

7. Low-stakes writing assignments, such as “exit tickets” and free writes are typically ungraded and sometimes anonymous, and are often used as formative assessment. Effective, short writing assignments can occur either inside or outside of class. “Exit tickets” are typically given at the end of class with a single, short-answer question (e.g., What concept from today’s class is still unclear? What success did you have today? Describe one relationship between idea X and idea Y). Upon departure, students submit their answer on an index card or online. In-class free writes (sometimes called “minute papers”) give students time to organize their thoughts and develop an argument or hypothesis regarding a novel phenomenon or problem. Assignments written outside of class include the paragraphs assigned by Senior Lecturer Mary Pat Wenderoth and described in a video produced by the Office of the Provost’s 2v2d Initiative. These in-class and out-of-class exercises can provide useful data that prompts extension and application of course content or helps instructors prepare for discussion. Minute papers are described in Thomas A. Angelo and K. Patricia Cross, Classroom Assessment Techniques: A Handbook for College Teachers, 2nd ed. (San Francisco, CA: Jossey-Bass, 1993), 148–53, http://www.ncicdp.org/documents/Assessment%20Strategies.pdf (excerpt).

8. Learning Management Systems (LMSs) are online integrated software packages—such as Canvas, Moodle, or Blackboard—that enable instructors to manage a course, deliver materials and resources, and promote student interaction. An LMS supports online discussion, querying, submission of assignments, sharing of files, and assessment and grading. Canvas is the preferred full-function LMS at the UW. Catalyst continues to be available; however, it will not be developed further by UW-IT and lacks many of the integrated features of Canvas.

9. Social media—such as blogs, Twitter, Tumblr, and Facebook—allow instructors and students to share and comment on relevant articles, resources, and events outside the classroom. Each tool has different strengths and each type of forum different norms. However, all can be useful for sharing written work, commentary, links, and media. When successfully incorporated into a course, social networking tools can help students become better consumers and curators of media, refine their writing skills, connect with public figures and events, and engage networks of people who are working to learn more about the very questions that a course is addressing. Social media offer students the opportunity to shift from being consumers of information to active participants in broader, public conversations about course topics. Read more: Rey Junco, Greg Heiberger, and Eric Loken, “The Effect of Twitter on College Student Engagement and Grades,” Journal of Computer Assisted Learning 27, no. 2 (2011): 119–132, doi: 10.1111/j.1365-2729.2010.00387.x.

10. Google Docs allow people to easily share and collaborate on documents online, saving the trouble of emailing attachments back and forth. Furthermore, individuals can create documents, including presentations and spreadsheets, directly within Google Docs, without having to upload and download files across computers. These documents can be edited by multiple contributors in real time. All UW faculty and students have access to Google Docs using their UW NetID.


14. “Clickers,” or audience response devices, are small keypads that allow students to instantly “vote” for an answer to a posted question (UW clicker information and policies). The instructor’s computer receives and collates the submissions, and the instructor can then post the responses publicly (e.g., on a bar chart). Some instructors have students purchase clickers along with textbooks at the start of a course, while others use inexpensive or free computer and smartphone apps such as Poll Everywhere and Socrative. Read more: David C. Haak, Janneke Hille Rij Lammers, Emile Pitre, and Scott Freeman, “Increased Structure and Active Learning Reduce the Achievement Gap in Introductory Biology,” Science 332, no. 6034 (2011): 1213–1216, doi: 10.1126/science.1204820.


19. **Portfolios (including ePortfolios)** are cumulative end-of-course or end-of-degree collections that demonstrate mastery. They consist of a variety of student work, typically called “artifacts,” organized with justifications and reflective commentary. Portfolios vary in format; some are paper, some are electronic documents, and some are multimedia. Read more: Darren Cambridge, *E-Portfolios for Lifelong Learning and Assessment* (San Francisco, CA: Jossey-Bass, 2010). Learn more: *Why Use ePortfolio*, Boston University’s comprehensive guide and collection of examples and resources.


23. Windschitl, “Rigor and Equity by Design.” See also Gikandi, Morrow, and Davis, “Online Formative Assessment.”


27. Rubrics are scoring tools that clearly communicate to students how their work will be evaluated and what constitutes different levels of quality. Using a rubric makes grading easier for the instructor, as well as more consistent. Learn more: *Using Rubrics*, a review and guide by the Center for Teaching Excellence at Cornell University; and *Grading and Performance Rubrics*, a review and guide by the Eberly Center for Teaching Excellence & Educational Innovation at Carnegie Mellon University.


31. **Team-based learning** focuses on the careful design of collaborative work among student groups. It is characterized by long-term affiliations, structured processes, and well-defined roles. Learn more: The Team-based Learning Collaborative provides extensive resources, videos, and workshops.

32. **Problem-based learning and case-based teaching** hinge on the nature of the task presented to students. In these constructs, instructors choose or design particular scenarios that are complex, authentic, and do not have a single, discrete solution. Originally popularized in professional schools (e.g., medicine and business), but now applied across disciplines and levels, these approaches require students to apply disciplinary knowledge, higher-order reasoning skills, and evidence in the service of argument, and usually encourage collaboration among peers. Learn more: *Problem-Based Learning,* a review by the Center for Research on Learning and Teaching at the University of Michigan. Read more: Deborah E. Allen, Richard S. Donham, and Stephen A. Bernhardt, “Problem-based learning,” *New Directions for Teaching and Learning* 2011, no. 128 (2011): 21–29, doi: 10.1002/tl.465; John Doran, Margaret Healy, Maeve McCutcheon, and Steve O’Callaghan, “Adapting Case-Based Teaching to Large Class Settings: An Action Research Approach,” *Accounting Education: An International Journal* 20, no. 3 (2011): 245–263, doi: 10.1080/09638180.2011.583742.


34. Wikis are spaces on the web where multiple contributors, such as students in a class or team, can share work, ideas, pictures, links, videos, and media. Wikis can be hosted in any number of ways (such as through social media tools such as blogs and Google Docs) other than the original platform. *WikiSpaces Classroom* offers free wiki services for teachers and students. Read more: Pekka Makkonen, Kerstin Siakas and Shakespeare Vaidya, “Teaching Knowledge Management by Combining Wikis and Screen-capture Videos,” *Campus-Wide Information Systems* 28, no. 5 (2011): 360–366.


**Acknowledgements**

Many thanks to the UW faculty, students and staff who contributed their stories, and to the UW subject matter experts who lent their advice to this report series, including the CTL’s Beth Kalikoff, Thessa Ronquillo, and Karen Freisem; UW-IT’s Tom Lewis, Cara Giacomini, Cindy Brown, Kay Pilcher, and Alexis Raphael; UW Bothell’s David Goldstein and Andreas Brockhaus; and UW Tacoma’s Colleen Carmean and Darcy Janzen.

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