Designing for Learning

This concept paper is presented in two parts. First is a three-page executive summary explaining how the principles of *How People Learn* inform learner-centered pedagogy and instructional designs. Appendices go into greater depth for those wanting more detail.  
  
A. Principles of How People Learn  
In a book entitled *How People Learn*, the National Research Council (2000) summarizes what has been discovered through decades of research about how people learn. Based on this research, we know that effective learning environments are learner-centered, knowledge-centered, assessment-centered, and community-centered. According to *How People Learn* (pp. 14-23), three guiding principles have emerged from the science of learning:

1. People learn by connecting new information to concepts already learned.
2. To learn how to reason, solve problems, and augment knowledge in a field of inquiry, people need to understand facts and ideas in the context of a conceptual framework that facilitates application to real-world problem solving.
3. People are motivated to learn when they can set their own goals, reflect on their progress, and feel in control of their learning.

From these principles, it follows that learning environments will be effective when instructional designs:

1. Take into account the learner’s preexisting understandings and correct any faulty preconceptions in order to prevent future misunderstandings;
2. Enable students to study multiple examples of the concept at work in order to learn it in depth in authentic contexts; and
3. Include metacognitive supports that make visible the learner’s reflections and enable an instructor to provide scaffolding and guide revisions to improve student learning and reasoning.

# B. Instructional Designs that Support How People Learn

Printed here is an executive summary of six instructional designs that align with the principles of *How People Learn*. Appended to this paper is a more detailed explanation of the research informing these designs.

## B-1. Flipped Classrooms

The flipped classroom is an instructional design approach where students receive the lecture prior to class and class time is used for other productive tasks.

## B-2. Hybrid Courses

When the learning environment mixes online with face-to-face techniques, the best of both worlds are leveraged to maximize learning in so-called hybrid courses.

## B-3. Online Learning Communities

Opportunities abound for instructors to provide students with online discussion forums. Powerful learning communities form when students are encouraged to read, respond, and create new topics in an online forum that is moderated by the instructor.

## B-4. Multimedia Learning

As the nation’s most well-known educational psychologist, Richard Mayer (2001) has conducted extensive research leading to the creation of a cognitive model through which eight principles of multimedia learning have emerged. Making faculty aware of these multimedia learning principles could lead to significant improvements in student learning.

## B-5. Universal Design for Learning (UDL)

UDL is the educational equivalent of curb cuts and wheel chair ramps, which enable people with physical challenges to navigate the architectural world. In education, UDL involves making learning resources available in multiple modalities.

## B-6. Badges

As an alternative to courses, imagine reorganizing the curriculum into a system of badges. Each badge represents mastery of a module of instruction. The badges connect to each other through a visual network that shows the order in which students can work on the badges.

# C. Pedagogical Considerations of How People Learn

This is an executive summary of the pedagogical strategies that align with the principles of How People Learn. More detail is provided in the appendix that documents the theories behind these methods.

## C-1. Engagement

People are motivated to learn when they can (1) set their own goals, (2) reflect on their progress, and (3) feel in control of their learning. Faculty who teach from an instructor-dominated perspective tell students what their goals are, thereby missing this opportunity to engage learners early in their course.

## C-2. Authentic Learning

At the beginning of a course, the time spent negotiating topics creates the foundation for deep engagement later in the course. To maximize learning, it is important to negotiate real-world topics by engaging students in authentic contexts.

## C-3. Making Thinking Visible

Educators are fortunate having so many tools readily available for making thinking visible, such as blogs, wikis, and discussion forums. By making student thinking visible, faculty can do a better job of helping students learn.

## C-4. Teaching in the Zone

Making thinking visible enables faculty to notice when students begin encountering difficulty. This is the stretch zone in which coaching is most effective because faculty can prevent students from forming misunderstandings that lead to faulty learning.

## C-5. Feedback as Learning System

Faculty can enhance learning by designing instruction into their feedbacks. This is a powerful supplement to syllabi, lectures, textbooks, and assignments, because it prepares faculty to respond effectively in teachable moments that occur when students enter the zone.

## C-6. Differentiating Instruction

We know that people learn by connecting incoming audio or visual information to what they already know. That is why it is critically important to assess prior knowledge and correct misconceptions before teaching something new.

## C-7. Videoconferencing

UD needs to improve its outreach. Web-based videoconferencing has progressed to the point at which faculty can create a classroom stream to which distant students, especially those in Southern Delaware, could log in and thereby attend class over the Web to avoid the drive to Newark.

## C-8. Assessment

Faculty influence how a course feels by determining the manner in which students earn grades. To engage students who are motivated to learn, faculty need to use learner-centered assessment strategies.

Appendices

More Detail Regarding the Instructional Designs

B-1. Flipped ClassroomsBack in the day, face-to-face lectures were the primary means for delivering instruction. Now that video streaming is widespread, no longer is it necessary to make students listen to lectures in classrooms. Instead, faculty can put digital recordings online for students to view at any time. Students can pause the video and replay concepts to review for understanding. In the flipped classroom, instead of having the instructor dominate the face-to-face time, students can work together on projects, and the instructor can help students who are having difficulty. As the sayings go, the teacher emphasis shifts from sage on the stage to guide by the side.

## B-2. Hybrid Courses

Besides flipping the classroom, technology provides opportunities for instructors to rethink how much of a course needs to be classroom based versus how much can be facilitated online. According to the Sloan Consortium’s industry standard definition, courses are called hybrid when online techniques constitute 30% to 80% of the instructional delivery, and the rest is delivered face-to-face. Courses are called online when at least 80 percent of the course content is delivered online. The term face-to-face refers to courses in which zero to 29 percent of the content is delivered online. The sweet spot is somewhere in the middle when the learning environment mixes online with face-to-face techniques, thereby leveraging the best of both worlds to maximize learning in hybrid courses.

## B-3. Online Learning Communities

Learning management systems typically provide discussion forums. Both of the systems used here at UD, namely Sakai and Canvas, have discussion forums built in. Faculty who do not use an LMS can host discussions in Facebook, where the vast majority of students already have free accounts. As Manfra (2009) noted, the learning communities that form in these discussions become so powerful that faculty find themselves learning from students. Zhao and Kuh (2004) found that “Participating in learning communities is uniformly and positively linked with student academic performance, engagement in educationally fruitful activities (such as academic integration, active and collaborative learning, and interaction with faculty members), gains associated with college attendance, and overall satisfaction with the college experience.” (p. 124)

## B-4. Multimedia Learning

Based on his cognitive model of multimedia learning, the renowned educational psychologist Richard Mayer (2001) has identified eight principles of multimedia learning. These principles are (1) Multimedia: Deeper learning from words and pictures than words alone; (2) Contiguity: Deeper learning from presenting words and pictures simultaneously rather than successively; (3) Coherence: Deeper learning when extraneous words, sounds, or pictures are excluded rather than included; (4) Modality: Deeper learning when words are presented as narration rather than as on-screen text; (5) Redundancy: Deeper learning when words are presented as narration rather than as both narration and on-screen text; (6) Personalization: Deeper learning when words are presented in conversational style rather than formal style; (7) Segmentation: Deeper learning when complex lessons are presented in smaller parts; and (8) Pre-training: Deeper learning when key terms are explained in advance.

For each of these multimedia learning principles, Mayer has conducted dozens of experiments validating positive impacts on learning. By helping our faculty learn how to apply all eight of these proven multimedia learning principles, our university’s learning environments could realize the potential of Mayer’s cognitive model of multimedia learning. Perhaps the easiest principle to implement is Personalization. As Mayer explains it, “The personalization principle is that people learn better when the instructor uses conversational style rather than formal style. The rationale is that people try harder to make sense of the presented material (i.e., engage in the cognitive processes of organizing and integrating) when they feel they are in a social partnership with the instructor.” (p. 394) You achieve this by writing in first and second person. Imagine improving results (es=1.30) so simply! Although it seems too good to be true that learning could be improved so impactfully, all ten experiments in which researchers studied this effect found significant improvements in learning outcomes.

## B-5. Universal Design for Learning (UDL)

Students with special needs require educational resources in modalities appropriate for addressing their learning challenges. Obvious examples are creating subtitles in movies for students with hearing impairments and making audio books for the seeing impaired. More subtle are the federally mandated Section 508 requirements, which require U.S. education to support the World Wide Web Consortium’s (W3C) Web accessibility guidelines. Just as curb cuts help everyone physically, such as when you need to wheel something over a curb, so also does UDL benefit learners beyond those for whom it was designed. Mayer’s research into multimedia learning, for example, documents the gain (es=1.50) that can be obtained when educational materials combine words and pictures as opposed to using words alone (Clark & Mayer, 2008, p. 383).

## B-6. Badges

The curriculum currently gets delivered in educational chunks called courses. By taking these courses, students earn credits that count toward graduation. Students typically enroll in four or five courses per semester. Depending on whether students are able to enroll in the course they want, students may end up in courses that are not motivating them to learn. So the faculty use grades as motivators, and the students better learn the material or they will get a low grade. Badges are an alternative way of organizing the curriculum. Each badge represents that the student has achieved competency in a module of instruction. Imagine a network of badges connected to each other through a visual network showing the order in which students can work on the badges. Certain pathways lead to certifications that students can earn for completing different clusters of badges. Degree programs consist of meaningful networks of badges instead of amorphous lists of course electives.

# More Detail on Aligning Pedagogy with *How People Learn*

## C-1. Engagement

From the research about *How People Learn* (2000, p. 18), we know that people are motivated to learn when they can (1) set their own goals; (2) reflect on their progress; and (3) feel in control of their learning. The key to engaging students is to apply these principles to your course design. Using commonly available assignment tools in a learning management system such as Canvas or Sakai, for example, you can ask students to tell you what they hope to learn in your course and you can respond by suggesting appropriate learning resources. This creates a dynamic conversational framework that establishes an empathetic bond (Holmberg, 2003) among students and professors. In an interview study of faculty perceptions of student engagement, Berardi (2002) suggested that faculty need to share a definition of student engagement. UD could create such a shared vision and promote it campus wide.

## C-2. Authentic Learning

The innate human desire to develop competence is an important factor in motivating people to learn (National Research Council, 2000, p. 60). It is important to negotiate real-world topics by engaging students in authentic contexts. In analyzing forty-five scholarly articles about authentic learning, Rule (2006, p. 2) identified the following four themes: (1) The activity involves real-world problems that mimic the work of professionals in the discipline with presentation of findings to audiences beyond the classroom; (2) Open-ended inquiry, thinking skills, and metacognition are addressed; (3) Students engage in discourse and social learning in a community of learners; and (4) Students are empowered through choice to direct their own learning in relevant project work. As Jonassen (2014) found in assessing problem solving, “When students construct and elaborate their own cases, they are more deeply engaged in learning than when interpreting someone else’s cases.” (p. 282) That is why the time spent negotiating topics at the beginning of a course creates the foundation for deep engagement later in the course.

## C-3. Making Thinking Visible

Along the way, while students work on their projects, instructors can have students blog about their progress. Here at UD, blogs are built right in to Sakai. In Canvas, you can create Checkpoint assignments in which students log their progress at periodic checkpoints during the course. The reason why you have students blog is because it makes their thinking visible, not only to you, but also to them and their peers! When students reflect on their thinking that is made visible, metacognition happens, and students improve their ability to learn.

## C-4. Teaching in the Zone

When students begin encountering difficulty, they enter an educational space that the great Russian psychologist Vygotsky (1978, p. 86) called the Zone of Proximal Development. By making thinking visible, faculty can coach students in their zone. Here at UD, both of our learning management systems (both Canvas and Sakai) contain excellent tools for coaching students in their zone. When students submit a project that misses the mark, for example, you can assign a low grade along with feedback explaining what the student needs to do in order to earn a higher score. This creates opportunities for learning that are lost when faculty assign grades but never hand back assignments with feedback and second chances.

## C-5. Feedback as Learning System

Especially if your class is large, how will you have time to engage all your students if you must write this amount of dialogical feedback online? In a large class with hundreds of students participating online, there will not be hundreds of thinking patterns. Instead, as you grade the checkpoints, you will detect a relatively small number of patterns of student thinking in the course. By preparing feedbacks to scaffold students at critical points in this thinking, you can be prepared to interact effectively by engaging each student in their zone. For example, you can create a file in which you keep designed feedbacks. Each time you write a new feedback, you put it into this file from which you can retrieve it on demand whenever another student encounters a similar problem. As we learn from Molloy and Boud (2014, p. 413), “A constructivist view on feedback encourages learners and educators to view feedback as a system of learning, rather than discreet episodes of educators ‘telling’ learners about their performance.” When students “have frequent opportunities to engage in productive, dialogic exchanges with multiple others, they are more likely to see feedback as a tool for ‘them’ rather than as a destabilizing or debilitating act ‘done to them’ by those in authority.” (p. 422)

## C-6. Differentiating Instruction

Because the research about *How People Learn* confirms that people learn by connecting incoming audio or visual information to what they already know, it is critically important to assess prior knowledge before attempting to teach something new. Students who have faulty misconceptions of prior knowledge will only become more confused if you do not first correct their misunderstandings. The National Education Technology Plan uses the metaphor of a playlist. The idea is that you assess a student’s knowledge and create a sequence of learning materials appropriate for the current knowledge, needs and abilities of that particular student. Here at the University of Delaware, the Department of Mathematics has begun testing the prior knowledge of every incoming student using NSF developed software called ALEKS (Assessment and Learning in Knowledge Spaces, www.aleks.com). Results are used to place newly admitted UD students into the mathematics course appropriate to their current knowledge and understanding. Imagine textbooks containing quizzes that can test the student’s understanding while learning is in progress. To make this possible, the international EPUB standard is currently undergoing developments called EDUPUB that will enable books to communicate with learning management systems and vice versa. One can predict that EDUPUBs will be a predominant means of containing educational resources in the future. Thus, books themselves will align with the principles of *How People Learn*.

## C-7. Videoconferencing

Here at UD, although a few professors use videoconferencing to extend the classroom to distant learners, most faculty do not yet do this. UD supports Adobe Connect whereby any UD faculty member can obtain a virtual classroom. By logging on to Adobe Connect during class, the faculty can create a real-time classroom stream to which distant learners can log on. Students in Southern Delaware, for example, can attend class by logging on instead of driving two hours to the Newark campus. During class, the students can chat with the instructor and with each other, and faculty and students can share learning resources. Through screen sharing, students can make presentations remotely and the instructor can enable distant students to view any window onscreen. Thus, UD can improve its outreach through extending the physical classroom to distant learners via web-based videoconferencing.

## C-8. Assessment

Faculty influence the feeling of a course by defining the manner in which it will be assessed. Listed here are some ideas for creating learner-centered assessment.

* Early in the semester, create an assignment in which you negotiate goals with each learner to create an empathetic bond at the beginning of the course.
* Turn extrinsic motivation intrinsic by creating topic assignments in which you negotiate with students the topics of their projects and term papers. Put the emphasis on negotiating topics that students feel passionate about.
* In discussions, form a learning community that encourages students to communicate meaningfully with peers and instructors in online discussion forums. Assign students to respond to prompts in which you ask them to respond to graded discussion topics. Grade the responses with a rubric that requires the students to be timely, cite from assigned readings, and include references to other student responses.
* Make thinking visible by creating periodic checkpoint assignments in which students write logs describing their progress and explaining any problems they encountered and how they solved them. If your LMS supports blogs, consider having students make their thinking visible by keeping a blog.
* When students submit assignments, provide them with feedback and a chance to earn a higher grade if they revise their work according to your suggestions. Along the way, keep a file containing the feedbacks you give so as to minimize the time required to provide similar feedback in the future. Thus, you learn to view feedbacks as a learning system by designing instruction into prepared feedbacks for coaching students in their zone.
* Replace exams with real-world projects whenever possible.
* Encourage students to comment on each other’s work and help each other improve.

Learning analytics can help the campus measure the extent to which students are attaining their learning goals. Informed by this analysis, faculty can make data-driven decisions about how to improve their learning environments. Just as faculty can do this at the course level, so also is the nation doing this at the macro level, whereby the National Research Council is working on the next edition of *How People Learn*. As a major research university, UD can and should participate in the continued research about How People Learn. The new college proposed in *An Eighth College* concept paper could offer master’s and doctoral programs in learning technology. Such a program could offer certificates whereby existing faculty and teaching assistants can learn how to apply the science of learning to achieve the possibilities envisioned here in this concept paper. Thus, instructional improvement becomes systemic as UD uses research for continuous improvement in curriculum, delivery, and learning.

## References

Berardi, L. (2002). *University faculty members' perceptions of student engagement: An interview study*. Normal, IL: Illinois State University.

Clark, R.C., & Mayer, R.E. (2008). *e-Learning and the Science of Instruction* (2nd ed.). San Francisco, CA: Pfeiffer.

Holmberg, B. (2003). A Theory of Distance Education Based on Empathy. In M.G. Moore and W.G. Anderson (Eds.), *Handbook of Distance Education* (pp. 79-86). Mahwah, NJ: Lawrence Erlbaum.

Jonassen, D.H. (2014). Assessing Problem Solving. In *Handbook of Research on Educational Communications and Technology* (4th ed., pp. 269-288). New York, NY: Springer New York.

Kenny, G., Kenny, D., & Dumont, R. (1995). *Mission and place: Strengthening learning and community through campus design*. West Port, CT: Praeger Publishers.

Manfra, M. M. (2009). Critical inquiry in the social studies classroom: Portraits of critical teacher research. *Theory and Research in Social Education*, 37 (2), 298-316.

Mayer, R.E. (2001). *Multimedia Learning*. New York: Cambridge University Press.

Molloy, E.K. and Boud, D. (2014). Feedback Models for Learning, Teaching and Performance. In *Handbook of research on educational communications and technology* (4th ed., pp. 413-424). New York, N.Y.: Springer.

National Research Council. (2000). *How People Learn* (expanded edition edited by J.D. Bransford, A.L. Brown, and R.R. Cocking). Washington, DC: National Academy Press.

Romiszowski, A.J. (2005). Online Learning: Are We on the Right Track? In G. Kearsley (Ed.), *Online Learning: Personal Reflections on the Transformation of Education* (pp. 321-349). Englewood Cliffs, NJ: Educational Technology Publications.

Rule, A. (2006). The Components of Authentic Learning. *Journal of Authentic Learning*, 3(1), 1-110.

Scardamalia, M., & Bereiter, C. (2006) In Sawyer, R.K. *The Cambridge Handbook of the Learning Sciences* (pp. 97-115).

Vygotsky, L.S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.

Zhao, C. and G.D. Kuh. 2004. Adding Value: Learning Communities and Student Engagement. *Research in Higher Education*, Vol. 45, 115-138.