The ABC's of E-learning

By Larry Zaleski

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The introduction of affordable computers and high-speed electronic networks has made interactive *distance learning* possible. Strictly speaking, distance learning includes books and other instructional texts, which have been used for centuries, since both these means allow for separation in space between instructor and student. When most people think of "distance learning" today, however, they picture instruction delivered electronically.

The techniques of modern distances learning are collectively called electronic learning, or more simply e-learning. E-learning includes a variety of approaches to instructional delivery ranging from webinars and video teleconference (VTC), delivered by live instructors over the internet or telephone, to self-paced, computer-based training (CBT), delivered by computer over the internet, compact disk, or other storage device.

The use of e-learning is growing rapidly, spurred primarily by economics (Kornacki). In both government and the private sector, budget cuts drive managers to adopt e-learning to reduce travel costs and to provide just-in-time training. Similarly, in higher education, reduction in state support for public colleges and universities, rising tuition, competition, and the need to reach working students who cannot attend classroom-based courses drive educators to adapt.

E-learning has both supporters and detractors. While some see it as progressive, structured, and effective, others see it as tedious, likely to cause students to drop out, and even an economic threat.

Comparative studies routinely conclude that e-learning is as effective as the classroom. Some proponents suggest that e-learning is the most significant development in the way we conduct training since the invention of the alphabet and chalkboard (Horton, *E-learning*). TV advertisements and news reports are replete with stories of university e-learning programs (Lewin).

One example is the Massively Open On-line Course, or MOOC, such as the artificial intelligence (AI) course delivered for free by Stanford University, in which 160,000 students participated in a single offering. MOOCs pose a serious question: how do colleges compete with "free"? At the same time, however, MOOCs are notorious for their high dropout rate. Only 14 percent of participants completed the Stanford AI course; still, those 23,000 graduates constitute more students than were educated by the world's remaining AI instructors combined (Rosen).

Nonetheless, some public education programs are reconsidering their commitment to e-learning. Maine, New Jersey, and North Carolina, for example, placed a moratorium on new virtual schools due to sub-par performance (Lawrence).

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In this paper, I will examine the reality of e-learning by answering four questions:

1. What is e-learning?
2. How is it made?
3. Which methodology is best?
4. What makes instruction effective?

What is E-Learning?

E-learning is simply instruction delivered electronically. The methodology for designing course content for

e-learning is identical to that used for classroom instruction. Consequently, the content for both methods should be similar. Only the development and delivery methods differ widely.

E-learning takes three forms:

1. **Synchronous instruction** – Synchronous refers to the simultaneous participation of both student and instructor, who are separated by location, but not time. Synchronous instruction is delivered live.

2. **Asynchronous instruction** – Asynchronous refers to the separation of the instructor and student by both location and time. Asynchronous does not require the simultaneous participation of either party because asynchronous instruction is pre-recorded.

3. **Blended learning** – Blended learning consists of a mixture of delivery methods including synchronous, asynchronous, traditional classroom and on-the-job training as needed.

Synchronous Instruction uses two main delivery systems: webinar and video teleconference (VTC).

Webinars are live, two-way, web-based seminars. They resemble traditional classroom instruction, but typically, students receive audio by telephone through a conference call while viewing a PowerPoint presentation over the Internet. Students usually hear, not see the instructor. The software for presenting webinars contains features for asking students questions, including multiple choice and short answer, and for evaluating student response in real-time. Students can ask questions by phone or e-mail and can download class materials. Class size is limited to about 25 students. Beyond that, the system slows.

VTC is a live, two-way video and audio presentation. Designed for teleconferencing, VTC is much like watching the instructor on TV. Instructors are seen while speaking and can display PowerPoint and graphics. VTC uses high capacity broadband telecommunication coupled with computers and video compression. Through a multipoint control unit or "gateway," multiple sites with different equipment can participate. Students can answer and ask questions and download class materials. VTC is suitable for government, corporate, and university use at expensively equipped sites. VTC is complex, requiring technical support.

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Asynchronous instruction uses both primary and support delivery systems.

Primary delivery systems include computer-based training CBT and recorded lecture.

CBT is self-paced programmed instruction delivered by computer. The instruction may be delivered over the Internet, from compact disk, or from other storage media. CBT ranges from simple checklists and page-turners to highly interactive lessons providing audio, video, text, questions and feedback, using the full range of instructional design and presentation tools. Most CBT courses provide the student with control over the pace and the order of presentation.

Recorded lecture is like a pre-recorded webinar. Most such presentations permit students to rewind and repeat parts of the lecture.

In addition to the primary delivery systems just mentioned, asynchronous instruction uses three support systems: threaded discussion, voiceboards and e-mail.

Threaded discussions simulate classroom discussions. Students post written content to a discussion topic and react to postings from other students. Threaded discussion boards are common on the Internet. Voiceboards also simulate classroom discussions, but use recorded voice postings and text rather than text alone. E-mail allows both instructors and students to communicate (assign work, ask question, provide feedback, and share information).

Blended Learning combines delivery methodologies as needed to address the content, drawing on all of the methods described above. It permits course designers to use e-learning to reduce costs, where appropriate, while preserving the advantages of more traditional approaches.

How is It Made?

Courses are developed and delivered using software and hardware, depending on the type of e-learning used.

CBT, for example, is typically developed using an authoring system. Authoring systems do not require programming for course development; most authoring systems function similarly to PowerPoint and either create Flash slides (Flash is a *multimedia platform* developed by Adobe Systems, used to add animation, video, and *interactivity* to web pages ["Adobe Flash"]) or convert PowerPoint slides into Flash. Authoring systems allow the

addition of interactions, simulations, and branching. Two examples of commercial authoring systems that use Flash are Adobe Captivate® and Articulate.®

Webinars and VTC are developed using Microsoft PowerPoint™ or similar presentation software. PowerPoint and similar applications enable developers to assemble instructional text, graphics, photos, videos, and sound in a single, easy to use package. Attachments are developed in a word processor for students to download beforehand. Webinars can be recorded and then used asynchronously as well.

CBT, Webinars, and VTC are often delivered through a *Learning Management System*. Learning management systems are LAN-based software that organize on-line courses and provide various features such as space for students to access stored courses, post their assignments, and receive grades and feedback from instructors. Learning management systems also provide virtual meeting rooms, allowing students to use tools like chat, whiteboard, note, and more. One example of a learning management system is "Moodle," a free source system for use with the Internet ("Moodle").

Asynchronous e-learning can also be mailed on compact disk or provided through a web-site. Developers have many options.

The combination of software and hardware gives e-learning most of the capabilities of classroom instruction and curriculum presentation. Given this similarity, the question arises: which is better, classroom learning or e-learning?

Which Delivery Methodology is Best?

This, of course, is a trick question. The short answer is "all of them" (classroom, CBT, recorded presentation, webinar, and VTC).

As a practical matter, instructors can use any delivery media (chalkboards, computer screens, lecture, books, video, and audio) to teach any topic. Delivery methods such as CBT and classroom presentation are simply instruction using different media. When used in combination, they become multimedia.

People learn by observation of random events, from workplace experience, from both positive and negative examples—by listening, seeing, and touching. No one can stop a motivated person from learning because humans are wired to learn.

Richard E. Clark – an Educational Psychologist from the University of Southern California and a prominent researcher – writes that "media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition" (22). Clark further points out that studies repeatedly show that necessary teaching methods can be designed into a variety of presentation media. As evidence for media equivalence, Clark cites the more than 70 years of research that have failed to find evidence that media influence learning in any essential and structural way (28). Additionally, studies repeatedly show that both CBT and web-based presentations produce results equal to the classroom (Knebel; U. S. Department of Education 51).

Equivalence in results, however, does not mean that all media are interchangeable. Depending on the nature of the subject, one medium may be preferred over another. For example, most would probably not want their eye surgeon to be trained by CBT alone. The ability of the medium to adequately simulate the behaviors being taught matters. Consequently, developers should select media based on their ability to convey key behaviors economically.

Despite a history of success, e-learning (and classroom) courses sometimes fail. If media are not the key, then what makes instruction effective, and what does "effectiveness" look like?

What Makes Instruction Effective?

Learning occurs regardless of how effective (or defective) the instruction is and occurs even when there is no instruction. People learn by observation of random events, from workplace experience, from both positive and negative examples—by listening, seeing, and touching. No one can stop a motivated person from learning because humans are wired to learn.

Conversely, no instructional method can make an unmotivated person learn, because such a person mentally shuts down: "It's too hard," "It's too boring," "I'll never use that," I'd rather be somewhere else." Additionally, replacing false, half-truth and dysfunctional information can be a challenge if that information is deeply ingrained.

Effective instruction is instruction that achieves the goal of transferring information to long-term memory *efficiently*—that is, optimizing the time needed to learn and maximizing retention. But what information should be transferred and why so? The answer is critical because most adults are interested in learning useful information, not wasting time. Useful information is that which promotes desired accomplishments and behaviors.

Accomplishment. In business and government (a.k.a. the "real world"), effective people are those that produce valued accomplishments: hamburgers prepared sanitarily, bridges built to standard and within budget, causes of the French and Indian War documented, specimens analyzed, illness diagnosed, standardized tests passed, legislation passed, battles won, criminals captured, perpetrators sentenced. It is the accomplishment (the output) of human effort that we value and pay for. We expect education to cause productive behavior resulting in valued accomplishment (Hyde).

Behavior, productive or not, is the way people act in response to a situation. It comes in two categories: overt and covert. Overt behavior consists of activities that *can be observed* such as splinting a broken arm or rebuilding a carburetor. Overt behavior is external. Covert behavior, in contrast, consists of behaviors that *cannot be observed* such as *deciding* how to treat a wound, or *evaluating* the relative impact of factors leading to the French and Indian War. Covert behavior is internal. Covert behavior is mental and can only be inferred from a person's actions (their overt behavior). For example, you might observe how someone treated a wound, or read someone's essay on the causes of the French and Indian War, or ask them to describe their thought process. Usually, behavior is a mixture of overt and covert actions.

All meaningful instruction seeks to alter behavior. Behavior, however, is influenced by three broad factors: skills and knowledge, motivation, and environmental influences. To achieve performance, all three must be addressed. The indispensable first step—the key to effective instruction, whatever the media involved—is good *design.*

Design. Research repeatedly shows that applying a systematic approach to instructional design, one based on laboratory-tested principles drawn from what we know about human learning, results in more effective instruction (Halpern and Hakel 37-41; Knebel 5; Clark, "What Works"). The alternative—unsystematic design—is more likely to skip steps and ignore cognitive limits.

Early in the design process, developers identify what to teach through "needs analysis". Here, developers identify valued accomplishments and key behaviors.

Poorly designed instruction fails primarily for three reasons: loss of retention due to delayed application (failure to account for the temporary nature of working memory, or WM, the temporary storage space that allows us to follow directions and learn); insufficient practice; and teaching too much at a time.

Early in the design process, developers identify what to teach through "needs analysis." Here, developers identify valued accomplishments and key behaviors. This information is used to document processes, to write learning objectives, and infer the necessary supporting information. Later, developers use the learning objectives to develop the instruction, called strengthening.

Strengthening. Learning is accomplished through "strengthening," which reinforces the learner's response to stimuli (signals), thus increasing the probability that the correct response occurs, and thus modifying behavior. Strengthening consists of activities that promote the *transfer* of information from working memory to long-term memory. Once transferred to long-term memory, information can be recalled when needed. Strengthening occurs by:

- "Chunking" information into smaller units to account for memory limitations.

- Priming (teaching)—showing the signal and desired response.

- Linking new information with existing information—adding new steps and placing the information in context (making associations between old and new).

- Repeating information through practice and feedback in close temporal proximity to its teaching.

These activities organize the information so that students can more *efficiently* learn, improving recall and performance (Clark, Don). Additionally, providing practice *in context* (in a manner similar to the way the learner will perform on the job) further strengthens long-term recall by presenting the signal as students will encounter it later, making the appropriate response more likely.

"Chunks" are elements of memory. A chunk can be an item, a number, a phrase or sentence, or a grouping of information. A phone number, for example, is easier to remember if you chunk it into units of 4 or fewer: "240-529-2977: is easier to remember than its "unchunked" equivalent, 2405292977. Current research shows that the size of working memory is 4±1 elements (Cowan). Instructional designers take advantage of this con-

cept by limiting the number of elements in menus, lessons, and topics to four or fewer, and to groupings of four or fewer.

Learning occurs regardless of how effective (or defective) the instruction is and occurs even when there is no instruction. People learn by observation of random events, from workplace experience, from both positive and negative examples by listening, seeing, and touching.

Repetition is perhaps the most important instructional tool. Repetition is necessary because of the rapid decay rate of working memory (WM decays approximately 50 percent after 6 seconds and nearly 100 percent after 18 seconds [IGL]). Repeated passes of information through working memory, however, cause physical changes to the brain, forging new connections between neurons and increasing the signal strength (excitability) between dendrites. These new connections plus increased excitability results in long-term memory (Strouse; Hausser). Consequently, instruction should provide repetition and practice *soon* after presentation for optimal strengthening. And practice should include feedback so students can self-correct, further strengthening memory. Without practice, information is forgotten. The longer the delay between presentation and practice, the less efficient the transfer.

The following instructional features—called the "6P model," presented in the order shown—take advantage of the current psychological and neurological understanding to efficiently strengthen learning:

1. **Preview** – Provides an overview and the context of the behavior.

2. **Prerequisite** – Provides facts, definitions, and linkages to previous knowledge needed to enable and enhance transfer.

3. **Prime** – The "teaching" activity. A demonstration or description of the skill or knowledge. It shows the signals students will encounter and the response they should make.

4. **Prompt** – Provide the signal with cues and ask for the response.

5. **Perform** – An isolated practice exercise where the participant conducts a simulated application of the behavior. Give the signal and ask for the response.

6. **Practice** – An integrated practice, or test, or simulation at the end of the lesson that covers all of the learning objectives.

The "P's" are assembled as follows, and repeated for each learning objective:

Enabling Objective 1		
1a. PREVIEW: Tell them (summarize) what they are about to learn		
2a. PREREQUISITES: Provide terminology or other needed information		
PRIME	**PROMPT**	**PERFORM**
3a. Step 1	None	None
4a. Step 2	Step 1	None
5a. Step 3	Step 2	Step 1
6a. None	Step 3	Steps 1 & 2
7a. None	None	Steps 1, 2, & 3
PRACTICE: An integrated knowledge check (integrated perform).		
Enabling Objective 2		
1b. PREVIEW: Tell them (summarize) what they are about to learn		
2b. PREREQUISITES: Provide terminology or other needed information		
PRIME	**PROMPT**	**PERFORM**
3b. Step 1	None	None
4b. Step 2 & 3	Step 1	None
5b. None	Step 1, 2, & 3	Steps 1, 2, & 3
6b. None	Enabling objectives 1 & 2	None
PRACTICE (Test): A knowledge check (integrated perform) testing/practicing all enabling objectives for the task.		

This arrangement as outlined will rarely work out so cleanly in practice, but developers should be able to *approximate* the design in any media. Also, the model is intended to cause memorization (storing the information in one's head). Alternatively, when teaching to "look up" (storing information in a manual or book), designers would simply remove the prompt column.

The advantages of the 6P model are obvious – it uses chunking, priming, linking, and practice accounting for the limits of working memory resulting in efficient learning.

Conclusion

No instructional medium is inherently superior to any other. The combination of software and hardware gives e-learning most of the capabilities of classroom instruction and curriculum presentation, making e-learning a viable alternative to the classroom; the true strength of e-learning, however, is its role in blended learning, as a part of the instructional mix, reducing costs while maintaining effectiveness. Any form of instruction, regardless of the media involved, can sometimes fail to meet expectations, but these failures are likeliest due to ineffective design. Instructional design succeeds by taking advantage of scientifically demonstrated learning principles including chunking, priming, linking, and repetition.

Works Cited

"Adobe Flash." Wikipedia, The Free Encyclopedia. Wikimedia Foundation, Inc. 12 December 2012. Web. 15 December 2012. (http://en.wikipedia.org/wiki/Adobe_Flash

Biech, Elaine, ed. *ASTD Hand Book for Workplace Learning Professionals*. Alexandria, Virginia, ASTD Press, 2008.

Clark, Don. "Learning and Memory." Big Dog & Little Dog's Performance Juxtaposition. 6 November 2010, 30 November 2012. (http://www.nwlink.com/~donclark/hrd/learning/memory.html)

Clark, Richard E. "Media Will Never Influence Learning." *Educational Technology, Research and Development*, Vol. 42:2 (1994) 22ff.

Clark, Richard. "What Works in Distance Learning Instructional Strategies." Chapter 3 of *What Works in Distance Learning: Guidelines*. Ed. O'Neil, H. Greenwich, Connecticut: Information Age Publishers. 2004.. (http://www.usc.edu/dept/education/cogtech/publications/clark_ch6_what_works.pdf)

Cowan, Nelson. "The magical number 4 in short-term memory: A reconsideration of mental storage capacity." *Behavioral and Brain Sciences* 24 (2000) 87-185. (http://www.google.com/url?sa=t&rct=j&q=the%20magical%20number%204%20in%20short-term%20memory&source=web&cd=1&cad=rja&sqi=2&ved=0CDIQFjAA&url=http%3A%2F%2Fwww.pri.kyoto-u.ac.jp%2Fai%2Fdata%2FKawai-Matsuzawa-Magical_number_5_in_a_chimpanzee.pdf&ei=P7q_UI70NKfh0gHu1IC4DA&usg=AFQjCNHgRpxsG0abyhmf-IwoJa0hpDyHAA)

Halpern, Diane F. and Milton D. Hakel. "Applying the Science of Learning to the University and Beyond: Teaching for Long-term retention and transfer." *Change* July/August 2003: 37-41 (http://psyc.memphis.edu/learning/applyingthesciencechange.pdf)

Harless, J. H. *Dialogue: Module Design, Part 2: Performance Characteristics and Learning Problems. Accomplishment Based Curriculum Development.* Newnan, GA: Harless Performance Guild, Inc, 1991. Print

Hausser, Michael. "Storing memories in den dritic channels." *Nature Neuroscience* 7:2 (2004) 98-100. (http://www.nature.com/neuro/journal/v7/n2/full/nn0204-98.html)

Horton, William. *E-Learning by Design*: How to teach anyone anything anywhere anytime. San Francisco: Pfeiffer, 2012.

_____. *Designing Web-Based Training*. New York. John Wiley & Sons, Inc., 2000.

Hyde, Ann. "Defining Learning Expectations: Essay on how historians are defining what students need to learn. " *Inside Higher Ed*. 21 December 2012. (http://www.insidehighered.com/views/2012/12/21/essay-how-historians-are-defining-what-students-need-learn)

IGL. Chapter 6 - Working Memory. SMITMC06_0131825089.QXD. 28 March 2006. 30 November 2012. (http://www-psych.stanford.edu/~ashas/Cognition%20Textbook/chapter6.pdf)

Knebel, E. "The use and effect of computer based training: What do we know?" *Operations Research Issues Papers* 1:2 (2000). Published for the U.S. Agency for International Development (USAID) by the Quality Assurance Project (QAP), Center for Human Services, University Research Co., LLC, Bethesda, Maryland. (http://www.google.com/url?sa=t&rct=j&q=the%20use%20and%20effect%20of%20computer-based%20training%20in%20health%20care&source=web&cd=1&cad=rja&ved=0CDgQFjAA&url=http%3A%2F%2Fwww.chs-urc.org%2Fpdf%2Fresearchcbtx.pdf&ei=tTDTULHLLK6G0QHO-4GQDA&usg=AFQjCNHG08xUxlv7MxlgIEf4kpXTJzvsKQ)

_____. "The Use and Effect of Computer based Training: What do we know?" *Operations Research Issues Papers* 1:2 (2000), 7ff. Published for the U.S. Agency for International Development (USAID) by the Quality Assurance Project (QAP), Center for Human Services, University Research Co., LLC,Bethesda, Maryland.

Kornacki , Martin. "L&D budgets still shrinking." *Training Journal*. 05 Apr 2011 (http://www.trainingjournal.com/news/articles-news-ld-funding-still-shrinking/)

Lawrence, Julia. "Are Some States Having Second Thoughts on Online Schools?" *Education News*. 9 October 2012. 17 October 2012. (http://www.education-news.org/online-schools/are-some-states-having-second-thoughts-on-online-schools/)

Lewin, Tamar. "College Credit Eyed for Online Courses." The New York *Times*. 13 November 2012. (http://www.nytimes.com/2012/11/14/education/moocs-to-be-evaluated-for-possible-college-credit.html?_r=0)

"Moodle." Wikipedia, The Free Encyclopedia. Wikimedia Foundation, Inc. 15 December 2012. 15 December 2012. (http://en.wikipedia.org/wiki/Moodle)

Rosen, Rebecca J. "Overblown-Claims-of-Failure Watch: How Not to Gauge the Success of Online Courses." *The Atlantic*. 22 July 2012. 26 November 2012. (http://www.theatlantic.com/technology/archive/2012/07/overblown-claims-of-failure-watch-how-not-to-gauge-the-success-of-online-courses/260159/)

Strouse, D. J. "Memory and Dendritic Morphology." *The Rantings of a Baby Scientist* blog. 2006-2007. 12 December 2012. (http://djstrouse.com/dendrite-morphology-memory-capacity/)

U.S. Department of Education, Office of Planning, Evaluation, and Policy Development. *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies*. Washington, D.C.: 2010. (http://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf)