

White Paper

Do We Still Need Instructors for Complex Technical Training?

Abstract

For all its imperfections, instructor-led training is effective for the teaching of complex technical topics. Given the state of technologies for building and presenting self-paced training, and given evidence of its efficacy, it is appropriate to address the question of whether we still need instructors to teach such topics. While there are no high quality studies to prove the case one way or the other, the vast predominance of evidence suggests that those who need training in complex technical topics are far better served by instruction that involves instructors.

INTRODUCTION



A 14th century drawing by Laurentius de Voltolina depicts a university classroom that much resembles a 21st century university classroom.ⁱ

Training and education are expensive. Traditional classroom instruction, for all its imperfections, works, but is costly, relying as it does on the availability of excellent, knowledgeable (and therefore well-paid) instructors, carefully crafted (and pricey) instructional materials, large

investments in classrooms and hardware, and often, time away from work and home, not to mention the cost of travel.

So we humans have long looked for better ways to teach and learn. Technology has had an enormous impact, from clay tablets to parchment to the printing press to the advent of computer-based training.ⁱⁱ If you look through literature dating from the invention of photography in 1826, you'll find scholarly papers, articles, advertisements and claims that the new technology, whatever it was, would change everything. This was said of photography, the phonograph, radio, moving pictures, television, filmstrips, slide projectors, overhead projectors, video, computers, the Internet, and the World Wide Web.ⁱⁱⁱ And while these developments were all somewhat helpful in the business of delivering information, none since the printing press had a profound or fundamental effect on how we learn.

However, the nearly universal availability of broadband Internet service, along with the remarkable advances and affordability of software tools for the creation of media-rich, interactive, web-based courseware, have changed the equation. Add in the ever-increasing cost of travel and the eternal corporate struggle to drive down costs, and the conclusion is clear: e-learning solutions serve as an effective supplement and even as a replacement for certain types of training. If employers have an employee who needs to learn to use a word processor, they hardly need to remove them from the office, put them on an airplane and send them to a costly training event in another city.

The question we address in this paper is: can e-learning provide an educationally effective and cost-effective alternative to instruction that is provided by instructor-led training (face to face or remote) *for complex technical topics*?

CRITERIA

In our context, *technical training* is educational activity that teaches the skills needed to design, develop, implement, maintain, support or operate a particular technology or related application, product or service.^{iv} *Complex technical training* is training wherein the subject matter is characterized by a complicated arrangement of information and processes, and composed of many interconnected parts. There is no clear dividing line between *technical training* and *complex technical training*, but it is fair to say that, as a rule, learning the basic functions of an application such as a spreadsheet is *technical training*, while learning the complete functionality, language, syntax, sound practices, and pitfalls of a programming language such as C++ or Java™ is *complex technical training*.

We must also be careful to differentiate between *training* and *information*. By itself, a videotape or textbook is not training. *Training* is characterized by the presence of clearly stated, measurable objectives, the presentation of information, the performance of practice activities, assessment, and feedback. We are concerned with *training*.

Finally, we must be clear about when and how instructors are or are not involved in instructor-led training, e-learning, and blended learning. *Instructor-led training* is just that, training conducted by an instructor. *e-learning* is training that takes place exclusively via electronic means on a computer, tablet or portable device, primarily via the World Wide Web, and does not typically involve an instructor. *Blended learning* is training that relies on a combination of e-learning and instructor-led training, and involves an instructor only for the instructor-led segment of the training.

CHALLENGES

Given this, we now better understand the original question: can e-learning provide an educationally effective and cost-effective alternative to instruction that is provided by instructor-led training (face to face or remote) *for complex technical topics*?

Obviously, in an ideal world, the answer to the question would lie in statistical observations from high quality studies. Unfortunately, it is brutally difficult to make apples to apples comparisons of the effectiveness of training. Before we even consider the styles and/or media of a learning experience, the waters are muddied by such issues as the individual's intellectual capacity, learning preferences, cognitive and learning styles, the physical attributes and states of the learner, the student's understanding of the process of learning, background, and prior knowledge. Beyond that, there are the issues of interest, learning skills (the ability to remember and the tendency to forget), available time, availability of feedback and tutoring, and the context and importance of the learning.^v To construct accurate studies and reach valid conclusions, it is necessary to have massive test groups and exercise rigorous controls. No such studies have been conducted.

It's easy to find articles that refer to small studies which claim to conclude that e-learning is equally effective to or superior to instructor-led training for complex topics. The trouble is, they often go on to make the opposite point. One such example, headlined, "New study: e-learning works for complex subjects and problem-solving," starts by saying, "A randomized, controlled trial just published in the open access journal PLOS ONE compared two methods of e-learning to one face to face classroom group, and online learning came out well from the comparison." But soon thereafter, we are told, "The course was an **elementary** unit on lung volume" (emphasis added). And finally, we learn, "the experimental design may have been subtly biased" in favor of those in the e-learning group.^{vi} So, we are told that the study suggests that e-learning is more effective than instructor-led learning for complex topics, if we overlook the fact that the topic was "elementary" rather than complex, and that the study was biased. This is typical.

It is difficult to impossible to find neutral, disinterested sources who believe e-learning is superior. It is common to find comments like this one: "A *Training* reader sent me an article about a study done at Washington community colleges, which showed that more students drop out and fewer get a passing grade when they take a class online than when they take it in a classroom. And students who already were struggling do worse when a course is changed over to online delivery than when it was delivered in a classroom setting."^{vii}

Even those who literally make a living from espousing the benefits of self-directed learning environments admit instructors are inherently necessary. Sugata Mitra, who received a \$1 million TED Prize in 2013 for his work devising "self organized learning environments" as an alternative to teacher-led instruction, says that he "doesn't think teachers are obsolete but suggests their roles may be changing as students increasingly have access to self-learning through computers."^{viii} Well, of course.

In any case, we are cautioned that it is, as always, unwise to leap towards the latest trend until and unless it is proved that it is sensible to do so. The *Committee on Developments in the Science of Learning* reminds us, "In considering which findings from brain research are relevant to human learning or, by extension, to education, one must be careful to avoid adopting faddish concepts that have not been demonstrated to be of value..."^{ix}

Ultimately, it is difficult to answer our question authoritatively.

TECHNIQUES

One approach we considered was to explore the literature and see *how* one can teach complex technical topics without an instructor. We were initially delighted to find that academia and the marketplace are full of advice on how to teach "technical" topics via e-learning. Unfortunately, we were unable to find sound advice on how to teach topics that are both technical and complex. A typical article, titled "Easily Turn a Technical Subject into an Interesting e-learning Course," starts with the advice to simplify, and uses as an example a cartoon that shows how to use an asthma inhaler.^x This is barely technical, certainly not complex, and absolutely not helpful.

Another article, titled, "How to Train on Complex Topics," emphasizes the advice to "Keep Training Simple," offering as an example (this is an exact quote): " $1 + 1 = 2$." We call *shenanigans*: This is simply *not* a complex topic.^{xi}

We were disappointed to find nothing that even attempted to address the problem of facilitation of lab exercises. Clearly, for learning complex technical topics, *facilitated* hands-on lab work is essential. Without facilitation, labs cannot be complex or difficult, because there is no one to get students who are stuck, "unstuck." And without comprehensive, complex lab work, true competence will not be achieved via the training.

Despite exhaustive searches, we are convinced that there is no literature (at least no generally available literature) that effectively addresses the problems that are unique to the combination of self-paced training and complex technical topics.

MYTHOLOGY

It is important to note that we also steered clear of relying on certain mythology regarding the efficacy of e-learning for which there is no credible support. One of the great ironies of the move towards self-paced technical training is that it is often justified by the belief that self-paced training is more suited to the recently evolved learning style of millennials (those born from roughly 1980 to 1996). Careful thought and consideration, even by ardent supporters of e-learning, refutes this notion. A white paper from Skillsoft, the massive e-learning company, observed:

Some widely accepted generalities [about millennials] include:

- *Millennials value collaboration*
- *Millennials desire meaningful work*
- *Millennials seek life-work balance and flexibility*
- *Millennials have a thirst for building their capabilities*
- *Millennials prefer frequent feedback about their performance*
- *Millennials aspire to grow in their career*

When considering these descriptions about millennials, take pause. What generation doesn't want these things for their professional experience?^{xii}

After noting that these characteristics are universal rather than generational, the author went on to refute them, and then to describe a "formula for modern learning" that ignored them. Unfortunately, they had it right the first time: these *are* universal desires. Ignoring the human urge to collaborate in learning is a bad idea.

Likewise, the oft-cited statistic that the human attention span shrank from 12 to 8 seconds between 2000 and 2015, so often cited as a reason we need to change the way we train, turns out to be bunk, which is hardly a surprise.^{xiii}

We have avoided the myths.

DATA

Here is what we know.

Humans have evolved to learn from other humans. We are, in popular parlance, hard-wired that way. Dr. Peter Gray did a splendid job of summarizing this case in a series of articles over a decade ago.^{xiv} Through most of human history, there has been much to learn, and children learned through a combination of observation and play, while certain details were handed down from parents to children. As we evolved, we evolved such that those who were successful in learning through observation and practice, and who learned well from their parents and elders, were most likely to survive. It's fair to say that we evolved in such a way that we learn best through person-to-person teaching and actual practice with personal attention from a mentor.

When faced with difficulty, humans instinctively turn to teachers for help. While both children and adults may be embarrassed by going to elders or superiors or colleagues when they are having difficulty, there is little such mortification involved with going to a teacher for help. As a result, it's well established that self-directed education most hurts the students who have questions and need assistance.^{xv} Likewise, it hurts students who are learning complex information, such as programmers who are dealing with truly complex topics. Without a teacher or some sort of personal facilitator, there is nowhere to turn but online sources providing canned responses, which are often helpful but not necessarily complete or precisely on target.

There is little to no disinterested evidence that e-learning or online learning is as effective as or more effective than instructor-led training for complex technical topics. As we discussed earlier, there is simply nothing to suggest that e-learning works for complex topics. There are all sorts of claims and some credible evidence that e-learning is more effective than instructor-led training for certain students and certain audiences, but *nothing* supports the claim that it is superior for complex technical topics.

However, there is much evidence that instruction that lacks instructors is problematic.

People do not complete online training courses.^{xvi} Even proponents of online training admit that studies show that as few as 15% of learners complete self-directed e-learning courses. (For the record, we believe this estimate is not credible; it's too low. Surely more than 15% of learners complete self-directed e-learning courses!) But clearly, a majority of those taking e-learning courses do not complete them. We have heard the argument that "it doesn't matter if they don't finish," but dismiss this argument as ludicrous. One cannot retain what one is never taught. Either the course is worthwhile and needs to be completed, or it is not worthwhile. Also, since completion rates of live instructor-led courses on complex technical topics is well above 95%,^{xvii} the gap suggests that something is seriously lacking in the courses that lack actual instructors.

People are frustrated by certain inherent characteristics of e-learning. In particular, students complain that they do not get the time to actually complete courses, that they miss the interaction and collaboration of the classroom, and that there is typically little to no support for

e-learning students.^{xviii} While conscientious training staff may make an attempt to compensate for these shortcomings, these are problems that simply do not occur with instructor-led training.

People dislike bad training. One claim we saw on both sides of the question was that "this course stinks, therefore all courses presented via this medium stink." Complaints about a given poor instructor or a given poor instructor-led course are no more valid than complaints about a given poor e-learning course. There are poor instructors, poor courseware for instructor-led training, and poor e-learning courses. There are excellent instructors, excellent courseware for instructor-led training, and excellent e-learning courses. When one encounters poor training, it is not generally the fault of the delivery medium.

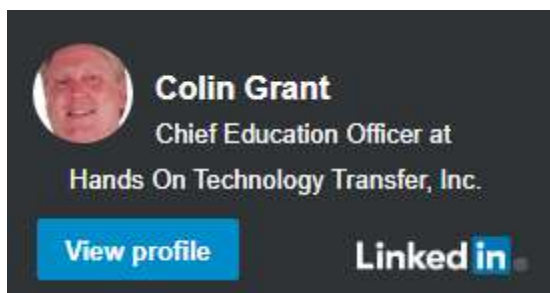
CONCLUSIONS

While there are no high quality studies to prove the case one way or the other, the vast predominance of evidence suggests that those who need training in complex technical topics are far better served by instruction that involves actual instructors and routine human interaction than by training that omits the human element. Blended learning, which involves occasional instructor/mentor interaction with students, is likely to be more effective than exclusively self-directed learning, but does not address the problem of how one both provides challenging lab exercises and assists in a timely fashion when the learner is stuck. But removing the instructor/mentor from the learning of complex technical topics is highly likely to reduce the efficacy of training.

Colin Grant

Chief Education Officer

[Hands On Technology Transfer, Inc.](#)



Colin Grant, the CEoO (Chief Education Officer) at [Hands On Technology Transfer, Inc.](#), has worked in the field of technical education for almost 40 years as a technical trainer, programmer, course developer, media developer, manager, executive, entrepreneur, editor, and author. He welcomes your comments, criticism and input. Please contact him at Colin.Grant@traininghott.com.

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Note: This is an obscure drawing by an obscure illustrator in an obscure book by an obscure author. It is noteworthy mainly because it is the earliest known illustration of a university classroom, which appears much as university classrooms appear today, complete with distracted, bored students, including at least who appears to be sleeping.

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