Hands On Technology Transfer, Inc.

White Paper

We Know What Makes Learning Effective. Why Don't We Do What It Takes?

Abstract

Today there is a greater understanding of the process of learning than ever before. We know what works, but in far too many cases, we fail to do what is necessary to provide effective training to technology professionals. Why is that?

Although high-minded people have been talking about the process of learning for at least 2,500 years, humans did not seriously start trying to figure out the biological, psychological and sociological mechanics of education until the 1800s.[1] It's a small wonder that, overall, we're still not very good at it.

We do know a few things for certain, and it's illuminating to take a brief look at the history of learning to help us understand some of those basic truths.

EVOLUTION AND LEARNING

Homo sapiens has been on earth for about 200,000 years. For the first 190,000 of those years, people survived by hunting and gathering. For virtually all of that 190,000 years, and for virtually all of the people, there was no need for any formal educational system. This is not because there was little of value to know, as the very opposite was true. For example, to hunt successfully, people had to know what species were valuable, how they behaved, when they were likely to be around, and where they could be found. They also needed to know how to create the tools they needed, such as spears, bows and arrows, and knives, and they had to learn how to hunt effectively in groups. There are many more examples: how to identify drinkable water, what plants were edible, how to store, preserve and prepare food, how to create tools for storing, preserving and preparing food, and so on.

With no formal educational system, children in hunter-gatherer societies were given great freedom to educate themselves through self-directed play and exploration. The skills necessary to survive were learned to a great degree through observation, and honed with play, while certain details were handed down from parents to children. That's important: 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 face-to-face teaching and actual practice**.

LEARNING BY DOING

About 2,500 years ago, someone in China (not Confucius, although people like to say it was) said something very much like, "I hear and I forget. I see and I remember. I do and I understand." Whoever it was, they were on to something.

We have known for a long time that we learn better when we both watch a lesson and apply a lesson, but it's only quite recently that we have come to understand why. It turns out that when we both observe and practice, we engage not only more of the brain, but parts of the brain that would otherwise be completely uninvolved.[2]

This is important because of the way the brain works. Memory is a complex process in which the brain stores different types of information in different parts of the brain, which communicate with each other via our internal wiring (formally, *neural pathways*). Later, when we attempt to recall something, the brain attempts to gather and reconstruct the information as best it can, usually with astonishing speed. The functioning of memory involves complex electrochemical processes, many of which are not well understood, but for our purposes, that's not important.

Most of what we experience is determined by the brain to be relatively unimportant, and this superfluous data gets screened out, and is never stored. This is why we probably cannot recall the color of the car that just drove past, or what was said over lunch on Tuesday of last week. A small amount of the data we process gets stored in short-term memory, and an even smaller amount gets stored in long-term memory. Some information gets stored in parts of the brain that specialize in visual data, some in language centers, some in auditory centers, and so on.

When we later attempt to recall a fact or a story or a process, the brain goes to work, searching high and low in various locations, and attempts to piece the information back together into a coherent story. When information is stored in many different parts of the brain, it has more and better sources from which to reconstruct memories, and the memories are not only more likely to exist, they are far more likely to be accurate.

So, it is indeed a fact that when one *does* something, one is much more likely to recall and understand the experience and corresponding knowledge than if one merely *observes* something.

QUANTITATIVE ANALYSIS

If there were merely a slight advantage to adding experiential learning to a lesson, it might not be worth the effort. But, again, we have recently come to understand just how important the hands-on part is.

In a recent study that involved over 27,000 students, it was demonstrated that students who engaged in training that included not only the viewing of lectures but also the completion of

hands-on activities scored about 16% better in tests than those who merely viewed lectures.[3] That's hardly surprising to anyone who has thought about such things. Indeed, the 16% differential seems shockingly *low*. That's because it is.

The problem, as described by Dr. Ken Koedinger, professor of Human Computer Interaction and Psychology at Carnegie Mellon University, is that too often, the "hands-on" part is trivial. As he says, "Many courses include quick follow-up questions at the end of a lecture."[4] To be effective, they need "more-engaged applications of knowledge that get at higher levels of thinking."[5] That is: they need better lab exercises.

That is a critical point: there's doing and there's *doing*. There is no debate about the fact that *lecture plus lab* is a far more effective teaching model than mere lecture. What may not be quite so obvious is that the efficacy of the lab work varies remarkably with the quality of the lab work.

An example: I recently took a technical course from a supplier who shall remain nameless. It was a self-paced, video-driven course, and the literature for the class spoke proudly about the amount of time the students would spend completing hands-on labs. And they told the truth -- sort of. I certainly spent a lot of time completing hands-on labs. But I was surprised when I realized that while I had spent a lot of time completing exercises, I had learned remarkably little. There were at least three problems with the labs.

1. They were of the *monkey see monkey do* variety. I was told exactly what to type and what to click, keystroke by keystroke and click by click, which assured that I would complete the exercises, while not assuring that I actually learned anything.
2. They were poorly explained and constructed. The introduction to the exercises would tell me generally what I was going to do -- always a good idea -- but would then leap into the stroke by stroke solution. That is, there was no conceptual guidance between the overview level -- "you will now write a program that calculates the distance between two heavenly bodies" -- and the detail level -- "type *void main { int...*". I experienced the recurring nightmare of being told what I was going to do, doing it, and then saying, "What just happened?" I did not learn how to approach the relevant problems.
3. They used a virtual environment; I was not working with the actual software in question, but with a simulation of the software. I understand why training providers are tempted to use virtual environments, which allows them to control the actions of the student and limit their opportunities to go off on the wrong track, but by so doing, they, well, control the actions of the student and limit their opportunities to go off on the wrong track. The learning is so finely targeted and limited that it's of limited value and bears little resemblance to the real world environment. I left the course having never actually worked in the software environment I was trying to learn. It's hardly surprising that I learned little about that software.

This experience leaped to mind when I saw that the same study cited above revealed that when the hands-on activities were exhaustive, challenging and properly mapped to practical objectives, students learned "six times as much as those who only read the material or watched a video."[6] It's not just a modest 16% differential in mere test scores. It's a ***600% improvement in actual knowledge over those who only viewed lectures***.

The study also made it clear that the best outcomes (by far) are achieved when students both watch the lectures and complete complex activities. There are no effective shortcuts.

Unfortunately, the inclusion of comprehensive, challenging, in-depth learning activities presents an additional roadblock: students routinely need help, which is best provided by an instructor, subject matter expert, or other easily available expert facilitator. Most providers of self-paced training treat such facilitation as an additional or unjustifiable cost or inconvenience.

WHY DON'T WE DO WHAT IT TAKES?

I should be clear about this: when I say "we," in this case I mean, "People other than myself." The problem to which I allude is this: we know how to teach effectively, and still, all too often, we don't. Why is that?

There are many reasons.

Expense and convenience. First of all, it is time-consuming, expensive and difficult to develop good lab exercises. Consider the time, effort and cost that go into creating the *virtual* lab environments that are so often used instead of authentic lab environments. Those expensive pseudo-solutions are attractive only because even at their high cost, they are still less expensive than developing exhaustive exercises and providing real-world lab environments, not to mention providing the facilitation that is needed for success.

I am reminded of an anecdote. Years ago, my parents were in town (Boston, MA) for a special occasion, and one night we were discussing where we might go for dinner. Looking at various restaurants online, I was surprised that even some of the swankier ones did not take reservations. In passing, I commented that I understood the trend, having read that enough customers failed to show up for reservations that it created a problem for the proprietors, and the restaurant business is a difficult one in the best of circumstances. My Dad, without looking up from his book, made the comment, "Never patronize an establishment who places their convenience above yours." I have found that to be sage advice. I prefer that my trainers do what they know will provide the best learning experience, even if it is inconvenient and expensive for them to do so.

This trend towards *light labs* is particularly prevalent in e-learning. It's so very tempting to create a completely self-contained course that can be rolled out over and over again without the involvement of actual instructors or subject matter experts. Frankly, this is only possible if the labs are all but worthless.

Appearance-based training.[7] In the marketplace, it's important for trainers to be able to say, "We provide lab exercises." Unless those who are purchasing the training are spectacularly meticulous about researching the quality of the lab exercises, there is little incentive for providers to do more than make the labs *appear* to be useful.

Wishful thinking. It would be wonderful for everyone if training were easy. We'd all be thrilled if students could develop a deep and broad understanding of complex technical topics by watching an online lesson, answering a few multiple choice questions and walking through a

carefully sandboxed software simulation. To believe such a thing is possible is just wishful thinking by both sellers and buyers of such training products.

CONCLUSION

At this point in history, for the first time we not only know what activities are most effective for transferring knowledge from teacher to student, but also why those activities are effective, and how much more students learn when the proper activities are included in the training experience. Training is most effective when humans interact with humans, but even more important, training must include comprehensive, challenging, in-depth learning activities in a realistic (not simulated) lab environment that necessarily includes expert facilitation. A few multiple choice questions and impossible-to-fail lab exercises are no substitute.

Fortunately, there are training providers (such as Hands On Technical Training) who know this and offer effective training solutions. To view our recommendations on how you can identify training that will deliver the effective results you need, please refer to our report, Six Questions You Must Ask to Ensure Your Training Will Build Competence.

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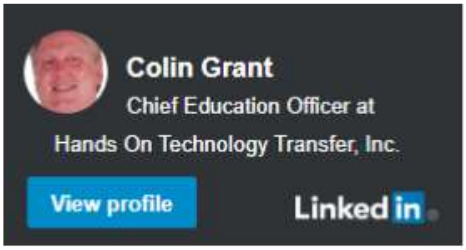

Colin Grant, the CEdO (Chief Education Officer) at Hands On Technology Transfer, Inc., has worked in the field of technical education for almost 40 years as a technical trainer, programmer, course developer, media developer, manager, executive, entrepreneur, editor, and author. He welcomes your comments,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

BIBLIOGRAPHY

The sources below were consulted in the preparation of this paper. Those sources which were directly quoted, or whose content was referred to directly, are listed *only* in the endnotes, which are below the bibliography.

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ENDNOTES

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