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THE eLEARNING
GUILD 2007 SM
THE ANNUAL GATHERING

Expanding Your e-Learning Horizons!

105

Deeper Learning: Cognitive Science and Instructional Design

Clark Quinn, Quinnovation

**Learning Design
for How People *Really* Learn**

Clark Quinn, Ph.D.
Quinnovation

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Path

- Context
- Enhanced ID
  – Objective
  – Intro
  – Concept
  – Example
  – Practice
  – Summary
- Action!

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About Quinnovation

- Independent Consultancy
- Making companies smarter
  – taking them to the 'next level'
  – using technology to support performance
- Games (read Simulations/Scenarios)
- Mobile
- EPSS/Workflow
- Strategic
- ...e.g. Advanced ID!

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Current wipeouts

- Focused on knowledge, not skills
- Under-designed and over-produced
- Lack of emotional engagement
- Uninformed by research

- Missed opportunities!

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Beyond Traditional ISD

- Advanced ID
  - *Learning Grounded*
  - *Skills-focused*
  - *Emotionally engaging*

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Some characteristics of our brains

- Pattern matchers
  - Good at detecting discrepancies
  - Bad at rote memorization
- Learns
  - (Compiles knowledge)
  - Inaccessible
- Builds Models
  - Explain, predict
  - Hard to extinguish

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It's about learning
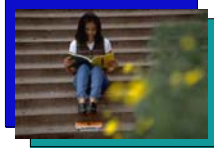
- Meeting objectives
- Achieving outcomes

Or, rather, about *doing*
- Retention
- Transfer

So, we:
- Create Content
- Design Learning

Right?

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No…

- We create learning *environments*
- We design learning *experiences*

- KEY perspective
  - *designing the 'flow'*

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Respecting Our Learners

- Meaningful Goals
- Most Effective Learning
- All Dimensions: Cognitive, Affective & *Conative*
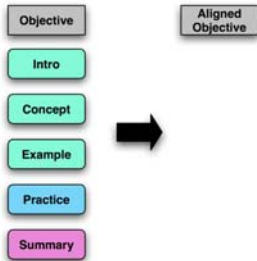 - Personality/Learning Styles
  - Motivation/Anxiety

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The traditional model (step by step)

Objective

Intro

Concept

Example

Practice

Summary

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Aligned Objectives

Objective → Aligned Objective

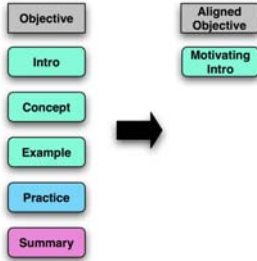Intro

Concept

Example

Practice

Summary

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Aligned Objectives

- Do not *assume* that it's about a course
  - Information update?
  - Job Aid?

- Then, do not *accept* what the SME tells you
  - Don't have access
  - Focus on K
  - Cog Sci & Inert Knowledge

- Make sure it's a meaningful decision change!
  - Having organizational impact
  - Skills, not K
  - *Jeroen Van Merriënboer*

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Motivating Introduction

Objective → Intro → Concept → Example → Practice → Summary

Aligned Objective → Motivating Intro

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Motivating Introduction

- Motivating Example
  - Hook viscerally
  - *John Keller*
- Overview
  - Connect from context to content
  - *Charles Reigeluth*
- Learner-centered Objectives
  - *NOT* designer-centric objectives
  - *Will Thalheimer*
- Experience Expectations
  - What's coming
  - *Stephanie Burns*

Follow a process? You mean I can't just make it up as I go along?
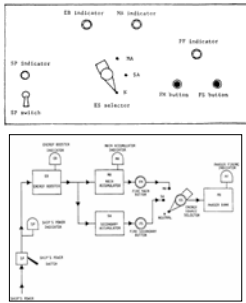
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Multiple, model representations of concepts

Objective → Intro → Concept → Example → Practice → Summary

Aligned Objective → Motivating Intro → Multi-Concept
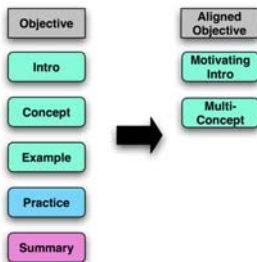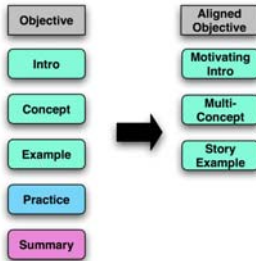
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Multiple, model representations of concepts

- Model-based
  - Reason with Models
  - *Don Norman*
- At *least*, text *+ a diagram*
  - Conceptual Relationships
  - *Jill Larkin & Herb Simon*
- Multiple representations
  - Different ways to look at it
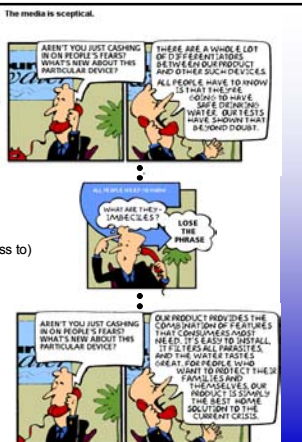 - Different media
  - *Rand Spiro*

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Story-based Examples

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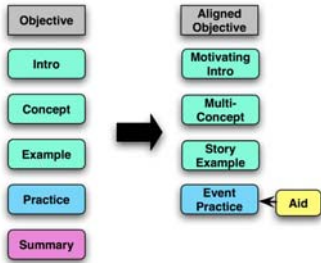## Story-based Examples

- Stories
  - Better Processed
  - *Roger Schank*
- Worked Examples
  - Steps
  - *Sweller*
- Cognitively Annotated
  - Underlying thought processes
    - (Experts no longer have access to)
  - Thought bubbles/narration
  - *Alan Schoenfeld*
- Backtracking
  - Expert's perfect process
  - Self-esteem, self-repair
  - *Alan Schoenfeld*
- Explicit Concept Link

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Event-based Practice

Objective → Aligned Objective

Intro → Motivating Intro

Concept → Multi-Concept

Example → Story Example

Practice → Event Practice ← Aid

Summary

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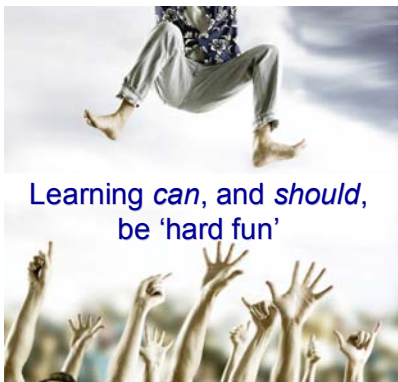### Event-based Practice

- High-enough level
  - Meaningful Problems
  - *David Jonassen*
- Meaningful Decisions
  - Contextualized
  - Meaningful to Domain
  - Meaningful to Learner
  - Active
  - Concept-based feedback
  - *Me*
- Misconceptions
  - Not random
  - *Kurt Van Lehn*
- Aided
  - *Rossett*

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Learning *can*, and *should*,
be 'hard fun'

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Enhanced Summary

Enhanced Summary

- Summary
  - Emotional Closure
- Individual Performance
  - Relate *their* performance to the material
- Further Directions
- Keeping Active
  - Supporting Beyond Practice
  - (learning follow-on)

- *Me*

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A *little* bit more…

Cognitive Apprenticeship
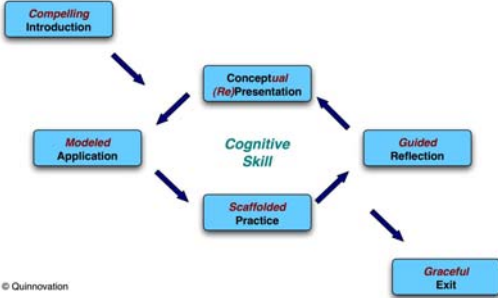
Contextualized & Enabled

Extending…

Extending Learning

Knowledge Test

Practice Scenarios

Action!

- More rigorous in your design
  - Proper Elements
  - Properly elaborated
- More flexible in your design
  - Emotionally Engaging
  - Minimalist
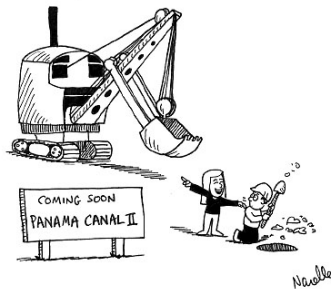 - Alternate Paths
- More flexible in your notion of a learning event
  - Little bits more often
  - Broader view of learner
  - Broader view of learning
- And so on…
- HAVE FUN!

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Coordinates

- Clark Quinn
- clark@quinnovation.com
- +1-925-200-0881
- http://www.quinnovation.com

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The Seven Step Program

for eLearning Improvement

Clark N. Quinn

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Introduction

Too much of eLearning is designed to minimize effectiveness! It's got the wrong focus, it's bloated, it doesn't engage the learner's interest, it doesn't apply what we know about how people learn, and more. Here I present seven principles that are designed to address these problems, and lead to improved eLearning effectiveness.

Recognize that the desired outcome of a learning intervention is a change in behavior; at the end of the day what we're really about is doing, not learning. Our goals for any such learning initiative, then, is for that change to be sustained over time, and to be applied at appropriate times: we are trying to achieve *retention* of the learning intervention, and *transfer* of that information to all relevant situations even if not seen in the learning experience. These principles cross and integrate both cognitive and emotional components of learning, and the more that happens, the greater the outcomes.

I've condensed cognitive research on learning into seven separate steps that, if followed, should not only make your elearning more effective, but also create a better experience for the learner. elearning more effective, but also create a better experience for the learner.

Overall

Two of the steps fit into the category of overall considerations that should be addressed at the beginning and be reflected throughout the learning design and the learning experience.

1. Skills Centered

The first step is to have a learning objective to change the skill-set of the learner, not just address their knowledge. That is, to make sure that the learners leave with the ability to do something new, not just knowing something new.

The problem is that, too often, Subject Matter Experts (hereafter referred to as SMEs), when told we want to address a particular gap, say that learners need to know X, or absolutely understand Y. The experts no longer have access to their own expertise, it's been 'compiled' and experts don't even have access to how they do things, they put together post-hoc explanations that focus on knowledge because that's what they remember. However, this focuses on knowledge, not on the ability to apply it. Instead, the focus should be on using X to do something like distinguish between a good and a bad implementation, or using Y to

explain a particular problem and predict a solution. An expert on Emotional Intelligence, for instance, mentioned that even the problematic supervisors could pass tests on appropriate management techniques, but still acted wrong in practice. They had knowledge, but they weren't equipped to apply it.

In the field of cognitive science, they have come to recognize that providing people with knowledge, and not supporting the transfer of that knowledge into meaningful skills, leads to the problem of "inert knowledge". That is, knowledge that a learner can answer questions on, but never applies even in appropriate situations. When given a knowledge objective, ask your SME "what should the learner be able to *do* differently with this information?"

Mager's work on objectives gives you a pragmatic handle on this, asking for objectives that talk about a measurable ability to do something. However, make sure that what they do is directly related to what they have to do on the job.

In a recent example, our goal was to present product knowledge to the sales force. Normally, we provide them with lists of product names and features. However, the real task is not to recite lists of features, but to match those features to customer problems (in fact, new features are chosen to meet customer pain points). Consequently, we're rewriting product features in terms of the pain they solve, with practice activities looking at specific customer situations and mapping that situation to specific product benefits.

To avoid the problem of allowing SMEs to focus on knowledge, make sure your objectives are framed in terms of what people will be able to *do* differently after the learning experience. If you're faced with an expert saying, "they need to know this", ask "what they can do differently than when they didn't have that knowledge?" Get your SMEs thinking in terms of new skills, not new knowledge.

2. Lean & Lite™

A second problem is illustrated in the figure below; we're pumping too much fat-laden content at our learners.

Our learning is verbose, our text is monotonous, our materials are overproduced. We're giving our learners unhealthy diets of learning. No wonder they're skipping around to get the necessary healthy bits and then dropping out. It's too easy for writers and instructional designers to believe it's important to write complete sentences in elegant and appropriate prose.

However, elegant prose is not what's appropriate for the online medium, nor for learning. John Carroll, with his minimalist instruction (http://tip.psychology.org/carroll.html), has shown that you can not only acknowledge your learners' pre-existing knowledge but also leverage it to streamline your training. Jakob Nielsen (http://www.useit.com/papers/webwriting/) has pointed out what is appropriate writing for the web, and it's not elegant prose. It's punchy, pithy short phrases. We're like those managers not following the emotional intelligence principles mentioned above: we know better, but we keep doing the wrong thing.

Similarly, we're not using the tools of whitespace, bullet points, and highlighting techniques. We should be using much more underlining, bolding, italics, even color. We're supposed to be helping our learners focus on the key words in a sentence, remembering the essence, not wading through reams of prose to find the nuggets. Time is money, people!

I learned this the hard way, when a professional comedy skit writer reliably and repeatedly stripped each of my paragraphs of elegant prose down to two sentences. While I had to change a few words here and there to regain the initial meaning, it remained cut down to 40-50% of its original size. I've tried to learn from that experience, and now find I can regularly cut most instructional prose down 30-40% (including my own). Try it yourself. If it's too hard on your own, trade off, but sharpen those knives and cut, cut, cut! (And highlight, highlight, highlight!)

Specific Components

The next five steps address components of the learning experience: the introduction, concept, examples, practice, and summary.

3. Emotionally Engaged

We currently are not hooking learners from the very beginning. In fact, what we do under the guise of course introductions is woefully inappropriate at best. At worst, it's downright learner abusive!

Specifically, one of the sins we commit is the pre-test. Why should learners have to take questions on material we've already determined they shouldn't likely know (or why are we creating the learning)? Unless the pre-test allows learners to skip sections of the content they can demonstrate competency on, allowing them an opportunity to shorten the learning process, I can't think of another reason to commit such a crime, and the reasons given are not sustainable. One of the arguments is that you need to compare the pre-test to the post-test to validate the instruction. However, you shouldn't have developed the learning unless you knew there was a need, and the post-test should compare performance to a measure based upon an analysis of necessary outcomes, not a delta between the previous knowledge and the new knowledge. The knowledge possessed by the learner coming in to the learning situation shouldn't be of interest once we've determined their knowledge state for the learning design. The other argument is that the questions activate relevant knowledge, supporting learning. Yes, that's true, but there are better ways to do that.

For instance, such activation can come from learning objectives. Will Thalheimer, in a conference presentation for the eLearning Guild, talked about learning objectives, and contrasts them with performance objectives and instructional objectives. Simply, learning objectives are for learners, while performance objectives are for the learning designers. I go further and suggest that those learning objectives should address the WIIFM (What's In It For Me) factor.

We know that learning is more effective when learners understand the value, and are emotionally committed. In addition to addressing their particular learning style, we need to be addressing their motivation. One trick I've seen is to exaggerate the consequences of *not* having the knowledge. Michael Allen's famous airplane video is a dramatic version of dramatically conveying the consequences, and I've also used cartoons that do the same thing humorously.

We need to help learners see that not only are they addressing goals that are important to someone else, we want to help them understand why it's important to them. Consequently, we might frame the objectives in terms of what they'll be able to do that they can't do now. And it needs to be framed in a way that they can care about.

As an additional element of emotional maintenance, we should also set expectations about what's to come. Learning can have some hard parts (learning *should* be hard fun), but we should communicate that there will be benefits. Let learners know what's coming, about how much time they'll be spending, and what their expectations should be about the overall experience. This helps them maintain focus throughout the experience. If they know it's a tough stretch, they're much more likely to persevere than if they feel like they're alone in the struggles.

Good introductions should engage learners' hearts as well as their brains. Help your learners understand *why* the content is important, using terms that will prime them cognitively as well, but also emotionally engage them and prepare them for the coming learning. Engage their interests, provide the personal value, and set expectations.

4. Connected Concepts

Once you've got them hooked, you're supposed to be giving them some new concept that is the basis for this performance. Too often, we give them some relatively directive information. Even when we're focusing on skills, we tend to give them a rubric without justification. Yet we know that several things actually help make the concept more accessible, more robust, and more likely to stick.

First, we know that getting a specific skill without reactivating the context in which this skill makes sense doesn't work. Reigeluth's Elaboration Theory suggests spiraling down from the top level to the particular skill quickly. So, for instance, when introducing a company-specific sales process, you would introduce it in the context of why sales are important, and why your company is adopting this approach. It doesn't need to be much, but it should help them place the material in a meaningful context, and associate it more appropriately.

Second, we should be providing a *mental model* for the process, which grounds the approach in a set of relationships, creating a meaning-based framework. For example, the Situational Leadership approach of Blanchard is based upon the recognition that not all employees are alike and discriminates between competence and compliance. It may actually take a little longer to learn via a model, and performance may not be as perfect, but as a benefit the performance is more robust. Learners are better able to adapt the process to problematic situations if they comprehend the underlying structure. Similarly, if they happen to forget a particular step, they can often regenerate the missing component rather than being utterly lost.

Finally, we know that for complex skills, particularly those that are ill defined (the type we really need to be focusing on), one representation of the concept may not be sufficient. We have a higher likelihood of ensuring our learners can comprehend the relevant framework, and that they will access it, if we use multiple representations. At a minimum, in addition to prose consider a graphic. It may seem difficult to always come up with one, but a reliable principle is to map the conceptual relationships to spatial ones. Of course, if it's a dynamic relationship, an animation may be more appropriate.

Good concepts are elaborated into a meaningful rationale, multiply represented, and model-based. While I typically see one or the other of these, I do not regularly see all three executed, and I think we owe it to our learners. Give them the best chance of not just understanding at the time of learning, but of retaining and applying flexibly and appropriately at the time of need.

5. Elaborated Examples

Now that we've created a meaningful basis for a skill performance, we need to help our learners understand how that concept is applied. Really, we need to help them understand how it applies to multiple contexts unless there's only one exact situation we're training for. Abstracting across multiple

contexts supports transfer, one of our learning goals. We also want to use the best communication techniques, and highlight mistakes and ways to repair.

That last may sound counter-intuitive; I know one of my clients has a culture where you never admit mistakes. Learners who see an expert performance can assume that, if they don't get perform correctly the first time, they've failed. (This is a big problem for kids and insecure learners.) However, experts often make mistakes, step back and take a different approach, until they find a solution, particularly in the difficult and complex areas of performance. Yet learners don't often see this, and can take away an artificial impression of what competent performance means. Seeing examples of the recognition of mistakes, and repair processes, can illuminate the framework more clearly, and make more flexible and empowered learners than if they've only seen a correct performance.

Another mistake is for experts not to articulate the underlying thought processes that accompany their problem solving. So, for instance, an expert might say "first you do X, and then Y, and finally Z", when they actually were thinking "well, this sort of problem can be solved by X or A, but these features of the problem make X the better choice, which gets me here, and from here I could go Y or B, but because of this factor I take Y, which gives me the option of Z or C to finish, but since my goal is stated like this I'll use Z". This is the same problem we talked about before where experts no longer have access to that level of thinking (it's compiled away from conscious access), in another guise. Yet those contextualized decisions are also important for learners to see.

For both of these reasons, having a way to communicate those inner thoughts is valuable. In video you can use voice-overs as a dramatic technique, and in comic strips you can use thought bubbles (you can also overlay them on photos). Communicating in the form of stories also provides a natural way to talk about the thought processes as well as the context. We know that our cognitive architecture is highly efficient at processing stories, if not fundamentally based around them.

Finally, making sure there are sufficient examples is important. The closer the training is to the specific task, the fewer examples you need. As you move toward more generalizable skills, however (from operating this specific machine to, for example, negotiating in all the instances in which you might find yourself), you start needing broadly disparate examples from which to abstract the common underlying principles. Your example contexts, combine with your practice contexts, provide the base for abstraction and transfer. Ensure that your coverage helps illuminate the breadth of applicability (for the negotiation example: everything from negotiating contracts with vendors, through raises with bosses and time off with employees, to chores with children).

Good examples indicate the context, model the underlying thought processes as well as the actual steps, and connect the application of the concept to varying contexts. Making them meaningful in an emotionally satisfying way, including good story telling, is an additional enhancement.

6. Pragmatic Practice

Some learners like to look at concepts first, some prefer examples first, and some would rather see a practice problem (problem-based learning) to help motivate them to pay attention. And others would rather take whatever order is presented rather than have to determine for themselves. This is OK! It's a way to adapt to individual learning styles. So, even if you don't have an adaptive system, you can have a default path, and then represent the structure of the content and make it navigable so learners can take control themselves.

Regardless, you want your practice to have some specific characteristics. Just as your examples should show the concept being used to address some real problems, you similarly want your practice tasks to provide context, and require applying the concept to solve. And, just as your examples should illustrate

the span of application, so your practice should assist in demonstrating coverage and requiring application that will facilitate transfer as well as retention.

Too much of elearning practice is knowledge test. As mentioned before, this is not effective. Your learning objectives, and hence your practice tasks, should emphasize knowledge application, and ensure that practice is about *using* knowledge to accomplish meaningful goals.

One of the reasons practice works is that it requires learners to commit, to make a decision and potentially be wrong. It's too easy to give them information they think they understand, but when it comes time to apply that knowledge, the find that they didn't understand the nuances. Better that mistakes happen in practice than when it costs equipment, an account, or a life!

Speaking of mistakes, it *is* a mistake to assume that learners make mistakes randomly, and then to choose our distractor options to be essentially nonsensical. Learners make mistakes because the import or create models that provide explanatory power, but happen to be wrong. Often, these are robust models from other domains that make sense but don't happen to apply in this domain. The problem is that such models are very hard to extinguish, as learners tend to patch them rather than replace them. What we observe, in general, are reliable patterns of mistakes or misconceptions. It's important to identify these reliable misconceptions, and make them the alternatives to the right answer. What leads one learner to a particular wrong answer likely will be very different from what leads a different learner to a different wrong answer. We want to address each specific misconception individually (which is why I complain about any quiz tool that only has one response to a wrong answer, instead of a separate one for each distractor!).

This approach has the added benefit of creating an appropriate level of challenge in the problem-solving task. Too often, I see elearning with tasks that are too easy. Problems that are too easy are not only boring, they are an insult to our learners, and don't achieve the necessary goals. I'll bet you have taken an elearning courses where you could make it through successfully even though you didn't have the requisite background nor paid sufficient attention. It's a fine line to strike, making tasks challenging enough to not be boring, but not too hard to be frustrating, but it's been argued that you need to fail before you really learn, and we err too much on the side of easiness. We'll get to the desired level of performance faster if we keep the challenge ramped up, and we'll keep from boring our learners.

By the way, if your learners will use specific tools in their work, make those tools available in their practice. When we take the broader picture of performance support, we design the job aids as well as the training, and then we should provide practice of the jobs with those aids.

Another important component is to making sure that the learning is not only challenging, but also uses examples that connect to the learner. We want to understand our learners and then use that knowledge to create problems that they viscerally understand are important to solve and to learn from. This can often require that you exaggerate the consequences, which is not a bad thing, as we know from forms of entertainment. You can exaggerate in a number of ways, from the internal circumstances in a regular story (the patient you're performing cardiac surgery on is the daughter of the latest winner of the Nobel Peace Price) to a fantastic setting (the patient you're performing brain enhancement surgery on is an alien from the Nebula system). I set one game about project management a level of exaggeration beyond what the learner's current task was: instead of building freeways, they were terra-forming planets.

And as one last point, the feedback from the practice should first play out in the context before the feedback then comes from an external voice. If the decision is about deciding how to inform the CFO of a fictional company, have the decision play out in the story of the company ("…the CFO mentions you by name before the auditing committee…") before external feedback (e.g. "…your choice to inform the CFO about the ethical violation is in full compliance with our standards of conduct…").

The ideal practice is contextualized, meaningful to the learner, sufficiently challenging, and plays out in a full story. My ideal practice is a game, where there's unpredictability, replay, and gradually increasing challenge (and this is not as expensive or time-consuming as you may think), but even writing your standard multiple choice questions as mini-scenarios is an improvement over straight knowledge test.

7. Refined Reflection

Finally, once we've provided practice until the learner has demonstrated success, it's time to provide *closure*, a completion of the learning experience. Too often that's a final test with a grade, and a summary of what they've learned. While this is good, I'd like to argue that we can and should be doing more to help make this whole experience more meaningful, and to provide greater retention.

Ideally, we'd first summarize individual performance through the learning experience, not just a generic summary. If we track learner performance, we *should* be able to do this, but I admit that it's as yet problematic. Still, that's a direction we need to be focusing on, pulling out what they did well and what they could still use work on.

More practically, we should provide support for abstracting from the experiences they saw. For instance, we know we've provided certain contexts in the examples and practice. How about an explicit suggestion to think of how the same principles would play out in other contexts, or more usefully, in their own contexts?

We also can do better about supporting the retention of information over time. One of the biggest problems with much of our training is the gap between when the learning occurs and when actual chances to apply the training in practice. If that gap is more than a day, the information from a learning experience is likely to have atrophied. One of the most powerful tools in supporting retention is reactivating the knowledge. We might stream out some reminders post-learning experience, but at least we can provide some suggestions for learners to reactivate that knowledge themselves. On one course we did about speaking to the media, the SMEs suggested practicing the statement framework on co-workers, children, and others. You may not be able to guarantee that your learners will do it, but at least you've provided support in case they wish to.

Finally, just as we drilled down at the beginning, we need to travel back up at the end to the broader context. We want to reconnect what they've been doing to the larger context of why this is important.

Summary

These suggestions, which are not typically executed in much of the elearning I've seen, provide the benefits of cognitive theory and research to make elearning that 'sticks'. The elements should support both retention and transfer.

As a framework, works out to an overall format of *lean* design of the following elements:

- Introduction
    - Emotional exaggeration
    - WIIFM (What's In It For Me) outcomes
    - Set expectations about process
- (*Skills* Focused) Framework
    - Drill down
    - Models-based
    - Second Representation
- Example(s)
    - Spanning contexts
    - Story
    - Connected to framework
    - (With thought processes made explicit)
- Online Practice
    - Contextualized decisions
    - Full experience
    - Challenging
    - (Integrated work tools)
- Reflection
    - Summary
    - (Learner's performance)
    - Generalization
    - Maintenance
    - Reconnection

I'm coming to believe in the importance of the social component of learning (despite pegging the social learning meter on the solitary side of the scale), and I expect that building social interaction into the learning experience really should be an eighth step, but there are times that's not feasible. But consider, at least, providing channels for conversation around the course, if not incorporating group discussions or projects as part of it, because as our learners move up the expertise curve, there will be less accepted and relatively static information and more negotiated or co-developed understanding, and communication and collaboration tools will *be* the learning environment.

Finally, I don't believe that all situations call for a full course, and I haven't here gone into the broader picture of the full learning ecosystem, but when substantial attitudinal or skill set acquisition is necessary, full courses are plausible, and these steps will increase the value, improving both effectiveness and learner experience. And those are goals worth shooting for.

About Quinnovation

Quinnovation works with organizations looking to move up the eLearning 'value chain', strategically using IT to deliver performance improvement results. Quinnovation combines a deep cognitive background, strong technology experience, and sound business understanding to deliver innovative thinking, with a track record of insightful strategic analysis and pragmatic and successful solutions. Quinnovation services include eLearning 'makeovers' and ongoing strategic partnerships. Recognized as a thought leader through presentation publication, and results, Quinnovation has delivered cutting-edge designs for Fortune 500 companies, business, government, education, and not-for-profits.