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The Design of Advanced Learning Engines: An Interview with Clark Aldrich

by Joel Foreman and Clark Aldrich

Clark Aldrich's expertise as an "e-learning guru" (one of three identified by *Fortune* magazine in November 2000) rests on substantial foundations: his service as the Gartner Group research director who initiated and developed the firm's e-learning coverage, his leadership of the world class team that created the commercially successful *Virtual Leader* simulation, and his authorship of *Simulations and the Future of Learning* (2004) and *Learning by Doing: A Comprehensive Guide to Simulation, Computer Games, and Pedagogy in e-Learning and Other Educational Experiences* (2005). About the latter, James Gee writes: "His new book is the best way available today to come to grips with changes that will eventually transform learning in our schools, workplaces, and society." I interviewed Aldrich over the course of several days in May 2005.

Joel Foreman [JF]: Clark, what is the relationship between computer games, education, and simulations?

Clark Aldrich [CA]: Many people talk about how similar education should be to computer games. For me, the next challenge is to think about how educational simulations are different.

For example, the expectation is that a computer game is going to be fun. Fun is partially a matter of design, such as a smooth learning curve, which is also part of a good educational simulation. But fun is also a matter of context. If my boss (or my teacher/professor) cares about how I do, even something that was fun is no longer fun. So the expectation of fun in an educational simulation becomes counter-productive.

I think educational simulations *can* be fun, but more importantly they *must* be satisfying. Let me put it this way. Doing anything well is fun. Being the best at something is fun. Getting something done that has not been done before is fun. Pushing your own limits is fun—if not while you are doing it, at least when you get where you are going.

The role of educational simulations is to enable the fabulous fun of victory *outside* the simulation, more than inside. Games, on the other hand, are very self-referential. Victory in the game is victory.

JF: Your latest book, *Learning By Doing*, contains a chapter on the Wright Brothers, which I think is relevant here. What's the point of that chapter?

CA: The chapter looks at what happens when you actually simulate history as opposed to making a game about history. The chapter is about making a flight simulator based on the Wright brothers' first flight. From an input perspective, the simulation designers used a real wind tunnel on a life-sized model of the plane to build table-based dynamics. From an output perspective, the simulation is very accurate *and* very hard. The users crash many times.

The point is that we are used to the game [Rise of Nations](#) (I was playing it last night), which is very inaccurate—without pretending to be otherwise. Doing well in this game is much easier than the real job of running a nation, and it [the game] focuses on tasks and decisions that a real leader would mostly *not* make.

If we want to create a simulation that really teaches how to run a country or plan for a battle, it is going to require rigorous and accurate data. There will be massive debates over specifics because the content doesn't

really exist anywhere in traditional documentation. We as a culture have vetted stories and sequences of events, but we don't have the underlying systems or even the subtle options available to individuals at any given time.

JF: In your recent book, you distinguish between the several different kinds of content in a simulation (sim). What are they?

CA: A good sim needs three kinds of content:

linear content (that moves the user along a defined path from a beginning to an end),

systems content (the components, parts, pieces, attributes, relationships, rules, and principles that govern a system, including primary and secondary variables and concepts like delay, energy of activation, feedback loops, and balancing loops), and

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- cyclical content (bundles of discrete action, timing, and magnitude that can be combined to impact an environment, and create an outcome, and thus drive the interface).

Again, consider *Rise of Nations*. The linear content includes the story that leads into each scenario and then the story that follows a successful outcome. The systems content includes the artificial intelligence of the opponent and the physics of the world, such as damage from a certain type of weapon, the role of nationalism on an invading army, and the productivity of iron mining. The cyclical content includes the interface for ordering a plane to attack a target, reassigning a worker from growing crops to digging for oil, or putting resources into researching stronger buildings.

For the systems content in educational simulations, models will have to be created that are fairly precise. This content has traditionally not been created by academics or even researchers. Very few historians, for example, produce models in spreadsheet form. We will be starting from a very early point in most cases. Having said that, these models will not be perfect, just quite good. There will also be places where random variables or probabilities will just be inserted when things are too complex to map.

JF: The Wright brothers sim was based on information gathered from wind tunnel tests. That seems to be a model of how to proceed with the development of something like a relationship management sim, but how do you get numbers on relationship management variables?

CA: Creating those systems models will be a new competency for most researchers. Mathematically modeling some aspect of human behavior is not for the risk adverse. But computer games do it, and so must educational simulation designers. There will have to be new disciplines and new methodologies.

JF: You appear to believe that game-like simulations will eventually alter the educational landscape. What will it take to bring about this change?

CA: Somehow we think that it is going to be teachers working in their basements over the weekend that will

produce revolutionary content, and that is just not going to be the case. They can nudge. They can implement. They can make case studies. But ultimately, this is a big deal and needs to be treated with the same respect as any other industry. The investment model is familiar to every industry, including car manufacturers, movie producers, even light bulb makers. There will be little efforts that will continue to make the case, but ultimately it will take a lot of money and a lot of time.

JF: What will the educational domain be like after the revolution has succeeded?

CA: I am assuming there will still be schools, at least as a place where most parents will want to send their children. There will still be classes. There will still be teachers. There will be a greater shift to remote study and self-study, where students can drop in on classes in other parts of the world. Teachers when teaching around simulations will be there as a coach, as a helper, as someone who is good at sensing when someone is getting too stuck or too frustrated or too detached. Teachers will also help students apply what they have learned in the sim to their experience in real life. Teachers might also assign "remedial" sims for areas where students are having trouble.

There will be a tighter integration of work and school. College students for the most part will not be locked away but integrated into interesting jobs. The curriculum of all schools will be different: it will change from obsessing about things like literature, to obsessing about things like project management, stewardship, relationship management, and ethics. This content can only be learned in a hands-on way, so there will be more integration between learning and doing.

I also believe the schools will develop the ability to swarm. By swarm, I mean predict some piece (or pieces) of popular culture and develop content that plays off of it. Television shows like *Biography* and specialized documentaries on The History Channel do a perfect job here. They know that Disney or whomever is going to put out a major movie in six months, say about Hitler or hurricanes or a start-up baseball league. They prepare content that plays off it, such as related events ("Third Reich week") or the real physics behind it ("The Truth about Tropical Storms").

JF: It's a type of "just in time" manufacturing—a better integration of consumer needs and producer output.

CA: Yes. That's a great way of thinking about it.

At a higher level, tighter integration between learning and doing, between schools and the rest of the world, between understanding history and impacting the future, has been prevented by a very primal truism: *What is taught is governed by what can be taught*. What can be taught today is material found in books and that can be delivered via lectures. And perhaps we should add: *what is captured from the past is governed by what can be captured*.

That has reduced most valuable information/knowledge/wisdom to rules, timelines, and the often complex internal monologue of others. Curricula and content have reflected and reinforced this limitation. Most of schooling has a historical nature to it. We teach calculus not because people need to know it, but because it is a stunning piece of historically relevant thinking. And we teach the content of books—the traditional "killer app" of linear content. Academics admire contemporaries who publish. What is the best thing to have on your resume? Articles! Books! Chapters!

There is a vicious loop between media and content: lectures and books as input, and papers as output. This metric warps the learning process.

JF: It biases the process. We teach what we can stick in a book, which is not necessarily what anybody really needs. Which explains how "what can be taught is taught" and goes back to how the dominant media biases education.

CA: Let me give you an example. One project my son is doing is growing food. There are the real tactical skills, like planting and watering. More importantly, there are the real high-level skills of stewardship—of building into every day a process of checking in, seeing how things are going, providing care and feeding, and taking corrective actions when something is not going well. But the traditional academic output from such an activity is a paper, perhaps with photographs and other documentation of the activity and "analysis" of results. This documentation becomes the thing to be optimized for a good grade, the thing that can be recorded and evaluated, rather than the hands-on activity of growing better food or the meta-skill and transferability of stewardship. The rewarded skills in our current model are detailed writing, spell checking, formatting of graphs, and comparing theoretical expectations with actual results. That is why there is a culture of "cramming."

It is interesting to note what type of content our current linear model prioritizes and then see how much that lines up with how schools are structured, which in part explains the dichotomy between schools and other enterprises.

This linear media bias is why many people really do not believe in education today. They want their children to go to the best schools, to meet with others of the "best and brightest." But schools and corporations are, basically, enemies of each other today. Schools have an impossible task. They teach stuff that, for the most part, enterprises don't value, other than the most basic competencies.

JF: Let's imagine that I run for public office, am elected as the "Education President," and recruit you to manage the Department of Education. What would you do?

CA: I believe there needs to be, say fifteen or twenty new simulation genres created—presumably open source, each of which focuses on one subject area. These genres would include the following:

Communication

Creating and using boards and advisors

Creating new tools

Decision making

Innovation/adaptation

Negotiation

Nurturing/stewardship

Project management

Relationship management

Researching

Risk management

Security

Solutions sales

Sourcing/contracts

Teamwork

Turning around a bad situation

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What these simulations will do is teach, in a predictable and scalable way, the information/knowledge/wisdom that cannot be taught using books and lectures. This will enable an alignment between schools and the rest of the world, which then impacts everything else.

Each simulation genre would probably cost ten million dollars. So we would start and finish two a year for eight years. (I am assuming that one can get re-elected!) These simulation genre engines could be changed, and tweaked, and updated.

One would also hope for a greater role for students as content creators, not just consumers. If you agree with what we should now christen the "20 simulation genre solution," we will create *genre engines* around twenty critical skill/knowledge domains. Since any simulation based on these core engines can be infinitely modified,

students can go in and mod a sim. They might take an existing historical sim built on a project management genre engine (say, constructing a barn in colonial New England) and rebuild it to apply to their sports team's fund-raiser, or the characters of a movie executing a plan to take over the world, or whatever interests them. Building and modding sims and evolving open-source genre engines will be a critical job for schools.

JF: Some might argue that for sim technology to be properly embedded in a knowledge domain, one should first begin with the specific nature of the domain and then structure the sim genres according to each domain. Do you believe that this is a less feasible strategy?

CA: One could ask, what does a great doctor do? What does an up-and-coming paralegal do? What does the head of a successful university do? What does the best scientist do? Mods will handle that. The look and feel of each particular sim, rather than each genre, will handle that. The starting idea, the premise for each genre, is *what is similar across* the doctor and paralegal and scientist? And then how do we take *that* perspective to better model—and better understand—Thomas Edison, or Peter the Great, or the rise and fall of the Roman Empire?

JF: This reformation of education— propelled by sims and the media transformation—will provide students with instruction that they should have been getting all along.

CA: Yes, but in the past we could not provide it in a way that was cost effective and scalable. Modern computers now allow a level of interaction that just was not possible before.

JF: Will these 20 genres also impact businesses and other enterprises?

CA: I estimate that the successful creation and deployment of these 20 genres would impact an entire nation's GDP in the order of 5%. Businesses have not been able to launch any scalable formal learning programs for these critical skills either because they are also tied to linear content. Adopting and customizing these 20 critical simulation genres would greatly increase productivity at the management level and decrease some of the ethics scandals as well.

And even though each employee would only spend about 5% of their professional life in these sims, there would be significant other benefits as well. Much of the "help" developed to support the sims will also be available to people doing "real" work. Also, the interface for each of the sims in the "20 simulation genre solution" will greatly impact how other knowledge tools are created and organized.

The creation of these 20 simulation genres solution is inevitable. The questions are, how soon will they be available and [whether] they will they be built by for-profit companies and patented or created through open source—or even by other countries such as India and China, optimized for internal productivity gains, and then sold afterwards to the US.

JF: Thanks for taking the time to chat with me, Clark. I hope that those who have the power to affect change will attend to your prognostications.

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