

LEARNING ABOUT LEARNING FROM A VIDEO GAME:

RISE OF NATIONS

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INTRODUCTION

This paper will argue that computer and video games have a great deal to teach us about how to facilitate learning, even in domains outside games. Good computer and video games are complex, challenging, and long; they can take 50 or more hours to finish. If a game cannot be learned well, then it will fail to sell well, and the company that makes it is in danger of going broke. Shortening and dumbing games down is not an option, since most avid players don't want short or easy games. Thus, if only to sell well, good games have to incorporate good learning principles in virtue of which they get themselves well learned. Game designers build on each other's successes and, in a sort of Darwinian process, good games come to reflect yet better and better learning principles.

The learning principles that good games incorporate are by no means unknown to researchers in the learning sciences. In fact, current research on learning supports the sorts of learning principles that good games use, though these principles are often exemplified in games in particularly striking ways (for a survey and citations to the literature, see Gee 2003). However, many of these principles are much better reflected in good games than they are in today's schools, where we also ask young people to learn complex and challenging things. With the current return in our schools to skill-and-drill and curricula driven by standardized tests, good learning principles have, more and more, been left on the cognitive scientist's laboratory bench and, I will argue, inside good computer and video games.

Game design involves modeling human interactions with and within complex virtual worlds, including learning process as part and parcel of these interactions. This is, in fact, not unlike design research in educational psychology where researchers model

new forms of interaction connected to learning in classrooms (complex worlds, indeed), study such interactions to better understand how and why they lead to deep learning, and, then ultimately disseminate them across a great many classrooms (see, for example, the papers in Kelly 2003).

There are many different types of computer and video games, such as shooters (e.g., *Deus Ex*, *Return to Castle Wolfenstein*, *Unreal II: The Awakening*), squad-based shooters (e.g., *Tom Clancy's Ghost Recon*, *Operation Flashpoint: Cold War Crisis*), adventure games (e.g., *The Longest Journey*, *Siberia*), simulations (e.g., *The Sims*, *SimCity 4*, *Black and White*), role-playing games (e.g., *Baldur's Gate II: Shadows of Amn*, *The Elder Scrolls III: Morrowind*, *Star Wars: Knights of the Old Republic*), real-time strategy games (e.g., *Age of Empires*, *Age of Mythology*, *Rise of Nations*), action/arcade games (e.g., *Sonic Adventure 2 Battle*, *Super Smash Brothers*, *Sly Cooper and Thievius Raccoonus*), and a good number of other types.

This paper discusses one real-time strategy game, namely *Rise of Nations*. Hereafter I will refer to real-time strategy games as “RTS games” and to *Rise of Nations* as “*RoN*”. RTS games are among the most complex and demanding of computer and video games. In such games, players play a civilization of their choosing, a civilization for which they must make a myriad of decisions. They send their citizens out to gather resources (e.g., food, wood, minerals, gold, etc.) and use these resources to build domestic and military buildings and engage in various forms of research. In these buildings, they can train soldiers and other sorts of people (e.g., leaders, priests, scientists, and/or professors), as well as build military and other sorts of apparatus. As they gather and build, they can advance to different ages, allowing their civilization to

achieve higher levels of complexity and sophistication. All the while they must go to war against or engage in diplomacy with other civilizations.

All of this is done in real time. While the player builds up his or civilization, other players (or the computer representing other players) are building up theirs as well.

Players must decide when to attack or engage in diplomacy. Victory may come to the swift, that is, to those who attack early (a strategy called “rushing”), or to those who wait and patiently build up (a strategy called “turtling”).

RoN is one of the best RTS games ever made (along with such excellent games as *Civilization III*, *StarCraft*, *WarCraft III: Reign of Chaos*, and *Age of Mythology*). *RoN* allows the player to play one of 18 civilizations (e.g., Aztecs, Bantu, British, Chinese, Egyptians, Maya, Nubians, Russians, Spanish, etc.), each with different advantages and disadvantages. The player can play against one to seven opponents (other real people or the computer playing other civilizations). Players can move through eight ages from the Ancient Age to the Information Age through various intervening ages such as the Medieval Age, the Gunpowder Age, and the Enlightenment Age. Like all RTS games, *RoN* involves players learning well over a hundred different commands, each connected to decisions that need to be made, as they move through a myriad of different menus (there are 102 commands on the abridged list that comes printed on a small sheet enclosed with the game). Furthermore, players must operate at top speed if they are to keep up with skilled opponents who are building up as they are. *RoN* involves a great deal micromanagement and decision making under time pressure.

This paper is based on an analysis of my own learning and personal interactions with the game as a game player. Learning differs from individual to individual, so we need to base our discussions of learning around actual cases of actual people learning.

This is does not say, however, that no generality exists here. How any one of us learners throws light, both by comparison and contrast, on how others learn. Learning is not infinitely variable and there are patterns and principles to be discovered, patterns and principles that ultimately constitute a theory of learning. Indeed, what I am offering here is a case study meant to offer suggestions for a theory of how deep learning works see, also, Barsalou 1999a, b; diSessa 2000; Glenburg 1997; Glenburg & Robertson 1999). In the end, I hope to convince you that today's young people often see deeper and better forms of learning going on in the games they play than in the schools they attend.

Though some of the information below is personal, I intend and hope readers will think about the comparisons and contrasts of my learning experience with *RoN* to the sorts of learning that goes on in schools. Ironically, perhaps, a baby-boomer trying to learn a modern computer or video game is not, in some respects, unlike a child in school trying to learn science or math. Both parties are being asked to learn something new and, in some respects, alien to their taken-for-granted ways of thinking.

PREPARATION FOR LEARNING: BEFORE *RoN*

By the time I started up *RoN* I had played lots of computer and video games. They had taught me new ways of learning and new things about myself as a learner (Gee 2003). However, I had not had good experiences with RTS games. I felt overwhelmed by their many details and by the pressure of competing in real time. I had watched my twin brother play RTS games at a high level and was amazed by the number of details he had mastered and the speed with which he had acted and thought in the games. I had watched my seven-year-old play the wonderful *Age of Mythology* and was stunned that he and his friends could play such a complicated game so well. Far from giving me

confidence these experiences just made me think that I was not suited for the micromanagement and on-the-spot decision-making RTS games demanded. In regard to RTS games, I was an “at risk” learner, at risk for failing to be able to learn and enjoy these sorts of games.

Though timid about RTS games, when *WarCraft III* came out, I tried it, prodded by my brother who loved the game. I made some progress in the single-player campaign, but eventually found the game “too hard”. We should pause a moment, though, at this phrase “too hard”. *WarCraft III* is a superbly designed game. In fact, it is well designed to get itself learned. So when I say it was “too hard”, what I really mean is that I failed to engage with it in a way that fully recruited its solid design and learning principles. Good games are never really “too hard”. They fail, for some players, either because their designers did not use good learning principles or because players have, for one reason or another, failed to engage the good learning principles that are built into the games.

So something has to come even before good learning principles. What has to come before is motivation for an extended engagement with the game. Without a commitment to an extended engagement no deep learning of a complex domain can happen (diSessa 2000). So what made me motivated to offer such extended engagement to *RoN* and not earlier to *WarCraft III*? Well, as good as *WarCraft III* is, *RoN* is yet better at allowing newcomers to learn it. But, more importantly, and ironically, perhaps, my “failure” at *WarCraft III* motivated me to try *RoN*. I had liked *WarCraft III*. It had made me feel that RTS games were important and worth playing. Though I had had limited success with the game, I had had some small success that made me feel that at another time and place, perhaps, I would do better. It had led me to read about RTS games and reflect on them. *WarCraft III*, it turned out—though I realized this fully only

when I started *RoN*—had prepared me for future learning (Bransford & Schwartz 1999) of RTS games. When I started *RoN*, I realized that I already knew something, somewhat more than I had thought. I felt I had a small foot up.

In a school setting, my experience with *WarCraft III* would simply have been seen as a failure as I received my low or failing grade. In reality, it was not a failure, but an important precursor for later learning. My experience with *WarCraft III* is what I will call, following the work of Stan Goto (2003), a “horizontal” learning experience.

“Vertical” learning experiences are cases where a learner makes lots of incremental process on a scale from low skills to high skills, as if moving up a ladder. “Horizontal” learning experiences are experiences where one does not make a lot of progress up the ladder of skills, but stays on the initial rungs awhile, exploring them and getting to know what some of the rungs are and what the ladder looks like. Horizontal experiences look like mucking around, but they are really ways of getting your feet wet, getting used to the water, and getting ready, eventually, to jump in and go swimming. They may, in one form or another, be essential to learning, or, at least, essential for learners who are “at risk”.

So, is there a contradiction in saying that when I started *RoN* I was still an “at risk” learner, but that my experiences with *WarCraft III* were important preparation for future learning? No. All that my being “at risk” meant, in the end, was that if *RoN* had failed to reward my preparation for future learning (the future was here with *RoN*) or had been a bad learning experience—a real failure—then I may have given up on RTS games forever, assuming I was too “dumb” to learn them. This is all “at risk” needs to mean in schools, too, though there it often means giving “at risk” learners a special dumbed-down

curriculum meant to catch them up on “basic skills”, a curriculum that all too often is a bad learning experience for these students.

Computer and video games have a built in advantage in the creation of motivation for an extended engagement. Human beings feel that their bodies and minds extend, in a rather intimate way, to the area around them over which they have direct control, usually a fairly small area (Clark 2003). Thus, as I type, I feel that my keyboard and mouse seem almost like extensions of my fingers, just as blind people often feel that their cane is an extension of their hand. The space closely around my body seems to be connected to it in such a way that I can feel that it is being “invaded” by others.

When humans can manipulate something at a distance, for example controlling with a keyboard a far-away robot seen on a screen, they get an uncanny feeling that their minds and bodies have been vastly extended (Clark 2003; Goldberg 2001). When people are playing a computer or video game they are manipulating a character (or many different things in a RTS game) at a distance in a very fine-grained way—in this case a virtual distance. They feel that their minds and bodies have been extended into this virtual world. This process appears to allow players to identify powerfully with the virtual character or characters they are playing in a game and to become strongly motivated to commit themselves to the virtual world the game is creating with their help.

When students are learning a content area in school—such as some area of science—this domain could be seen as a special world of its own, the world of doing science in a certain way and acting with certain values. Students could be encouraged to take on identities as scientists of a certain sort, to see and think about themselves and their taken-for-granted everyday world in new ways. In this case, school would be

functioning more like a good game than traditionally schooling which stresses knowledge apart from action and identity.

***RoN*'s TUTORIALS: FISH TANKS**

Let's begin to explore what makes *RoN* a good learning engine. When a player starts *RoN*, the designers immediately have two problems. First, learners are all different and the designers don't know what each one already knows, nor what their favored style of learning will be. Second, learners don't necessarily themselves know how much they do or do not already know and what their best style of learning will be in a given situation. Schools tend to handle these problems by assessing the learner and then deciding for the learner how these problems ought to be dealt with. *RoN*, like many other good games, solves the problem by letting learners assess themselves and learn things about what they do and do not know and what style of learning suits them here and now. Learners then decide for themselves how they want to proceed. Of course, *RoN* is designed to assist learners in this task; they are not left solely to their own devices. By the time you have interacted with *RoN*'s tutorials and skill tests and played your first few real games, you know a good deal about yourself as a learner, in general, and a learner of RTS games, in particular [In this paper the games called "Quick Battles" in *RoN* are what I refer to as the "real" game; a game called "Conquer the World" is also part of *RoN*, but I do not discuss that game in this paper. Conquer the World is composed of Quick Battles and other elements].

When *RoN* starts, you see a screen with the following choices (the numbers on the right are dates, ranging from 60 AD to 1940):

Tutorial			
Learn to Play	--	Quick Start	
Bodicia	--	Beginning Player	60
Alfred the Great	--	Beginning Player	878
The 100 Years War	--	Experienced Real-Time Strategy Player	1337
Henry VIII	--	Experienced Real-Time Strategy Player	1513
Battle of Britain	--	Advanced Topics	1940

Right away the learner sees choices: jump right in (Quick Start), learn step-by-step (moving from beginning player to experienced player to advanced topics), start with the experienced or advanced topics (thereby testing one's own assumptions about one's previous knowledge), or skip the tutorials altogether. Choice is built in from the beginning. Notice, too, there is no "remedial" in this learning world. You begin where you begin and move to advanced when you move there. None of this is timed. There are no invidious judgments based on one's previous "failures".

When the learner places the mouse on each choice above, a box is displayed at the bottom of the screen detailing just what historical event each choice will deal with and what skills the learner will learn by making that choice. Table 1 below shows each choice and what is displayed in the box when the learner places the mouse over that choice:

Learn to Play	--	Quick Start	
<div> <p>Quick Learn Learn-As-You-Play Introduction</p> <ul style="list-style-type: none"> -One-on-one battle -Hints and suggestions as you play </div>			
Bodicia	--	Beginning Player	60
<div> <p>Bodicia - Tutorial 2</p> <p>Help a queen fight off the Romans to reclaim her nation</p> <ul style="list-style-type: none"> - Unit selection - movement - map scrolling - help text - basic combat </div>			
Alfred the Great	--	Beginning Player	878
<div> <p>Alfred the Great - Tutorial 3</p> <p>Turn back the raging Viking hoard</p> <ul style="list-style-type: none"> - Constructing and using buildings - Training units - Minimap </div>			
The 100 Years War	--	Experienced Real-Time Strategy Player	1337
<div> <p>The 100 Years War - Tutorial 4</p> <ul style="list-style-type: none"> - Library research - Food, timber, and metal gathering - Capturing cities - Repairing buildings - Unit combat advantages and disadvantages - Transporting units across water </div>			
Henry VIII	--	Experienced Real-Time Strategy Player	1513
<div> <p>Henry VIII – Tutorial 5</p> <p>Defend against Scottish raids</p> <ul style="list-style-type: none"> - City construction - National borders - Knowledge and wealth gathering - Merchants and rare resources </div>			
Battle of Britain	--	Advanced Topics	1940
<div> <p>Battle of Britain – Tutorial 6</p> <p>Battle the Germans in Britain’s finest hour</p> <ul style="list-style-type: none"> - Diplomacy - Air combat - Generals - Oil - Enhancement buildings - Formations </div>			

Table 1: Tutorial Screens

All is not as it at first seems here, though. What you see in the boxes are by no means all or even the majority of the skills you need to play *RoN* well. They are the “basic skills” you need to play the game, but “basic” in a special sense: they are the skills that allow you to actually start playing and learning from playing. I will point out below that the designers of *RoN* don’t just take it for granted that players will be able to move from the basic skills in the tutorials to learning by playing. Once the player actually starts the “real” game, they ensure that this transition—from basic skill learning to learning by playing—will happen. But before I tell you how they do this (it’s all about players being able to customize the game to their own desires and goals), let me finish my discussion of the tutorials.

If we look back at the terms “experienced real-time strategy player” and “advanced topics” in Table 1 we see something interesting. “Experienced” and “advanced” mean something quite different here than they do in places like schools. The skills taught in the tutorials, as we have said, are “basic” (in the sense defined). They are not the deeper skills required to play *RoN* or any other RTS game well, skills like time management, speed, micro-managing many details at once, and strategic thinking. So it may seem odd that terms like “experienced” and “advanced” are used. But “experienced” and “advanced” here mean what players need to know to begin to take yet greater control over their own learning by discovery through playing. They don’t mean “at the top of the vertical ladder of skills” (or “you get an A in this subject”). The player is experienced and advanced in the sense of being prepared for future learning “on site”, not in the sense of necessarily being an expert.

Each tutorial places its basic skills in a scenario that is just a simplified version of the real game. This allows learners always to see how these basic skills fit into the game

as a whole system and how different skills integrate with each other. In school, on the other hand, very often these days children are exposed to basic skills one-by-one, step-by-step. For example, in early reading instruction they are taught first awareness of the sounds that compose words, then the decoding of letters, then reading aloud to attain more fluent decoding, then comprehension skills (Coles 2003). Then and only then do they get to play the real “game” of reading, namely reading for meaning and to carry out their own purposes. In schools, too often, skills are decontextualized from the system (the “game”) and from each other. This never happens in *RoN* or any other good game.

As an example of what I am trying to get at here, consider the tutorial labeled “Alfred the Great” (see Table 1 above). When you click on this tutorial, while the scenarios is loading, you see the following in print, while listening to the same thing (my own remarks below are placed inside brackets):

Eight hundred years after Bodicia rebelled against the Romans [this event was dealt with in the preceding tutorial labeled “Bodicia”], Britain was savaged by repeated Viking attacks. Alfred King of Wessex has been paying tribute to stave off the raiders, but in 878 the Vikings prepare for conquest. After a defeat, Alfred retreats to rebuild his forces and drive the Vikings away.

Once you press “Start” to start the scenario, you see the Vikings attacking the British town of Ethandum and hear the following:

Alfred suffers a stinging defeat when the Vikings attack in battle. The Norsemen loot the town and Alfred is driven back to his stronghold in Carlisle. Alfred must rebuild his forces and attempt to retake Ethandun.

Here we see that the scenario opens with a short context within which to understand and make sense of what one is going to do. After the Vikings' victory, the scene changes to the British town of Carlisle, the place to which Alfred has retreated. This is where we will play out our tutorial. We don't start from scratch, though. We start in the Classical Age, the second of *RoN*'s eight ages, not in the Ancient Age where real games start. We also start with a large city, granary, lumber mill, market, and fort, as well as several citizens and their farms. While the game always starts with a (small) city and some citizens, the rest of these things players would normally build for themselves. Furthermore, while players in the real game always start with a library where they can do lots of different types of research, including research that leads to new ages, this scenario has no library, because we are not going to use it.

The setting of the scenario has been designed to be a minimal game setting with no more and no less than we need to learn at this point, but with enough to see how things fit together as a system. I will call this a "fish tank tutorial", because a fish tank can be, when done right, a simplified environment that let's one appreciate an ecosystem (e.g., a river, a pond, or reef in the ocean) by stripping away a good deal of complexity, but keeping enough to bring out some basic and important relationships.

As we stare at the town of Carlisle, we hear and see the following, which importantly gives us an overall purpose and goal within which to situate the actions we are going to carry out and the skills we are going to learn:

The Vikings now control Ethandum. Before we can rally the nation, we must retake that city. Our first goal is to scout the Viking position and find a route for our attack. We need to keep watch on the Viking preparations and defenses. A Lookout [a type of building] is needed as close to the Vikings as possible. This is a good spot for the look out [the camera moves to a spot at the edge of the town and we see a big red circle marking the spot], close enough to see what's happening, but not so close that they'll notice it and attack. Now we'll learn how to construct new buildings. The action a selected citizen [the camera moves back to town and we see a big red circle marking a citizen] can perform are found in the lower left panel [we see a red arrow pointing to the panel]. Click the Build Military Button [we see a small yellow circle marking the button in the panel] to access a menu of building choices, one of which is the Lookout.

While you would normally have to click on the citizen to get the panel for types of buildings you can build (e.g., domestic ones, military ones, public monuments, etc.), in this case it is done for you when the game highlights the citizen. All you have to do is click on the Build Military Building button, which has a small flashing yellow circle around it. When you click on it, you see another panel appear, a panel for building

different sorts of military buildings. This time there is a flashing yellow circle around the button for building a Lookout. We also hear “Select the highlighted Build Lookout button”. Once we do this, we hear “Select the location for your Lookout by clicking near the target marker. Your citizen will begin construction there ” and see a big red flashing circle at the spot that had been indicated earlier. When we click this spot, we hear: “Good, now your citizen will move to that site and begin construction”.

We are having our hands held as we move through the fish tank (it’s what we can call a “supervised fish tank”). But notice some crucial features of this handholding. Information is given multimodally (Kress & van Leeuwen 2001), that is, in print, orally, and visually (note, as well, that if you place your mouse cursor on any person, building, or environmental object on the screen, a box will appear that tells you what it is and what you can do with it). There is lots of redundancy. Information is always given “just in time” when it can be used and we can see its meaning in terms of effects and actions. Unlike in school, we don’t get lots of verbal information up front and then have to remember it all when we can actually use it much later.

We see clearly how each piece of information we are given and each skill we are learning (and doing) is inter-connected to everything else we are learning and doing. We see the game as a system, not just a set of discrete skills. For example, we see how selecting a citizen, selecting a spot, and building a building are an integrated skill set. We see also how they relate to our overall purpose in this case, that is, to observe the enemy without getting too close. This let’s us see that this skill set is both a general one (used for building and placing all sorts of buildings) and a strategy in the specific case when we are building Lookouts. In fact, we learn that all skills and skill sets are always ultimately strategies when they are concretely instantiated in practice.

This fish tank tutorial is also, of course, an example of what Vygotsky (1978) called learning within the learner's "Zone of Proximal Development". The "teacher" (in this case, the very design of the game) helps learners (players) pull off more than they could on their own and yet still feel a sense of personal accomplishment. Furthermore, the "teacher" (the design) tells the learner how to interpret things (what they mean), but these interpretations (meanings) become part and parcel of the learner's own mind as he or she carries out actions that embody those interpretations, e.g., building a Lookout as an initial plan in battle.

RoN'S TUTORIALS: SUPERVISED SANDBOXES

Each of the tutorials below "Quick Start" in Table 1 function as fish tanks. So, then, what about the Quick Start tutorial? By its placement at the top of the list you are coaxed to take this choice first, though you need not (and if you don't like it, you can always quit, go back to the main menu, and make another choice). If you click on Quick Start what you get, in fact, is something a bit different from a fish tank, you get what I call a "sandbox tutorial". In the real world, a sandbox is a piece of the real world, but sealed off to be a protected and safe place where children can explore. You can throw anything you want in the sandbox for the kids to play with so long as it isn't dangerous (there may be spiders in there, but, presumably we don't let the family python in). It need not be as controlled and clean an environment as a fish tank.

So, too, the Quick Start tutorial is a space where the player is really playing the game, but is protected from quick defeat and is free to explore, try things, take risks, and make new discoveries. Nothing bad will happen. In other sorts of games, for example shooters, the first or first couple of levels of the game often function as sandbox tutorials

(e.g., the excellent *System Shock 2*), though they are not labeled as tutorials, but as real levels of the actual game (in the first level of *System Shock 2*, though it looks as if you must escape a failing space ship rapidly and are in great danger, in actuality the level is not timed and the player cannot get hurt).

Quick Start starts by telling the player:

This is a preformed scenario where you can play the game at your own pace. Try to capture the Barbarian capital or conquer 70% of the map. There'll be hints and reminders to help you as you play.

The Quick Start scenario is actually the “real” game set an easy level of difficulty with copious comments and hints. There is an opponent (in the real game you can have multiple opponents), but the opponent builds up slowly and does not make the smartest choices. The player gets a real sense of being in the game, even a sense of urgency, but can't really lose or, at least, lose at all early before having put up a very good stand.

Let me just show you just the beginning of the Quick Start tutorial, so that you get the flavor of what is going on. The material below deals with how I operated in the Quick Learn tutorial. Here, once again, I print my own remarks in brackets:

[Voice:] The leadership of your fledging tribe has fallen on your shoulders. The first task is to unify a new nation under your rule. You're free to build your

nation at your own pace. Occasionally you may receive advice to help keep things moving, but otherwise it's all up to you.

[If you wait, eventually you will read and hear hints about what to do. But there is "wait time" here to allow you to explore the screen and click on whatever you like. I clicked on the scout. When I did so I saw the box printed below and simultaneously heard the remarks listed below that:]

Scout: Currently selected (Hotkey ')

.**Scouts**, Ancient Age [picture with hotkey] –fast, but unarmed; good for exploring the map and finding enemies

.Can spot hidden enemy units, such as spies and commandos

.Can also destroy enemy spies

.Strong vs. spies; Weak vs. Archers, Gunpowder Infantry

[Voice:] This is your scout. Use him to discover rare resources or locate the enemy position. Scouts are very fast and can see farther than most units, but cannot attack. You can move your scout around the map manually or click the auto explore button to have him explore on his own.

[After a few moments, I saw the message printed below on the top left of the screen and simultaneously heard the words below that:]

[Top Left Corner:] Create citizens to gather more resources

[Voice:] Your first priority in the Ancient Age is to create citizens and gather resources. Click your capital city and click Create Citizen to add to your work force. Put as many of your people to work gathering food and timber as you can. If you're running low on resources, you can always build farms to gather food and fill up woodcutter's camps with citizens to gather timber.

[During another "wait time", I clicked on the library and then clicked on a red button that lets the player research military technologies. Once this research is finished, the player can build military buildings. After clicking on the red button, I hear the following]:

[Voice:] Now that you have studied the first red military technology, you can build a barracks and beginning training troops to protect your nation.

[After a few moments, I hear the following:]

[Voice:] If you want to see more of the map, you can always zoom in and out by using the mousewheel or pressing Page Up and Page Down on the keyboard.

The Quick Start tutorial goes on this way for a while. If the player explores and does things, the tutorial confirms these acts and explains them. If the player waits, the tutorial prints a hint about what to do on the top left of the screen and says the hint orally and explains what it means. There are also, from time to time, remarks about how the game works, for example, the remark above about how to see more of the map. The tutorial is a nice dance of the player's actions and designers' guidance and instructions.

Midway through the Quick Start scenario the following box pops up:

MID GAME

At this point you should be having fun exploring the game and following some of the prompts that appear in the top left of the screen. If you're not having fun, you may want to try one of the following options.

I'm having fun I want to continue playing

I need to know more basic information, take me back to the tutorial screen

The game is too slow. Let me start a Quick Battle.

This box is an excellent example of alerting players to the fact that they need to assess their own progress, desires, and learning styles. They need to be proactive, make decisions, think about what they are doing and learning, and take control of their own learning.

When I started *RoN*, I started by doing the Quick Start tutorial. I did this for a rather perverse reason. I was so sure I would fail that I wanted to reconfirm my own view that actually playing the game would be too tedious and complex for me. What happened was that I got excited, feeling, “Wow, I’m actually playing a RTS game and winning, to boot!” (of course, this may remind you of the great scene in the movie *What About Bob?* where the ever fearful Bob is lashed to the sail of a sail boat and yells to his friends, “Look, I’m sailing, I’m actually sailing!”). The Quick Start tutorial is a sandbox. The sandbox feels like the real world to a child, but is guaranteed not to destroy the child’s trust and ego before the child is strong enough to face more significant challenges. But this tutorial is a specific type of particularly efficacious sandbox. It is a sandbox with a wise parent present to guide and confirm efficacious play in the sandbox, in the case proactive game designers. Let’s call this a “supervised sandbox”.

Once I had done the Quick Start tutorial, I was energized to learn more, but, of course, I could not remember all the details the tutorial had introduced—nor was I meant to. Now I could turn to the specific fish tank tutorials and make each of these details, through focused practice, a part of my embodied intelligence and not just the caprice of my risky verbal memory. But I also knew now how these details fit into the larger scheme of the whole game, remembering that even in the fish tank tutorials skills are also introduced in terms of how they relate to other skills and to a simplified game system. Of course, other learners might do the fish tank tutorials first and use the supervised sandbox of the Quick Start tutorial to assess their learning and readiness to jump into the “real” game.

There is one last important point to make about the Quick Start tutorial. What it does, in addition to what we have already surveyed, is introduce the *genre* of RTS games

to players who may have not played such games before. “Genre” just means what type of thing a thing is, for example whether a novel is a mystery, romance, science fiction, etc., or a piece of writing is a story, report, essay, and so forth. RTS games are one type of computer/video game (there are many others, e.g., shooters, adventure games, role-playing games, etc.). They involve typical actions, rules, and strategies that are different from those involved in other types of games.

Schools often try to teach kids to read and write, rather than read or write specific types of things like stories, reports, field notes, essays, or expositions. But, just like games, these different types of reading and writing operate by different principles and are used to carry out different types of actions. Good learning always involves knowing early and well what type of thing we are being asked to learn and do (Christe 1990; Cope & Kalantzis, 1993; Martin 1990). Learners need to see this type of thing in action, not to be given static rules, if they are really to understand. In fact, for most types of things—like types of games, writing, movies, and so forth—there are no clear and static rules that define different types. Each type (e.g., a RTS game or an essay) is composed of many different instances that are variations around a theme. The only way to learn is to see some instances and live with them concretely.

Sure, there are some things you need to learn that help you to play most games, regardless of their type (e.g., moving and clicking a mouse), but these are the tip of an iceberg compared to what you need to know about how different specific types of games work. Thinking a RTS game is a shooter will make you a particularly bad learn of the RTS game or, at the least, will make you disappointed with it and not like it. The same thing is true of writing—there are some basic all-purpose things to learn (e.g., where to

put commas and periods), but they, too, are but the tip of an iceberg, and writing an essay thinking it is supposed to be a personal narrative won't work.

***RoN*: UNSUPERVISED SANDBOXES**

We are now ready—as the player is—to leave *RoN*'s tutorials and start the “real” game. I said that the skills *RoN*'s fish tank tutorials taught were “basic skills” in the sense that they are the skills that will allow you to actually start playing and learning from playing the game. The designers of *RoN* have ensured that these skills, once you learn them, will function just this way by building certain devices into the game play itself. When you leave the tutorials and actually start playing, there is a pause key that will stop time. This allows you to explore what icons on the screen mean and think about what you want to do. When time is paused, your opponent(s) do not continue building and so you do not have to worry about falling behind. Furthermore, you can set the game at one of two easy difficulty settings (easiest and easy) that greatly decreases the pressure of time. On these settings, opponents move slowly and not always in the smartest fashion. Finally, you can turn on (of off) hints that appear from time to time to remind you of what you have learned in the tutorials and teach you new things.

What all this means is that the player learns in the tutorial just enough to move on to learn more—and more subtle things—by actually playing the game, but playing it in a protected way so that deeper learning can occur through playing. The player can customize the game play to be, in fact, another sort of sandbox, in this case what we might call an unsupervised sandbox. The player is protected to explore and take risks, but, aside from the small hint notes that can be turned off and on, there is much less guidance and direction from *RoN*'s designers.

We see, then, that in *RoN* there is no clear division between the tutorials as a learning space and the player's first "real" games with difficulty set on easiest or easy and use of the pause key. These first real games are actually "hidden tutorials" which assist players in teaching themselves how to play *RoN*, not as a set of discrete skills, but as strategic thinking using an integrated system of skills. These unsupervised sandboxes make for a smooth transition between official tutorials and "really" playing the game (set on normal or a harder level).

LEARNING AND PLAYING

But there is a yet deeper principle at work here than the smooth transition between tutorials and playing. In a good game like *RoN* there is never a real distinction between learning and playing. The tutorials are simplified versions of playing the game. The game itself has a number of difficulty levels and at each level players must refine their skills and learn new ones. Players can also play other players in a multiplayer form of *RoN* on the Internet, getting into games with others whose skill levels are equivalent to their own. They can move up to play better and better players as their own skills progress, and, in doing so, will constantly be learning new things. When learning stops, fun stops, and playing eventually stops. For humans, real learning is always associated with pleasure, is ultimately a form of play—a principle almost always dismissed by schools.

There is one crucial learning principle that all good games incorporate that recognizes that people draw deep pleasure from learning and that such learning keeps people playing. Good games allow players to operate within, but at the outer edge of their competence. At lots of moments, a good game feels highly challenging, but

ultimately “doable”. Perhaps the player fails a few times at a given task, but good games show how much progress the player has made on each try and the player sees that this progress is increasing each time he or she “fails”. Eventually success comes. This feeling of being highly challenging, but ultimately doable, gives rise to a feeling of pleasurable frustration, one of the great joys of both deep learning and good gaming.

Good games, however, do not at all points operate at the outer and growing edge of the player’s competence. This is because they also recognize another important learning principle, what I call the “principle of expertise”, because it is the foundation of expertise in all significant domains (Bereiter & Scardamalia 1993). When learners learn a new skill set/strategy, they need to practice it over and over in varied contexts in order to make it operate at an almost unconscious routinized level. Then they are really good at it. But they are also in danger of resting on their laurels and learning nothing new. At this point, a good game throws a problem at the player where the routinized skill set/strategy won’t work. This forces the player to think consciously again about skills that have become unconscious, taken-for-granted, and routine. The player must integrate his or her old skills with new ones, forming a new and higher skill set/strategy.

Now, in turn, the game will let this new skill set/strategy get practiced until it is routine. The player has moved to a new level of expertise and will then eventually face a yet harder problem that will start the process all over again. Thus, good games cycle through times where they operate at the outer edge of (but within) the player’s competence and times where they allow players to solidify their skills. The times where players are solidifying their skills to the point of routine and taken-for-granted application give rise to another form of pleasure, the pleasure of mastery. Games cycle through periods of pleasurable frustration and routine mastery, a cycle of storm and calm.

These cycles are actually clearer in games like shooters (e.g., *Return to Castle Wolfenstein*, *Deus Ex*, *Unreal 2*, etc.) than they are in RTS games like *RoN*. In a game like *RoN* they are partially under the players' own control through the ways in which players can customize the game to their own skill level and interest. Players can themselves choose periods of skill solidification and high challenge, though the game gives them plenty of feedback as to when things are getting too easy or too hard.

But how do players know when they are prepared to move beyond the unsupervised sandboxes they can create by playing the game on easy difficulty levels? How do they know when they are ready to move on to the more rigorous challenges of the normal difficulty level and harder levels, as well as multiplayer play? As it happens—as happened with me, in fact—the player can certainly tell the game is becoming too easy by how fast and thoroughly he or she gains victory over the opponent(s). However, I found that when I moved on to the normal level, it was, at first, too hard, harder than I had thought it would be, given my swift victories on lower difficulty levels. The problem, of course, was that I had not properly evaluated my skills. I did not realize that my skill sets/strategies were not fast and efficient enough to take on harder challenges.

RoN does two things to speak directly to this problem. First, it offers players a whole set of “Skill Tests”. I list the skill tests in Table 2 below. Note that some tests are defined in terms of skills (e.g., mouse clicking) and others in terms of strategies (e.g., getting to the Classical Age fast). As we have said, in games, skills are always seen as strategies.

Skills Tests

1. Aging Madness – Age 2

How fast can you get to Classical Age? Find out if your resource management skill is good enough.

2. Aging Madness – Age 4

How fast can you get to Gunpowder Age? Find out if your resource management skill is good enough.

3. Aging Madness – Age 8

How fast can you get to the Information Age? Find out if your resource management skill is good enough.

4. Raiding Party

Take your bloodthirsty Mongol horde and pay a visit to some enemy towns in an exercise of micromanagement.

5. Hotkey Handling

Do you know your hotkeys? This is a test of hotkey knowledge.

6. Protect the Wonder

Protect your Wonder from jealous enemies in a exercise of defense.

7. Tactics

Defeat the enemy troops to take control of a valuable resource without losing more than half your army in this test of generalship.

8. Whack the General

How fast can you click your mouse? This is a test of clicking ability.

Table 2: RoN Skill Tests

These skill tests allow players to assess how well their skills fit into an efficient strategy set—how well integrated with each other and with the game as a system they are.

The skill tests are, as they often are not in school, developmental for the learner and not evaluative (judgments carried out by authority figures). Furthermore, they are tests of what skills mean as strategies, not decontextualized tests of skills outside contexts of application where they mean quite specific things.

The second thing *RoN* does to solve the problem of letting players know where the cutting edge of their competence is is to render the whole matter social. Sadly, I failed my very first skill test several times. But I knew just how to increase my learning curve so I could pass the test. Every player knows there are an immense number of Internet sites and chat rooms from which loads of things can be learned and to which lot of questions can be directed.

One very effective thing—though there are a great many others—that players can do is download recordings of *RoN* games played by players at different levels of expertise. Players can watch these to learn new things at ever increasing levels of expertise. Players can also easily record their own games and review them. They can also pit the computer against itself—at whatever level of difficulty they choose—and watch how things are done. On line, there is a world-wide university of peers and experts available to any player all the time. *RoN* lists its own web site on its program file, a site with much information, chat rooms, and links to other sites. There are also published strategy guides and many game magazines that will discuss games like *RoN*, offering hints, guides, and other sorts of helpful information.

This social aspect of *RoN*, and games in general, makes *RoN* and other games the focus of what I have elsewhere called an “affinity group” (Gee 2003). An affinity group is a group of people who affiliate with others based primarily on shared activities, interests, and goals, not shared race, class, culture, ethnicity, or gender. The many sites

and publications devoted to *RoN* create a social space in which people can, to any decree they wish, small or large, affiliate with others to share knowledge and gain knowledge that is distributed and dispersed across many different people, places, Internet sites, and modalities (e.g., magazines, chat rooms, guides, recordings, etc.). Distributed and dispersed knowledge that is available “just in time” and “on demand” is, then, yet another learning principle built into a game like *RoN*. Too often in schools knowledge is not shared across the students, is not distributed so that different students, adults, and technologies offer different bits and pieces of it as needed, and is not garnered from dispersed sites outside the classroom (for a case where it was, see Brown 1994). *RoN* has no such problems.

CONCLUSION

By way of summary, let me collect together here in a list some of the learning principles that are built into *RoN* and reflected in my interaction with the game. I believe that these principles would be efficacious in areas outside games, for example, in science instruction in schools, though I must leave that argument for another time. However, it is clear that these principles resonant with what theorists in the learning sciences have said about learning in content areas in school.

1. Create motivation for an extended engagement
2. Create and honor preparation for future learning
3. Create and honor horizontal learning experiences, not just vertical ones

4. “At risk” doesn’t need to mean any more than that you don’t need another bad learning experience
5. Let learners themselves assess their previous knowledge and learning styles and make decisions for themselves (with help)
6. Build in choice from the beginning
7. Banish “remedial”—the word and the experience
8. “Basic skills” means what you need to learn in order to take more control over your own learning and learn by playing
9. “Experienced” doesn’t need to mean “expert”, it can mean being able to take more control over your own learning and being able to learn by playing
10. Teach basic skills in the context of simplified versions of the real game so that learners can see how these skills fit into the game as a system and how they integrate with each other
11. Teach skills as sets and make it clear how they are instantiated in practice as strategies for accomplishing specific goals or carrying out specific activities
12. Offer supervised (i.e., guided) fish tank tutorials (simplified versions of the real system)
13. Offer supervised (i.e., guided) sandbox tutorials (safe versions of the real system)
14. Give information via several different modes (e.g., print, orally, visually). Create redundancy
15. Give information “just in time” and “on demand”

16. Learning should be a collaborative dance between the teacher's (designer's) guidance and the learner's actions and interpretations
17. Let learners create their own unsupervised sandboxes (i.e., let them be able to customize what you are offering)
18. Teach learners the genre they are involved with early and well (supervised sandboxes are good for this)
19. Ensure that there is a smooth transition between tutorials and actually playing (customized unsupervised sandboxes are good for this)
20. There should new no big distinction between learning and playing at any level
21. Allow learners to discover the outer edge of their competence and to be able to operate just inside that edge
22. Allow learners to practice enough so that they routinize their skills and then challenge them with new problems that force them to re-think these taken-for-granted skills and integrate them with new ones. Repeat
23. Offer learners developmental (not evaluative) skill tests that allow them to judge where the outer edge of their competence is and that let them make decisions about what new things they need to learn on their path to mastery
24. Ensure that learners at every level of expertise can readily use knowledge that is distributed and dispersed across a great many other people, places, sites, texts, tools, and technologies
25. Ensure that the learners become part of an affinity group composed of peers and masters near them and spread across the community and world

Young people exposed to these principles so powerfully in a game like *RoN* are engaged in a form of learning that, in my view, makes many schools look uninspired and out of touch with the realities of how human learning works at a deep level. Perhaps, too, this exposure causes in some of these young people a critique of schooling as it currently exists.

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