Game-Based Learning and Knowing

The design of Q2L has been informed by recent research and findings in the learning sciences, game studies, and educational reform methods. This section offers an overview of foundational ideas, including precedents and a rationale for a situated-assessment model.

History

The link between games and learning is not a contemporary phenomenon or a digital one. Long before *Quest Atlantis* or *Oregon Trail* hit the market, games were used as learning tools. Members of the volunteer Militia of Rhode Island played American Kriegsspiel in the years following the Civil War; theater games such as Sibling Rivalry were used in contexts ranging from activism to acting; and Friedrich Fröebel's invention of kindergarten in 1840 was premised in large part on the integration of learning, games, and play (Salen 2007a). Attempts to use computer technologies to enhance learning began with the efforts of pioneers such as Richard Atkinson, Mona Morningstar, and Patrick Suppes in 1968; the presence of computer technology in classrooms has increased dramatically since that time, including the use of games and simulations.

As a result of rapid changes in the way technology interacts with almost all aspects of contemporary life, today we live in the presence of a generation of kids who have known no time untouched by the promises and pitfalls of digital technology. Born into a world where concepts such as copyright, mastery, civic engagement, and participation are seamlessly negotiated and redefined across highly personalized networks spanning the spaces of Facebook, Yu-Gi-Oh! and YouTube, today's kids are crafting learning identities—hybrid identities—for themselves that seemingly reject previously distinct modes of being. Writer, designer, reader, producer, teacher, student, gamer—all modes hold equal weight. We used to call this generation "players-producers," "prosumers," or even "multitaskers"; now we just call them *kids*. The phrase that best explains this change comes from Mikey, a student, who in talking about games said, "It's what we do." The "we" he was referring to are kids these days, the young people of his generation.

Parlaying what is known tacitly and explicitly, informally and formally, about how learning happens and deepens, Q2L grounds itself in both the theoretical and the practical educational innovations borne out of learning research done the past 25 years. These innovations speak especially to learning as a process directly tied to contexts in which learners immerse themselves and take on the behaviors and identities endemic to particular domains of knowledge. Gaming and learning scholars have shown that games create for players the kinds of domain-immersive experiences that resemble the most contemporary understandings about learning. To be sure, current learning theories are at odds with education policies and practices interested only in further institutionalizing cognitive theoretical practices, such as rigid assessment programs, which have led increasingly to curricula driven by test-preparatory frameworks. To integrate what is currently known about learning, Q2L is working closely with learning researchers and game designers to create the kinds of immersive and social learning environments that not only facilitate learning, but feature cultural learning spaces that youth currently populate predominantly outside of places called school.

Theoretical and Research Foundations

The work of various fields in education and game design frame the Q2L learning paradigm (Torres 2009). Most significant, the field known as *learning sciences* in the past two decades has made significant scientific contributions to the nature of learning. Researchers in the learning sciences have conducted extensive research that posits learning *as context-based processes mediated by social experiences and technological tools* (Lave 1990; Sawyer 2006). This notion of learning departs from current cognitive theoretical views, which pose that learning and knowledge are computed and stored in the minds of individuals, much like in a computer. These views manifest themselves in prevailing instructional strategies, which take their cues from computer-like learning constructs such as memory, storage, and retrieval (Anderson, Reder, and Simon 1996; Driscoll 2005). Research studies, for example, have shown that the most common teaching strategy in American high schools is initiation/response/evaluation (Christoph and Nystrand 2001), which asks students low-level inferential questions concerned with attaining the right answer. Current national-assessment trends also reflect an adoption of information processing, with the core of the No Child Left Behind Act (2001) serving as an accountability system that assumes that knowledge and knowing can be stored in the mind and appropriately captured through standardized measures.

Situated Learning

In using current learning sciences research, Q2L adopts the view that learning is a highly social endeavor mediated by contexts and the situated practices that occur within particular domains (Brown, Collins, and Duguid 1991; Torres 2009). This view of learning as situated emerges in part out of the notion of *communities of practice*. Jean Lave and Etienne Wenger (1991) define communities of practice as those we participate in throughout our lives. These localities in which practices are exercised and learned *over time* are diverse and include domains such as families, a discipline such as biology, or a sport such as hockey. Distinct to this view of learning is that in addition to the skills and knowledge acquired as a result of participating in such communities, the communities' particular cultural and social practices are also part of what is learned (Klopfer 2008). In this way, a situated-learning view stipulates that learning cannot be computed solely in the head but rather is realized as a result of the interactivity of a dynamic system. These systems construct paradigms in which meaning is produced as a result of humans' social nature and their relationships with the material world of symbols, culture, and historical elements. The structures, then, that define situated learning and inquiry are concerned with the interactivity of these elements, not with systems in the individual mind, such as is proposed in the theory of information processing with stages of memory, storage and retrieval of information, pattern recognition, encoding, and the like (Driscoll 2005). For Q2L, taking the interactivity approach means that learning domains, their respective contexts, and the assessment tools that students and their teachers use to decompose and make meaning are carefully designed to ensure that students engage in situated and authentic, real-world learning experiences.

Much of the work of the learning sciences has been driven by the explicit innovation of learning environments—namely, an understanding of the ecology of learning. Extensive research into the practices of professionals, particularly within the science and math disciplines, has led learning sciences scholars to design effective learning interventions. Much of this work contributed to the now seminal book *How People Learn: Brain, Mind, Experience, and School* (Bransford, Brown, and Cocking 2000) published by the National Research Council. Overall, major contributing disciplines to the learning sciences, as a diverse and interdisciplinary research and education design field, include cognitive science, computer science, psychology, education, neuroscience, and social science. For an overview of the learning sciences, see the introduction to *The Cambridge Handbook of the Learning Sciences* (Sawyer 2006).

Games and learning research, along with studies that report on youths' increasing use of digital media technologies (Jenkins, Clinton, Purushotma, et al. 2006; Lenhardt and Madden 2005; Roberts, Foehr, and Rideout 2005), has led government agencies such as the National Science Foundation and private foundations such as Spencer, Robert Woods Johnson, and MacArthur to fund further research into the potential of games, digital media, and simulations as learning spaces. Indeed, one such project, funded in part by the MacArthur Foundation, is for the design and development of Q2L.

Games and Learning Research

Anchored in the learning sciences, a new field around video games and learning has emerged in recent years. Building on the premise that learning is an immersive process mediated by social activity and technological tools, games and learning researchers have begun to show how the design of video games imbed effective learning principles in highly motivating contexts (Torres 2009). For example, in working with low-income African American students engaged in playing *Civilization III*, both in a high school and in an after-school setting, Kurt Squire (2004) found that the participants, especially those reported to be among the lowest performing, "developed new vocabularies, better understandings of geography, and more robust concepts of world history." *Civilization III* is a highly complex computer strategy game in which its players succeed by building empires—through a *recursive* process of trial and error—by way of managing resources, employing diplomatic and trading skills, and managing the advancement of culture and military power. The participants' teachers had identified them as underachieving in history classes or otherwise disinterested in historical subject matter, yet these kids were able to engage in a game that asked them to account for a host of interacting variables, including, among others, the implications of working within six types of civilizations (e.g., American, Aztec, Iroquois, Zulu), six types government (e.g., despotism, anarchy, communism, democracy), and 13 geographical terrains (jungle, tundra, grasslands, flood plains, and so on). Squire reports elsewhere that engagement in this history-based game simulation motivated some participants to ask questions such as, "Why is it that Europeans colonized the Americas, and why did Africans and Asians not colonize America or Europe?" (Squire 2006, 21)—questions, to be sure, that rarely surface in U.S. history textbooks, which tend to narrativize U.S. and European history as the great westward expansion (Wertsch 1998). Squire's research, like that of others in this new field, points to how the very design attributes of video games support learning (see, e.g., Squire 2004).

Research Precedents

Like Squire's research, Eric Klopfer's work using mobile devices such as handheld computers and mobile phones points to the potential of games as effective learning platforms. As part of MIT's Education Arcade, Klopfer and his colleagues designed a game called *Environmental Detectives*: undergraduates took on the role of environmental engineers to investigate and advise the university about a course to take regarding a pollutant in the groundwater resulting from a recent building construction on campus. The students were given handheld computers programmed with global positioning system software (which allowed them to see their current location as they moved around campus), a schematic map of the area, and "virtual experts" who offered scaffolded information as needed. This project attempted to respond to the difficulty that engineers-in-training have with developing the ability to navigate effectively between primary (quantitative) data and secondary data (such as interviews with witnesses and experts). Hence, a primary goal of this game was to offer players realistic and situated experiences with the challenges of conducting environmental investigations—challenges that require complex thinking in search of dimensional and not "correct" answers, but rather "reasonable explanations." One player in this game reported that it was "a great way to simulate . . . a real life experience. Being in the field enables you to get a much better sense of the terrain that you are working with, and it allows for more authentic feel" (Klopfer 2008, 100). Indeed a core goal of games facilitated by mobile devices is to enable players to engage in complex quests that require interaction with real-world settings and people—from testing pollutants in a water source to interviewing members of the United Nations to sending feedback or information to other players networked into the game.

Systems Thinking

The term *system* is a very broad concept that relates to a number of general areas including social systems, technological systems, and natural systems. Though the subject has been studied from different angles and points of interest, an all-encompassing definition may include the following elements (Assaraf and Orion 2005): a system is an entity designed by humans or by nature that maintains its existence and functions as a whole through the dynamic interaction of its parts. The group of interacting or interdependent parts form a unified whole and are driven by a purpose. Systems attempt to maintain their stability through *feedback*. Hence, the interrelationships among variables are connected by a feedback loop, and the status or behavior of one or more variables consequently affects the status of the other variables (Torres 2009). Systems thinking has been identified as a skill necessary in the twenty-first century (Federation of American Scientists 2006). Researchers, game-development executives, and education leaders at the 2006 Summit on Educational Games—a national conference convened by the Federation of American Scientists, the Entertainment Software Association, and the National Science Foundation—described video games as "able to teach higher-order thinking skills such as strategic thinking, interpretative analysis, problem solving, plan formulation and execution, and adaptation to rapid change" (Federation of American Scientists 2006, 3). In addition, they point out that video games are the medium of attention for youth, who spend on average 50 minutes playing them each day (Roberts, Foehr, and Rideout 2005). While playing video games, young people perform complex tasks within rich and highly immersive multimedia-driven, interactive environments. Such tasks include running political campaigns (*Political Machine*) or football franchises (*NCAA Football 08*), building environmentally sensitive communities (*SimCity*), navigating virtual worlds they create (*Second Life*), managing complex social relationships (*The Sims 2*), or trying to find a diplomatic solution to the Israeli–Palestinian conflict (*Peace-Maker*). Don Menn (1993) claims that students can remember only 10 percent of what they read; 20 percent of what they hear; 30 percent of what they both see and hear if they see visuals related to what they are hearing; 50 percent if they watch someone model something while explaining it; but almost 90 percent if they engage in the job themselves, even if only as a simulation.

Redefining Critical Thinking

Q2L poses that systemic-design thinking defines "criticality" or "critical" thinking. Indeed, current research on video games focuses on the ability to develop a sense of criticality—in other words, the skill of critical thinking. Using the structure of games as a primary framework, Q2L students will be able to design, understand, critique, and manipulate the internal architecture of systems. James Gee (2003, 2007) uses the notion of "semiotic domains" to frame this sort of critical meaning making that learners should be able to do with respect to systems. Approaching meaning making, then, from the linguistics standpoint of semiotics, Gee contends that such an endeavor is characterized by the dynamic interaction between words, symbols, images, and artifacts and human behaviors, affinities and networks. These interactions happen within domains of knowledge to create particular meanings. A domain serves as a locality that draws a type of confinement to a particular space or field. Knowledge domains, which are systems themselves, are as varied as a school, a family, the sport of soccer, or the disciplines of biology and computer science. Each houses characteristics that situate a discourse and particular ways of being and seeing the world. Meaning making, then, is reliant on this *interactionism*. Hence, critical learners must see and appreciate a domain or system as a designed space—"*internally* as a system of interrelated elements making up the possible content of the domain and *externally* as ways of thinking, acting, interacting, and valuing that constitute identities of those people who are members of the affinity group associated with the domain." "It is my contention," Gee claims, "that active, critical learning in any domain should lead to learners becoming, in a sense, *designers*." Critical thinking, as he sees it, "involves learning to think of semiotic domains as design spaces that manipulate us in certain ways . . . and that we can manipulate in certain ways" (2003, 40, 99, 43, emphasis in original). Systemic-design thinking or critical meaning making, then, involves understanding design in two senses: "design" in the morphological sense of form and function, such as the design that "is" a building or a bird, for instance; and "design" in the sociological sense of the interactive, willed, human processes we undertake to meet goals, communicate, and live. Truly understanding the design of domains and systems, then means understanding both structure and human agency.

Reframing Literacy

The push to reframe twenty-first-century education came perhaps most notably from the New London Group (1996) in its manifesto on new literacies in particular and on teaching and learning in general. Made up of international literacy scholars, this group proposed a plan for the future of teaching and learning that called for a pedagogy that was resolute in teaching for critical understanding—by which they meant "conscious awareness and control over the intra-systematic relations of a system" (1996, 85). For this reason, they advocated that "design thinking" drive the creation and methods of postprogressive curricula and pedagogy. Humans design complex systems that interact with designed and natural systems in complex ways. Policy decisions and civic participation in the modern world need to rely on "design thinking" that focuses on intra- and intersystem relationships and patterns as well as on the intended and unintended consequences of local actions within a complex system (witness the intersections of religion, culture, language, industry, economy, and politics in the Iraq War and the disaster to which simplistic linear thinking has led). The New London Group also stressed the importance of seeing language and literacy not just as systems that humans accept and passively use, but as systems that they design in practice moment by moment through decisions and choices and based on deep understanding of the communicative resources (the "design grammar") constituted by different styles of language.

Situating Assessment

The material included in this chapter offers a broad outline for an eventual detailed assessment plan integrated within the sample curriculum. Through work with assessment experts such as Dan Schwartz of Stanford as well as master teachers who will join the team over time, we are refining this framework and toolset of strategies for assessment.

At Q2L, assessment is situated in learning—located in the discourse, actions, and transactions of individuals, peers, and groups. Assessment is a tool for gathering evidence about a student's domain-specific knowledge (concepts and processes), and dispositions). Q2L's Integrated Domains are uniquely designed, life-situated, cross-disciplinary, standards-based resources for its Mission–Quest curriculum. A quick look at the Mission–Quest template (in "Curriculum Structure") provides a schema for the embedded choreography of situated Q2L learning and its assessment—namely, its focus on data-collection and data-analysis tools to evaluate contexts of knowing: what, how, when.

The following key principles and values guide Q2L teachers' work around assessment:

1. Assessment is situated in learning—located in the discourse, actions, and transactions of individuals, peers, and groups. Embedded assessment assumes that data-collection and data-analysis tools will be appropriately chosen on a trajectory of activity:
   - Planning Quests
   - Doing Quests
   - Culminating Quests
   - Culminating Discovery Mission Fluency Assessment
   - Culminating Boss-Level Fluency Assessment
   - Teacher's reflection on Mission–Quest results.
2. An assessment program should be designed to allow learners to assess themselves eventually.

3. Assessments should measure the extent to which students can innovate within a domain.
4. Understanding students' learning and the school's effectiveness is best facilitated by data.
5. "Smartools" are a primary form of assessment. Students use data provided by Smartools that they themselves create to understand and meet their own learning goals.
6. Students are accountable to themselves, to their peer community, and to the school.
7. Success is mediated by continual reflection and evaluation of the school's goals and mission.
8. Knowledge to be assessed emerges from engaged participation, reasoning, and resolution of Missions and their Quests.
9. Assessment tools support valid inferences about learning. Assessment tools must facilitate answers to the question: "What does a particular performance reveal about how students know and about how they reason with and use their knowledge?"
10. Assessment is dynamic: equitable and inclusive, it meets student needs before, during, after, and in between learning experiences (Delandshere 2002). Planning and student advisory structures exist to design, monitor, counsel, or adjust learning Quests to meet students' learning trajectory needs. The major challenges of this standard are finding out what all students do know and creating a learning environment with "no floor, no ceiling" so that they all can work toward their maximum potential, achievement, and sense of self-worth.
11. Participatory assessment requires that expectations, co-constructed and delivered criteria, and documentation be "open source" for all participants. Students need to know what is

expected, specifically how they can successfully complete Missions and their correlated Quests. Supporting this goal will be students' coparticipation in choosing learning activities and eventually in designing Quests, constant reflection, and advisory structures. Processes such as purposeful collection of data, theorizing, reasoning, and critical reflection skills are pivotal for knowledge seeking, and performance is assessed using holistic, qualitative techniques. Thus, students need to be involved in setting criteria for assessment and using these criteria as a means to their own ends or aim.

Toolkits

Assessment resource Toolkits support teachers' dynamic assessment of student learning. Principles, guidelines, templates, and exemplars are included in Toolkits for making assessments at formative and summative stages of Missions and their correlated Quests:

- Rubrics (holistic and analytic templates: *concepts, processes, and dispositions*)
- Observation protocols (varying formats and suggestions to capture data):
    - In situ events
    - Students' learning logs/journals
    - Prior knowledge for planning Missions and Quests
    - Interventions
- Questioning protocols:
    - Teacher's instructional-design questions
    - Teacher's questioning of students as scaffolding strategy

Students' questioning ("What needs discovery?" "What is known?"
"What do I need to find out?")
Students' metacognitive strategies and reflection (In Being Me formats or Think Alouds)

- Interview protocols (teacher–student; peer–peer; student– expert)
- Interpretative representations criteria:
  Writing (all forms)
  Mapping (diagrams, schematics)
  Drawing
  Performing or presenting (live and online)
- Dedicated instructional-assessment methods
  Reciprocal teaching
  Guided prompting
- Discourse analysis (teacher–student talk; peer talk)
- Games as assessment: scenarios demonstrating uses of games as assessment systems.

Research design for gathering qualitative and quantitative data on student achievement over time can be developed with domain-specific educational research experts.

In sum, Q2L learning and its assessment cohabit the culture and context of its game-based, systemic design. How students know is embodied in what they do. How teachers come to know how students are doing is embodied in a cyclic layering of assessment activity: (1) collecting data, (2) interpreting data, and (3) documenting data. "Curriculum and Instruction" includes Mission curriculum templates indicating how we think Q2L participants can engage in a continuum of knowledge questing.

Three Learning Dimensions

Three learning dimensions frame the curriculum and assessment program at Q2L:

- Dimension One: Civic/Social-Emotional Learning
- Dimension Two: Design
- Dimension Three: Content

For each of the learning dimensions, rubrics assess specific competencies (see table 1). Competencies and the learning principles they represent come from Q2L values, as expressed in this planning document. They include:

1. *Learning for Well-Being and Emotional Intelligence* At Q2L, various programs compose a Wellness domain, such as an online social-networking platform, Being Me, and Home Base advisories. The Wellness domain supports students' emotional, nutritional, and physical development. A unique aspect of our programming is guided by the understanding that emotions are deeply connected to learning. Hence, opportunities are provided for students to understand and reflect on emotions.
2. *Learning for Design and Innovation* Q2L's standards-based curriculum supports students in becoming active problem solvers and innovators of the twenty-first century. Tinkering and theory building are critical practices supported across the curriculum. Students are given time, space, and purpose to tinker with systems (games, simulations, small machines, etc.). Students tinker and theorize as a core method of discovery.

3. *Learning for Complexity (Systemic Reasoning)* A core goal of our pedagogy is to help students learn to reason about their world. Systemic reasoning, or the ability to see the world in terms of the many interrelated systems that make it up—from biological to political to technological and social—supports students in meeting this goal.
4. *Learning for Critical Thinking, Judgment, and Credibility* One core component of our learning model is helping young people to understand many of the unintended consequences that may arise as part of their participation with and use of digital media. Students will learn how to judge the credibility of information drawn from online resources, for example, and learn how to reason about and evaluate content. They will learn how to manage and synthesize multiple streams of information. They will learn to be critical thinkers who are able to appreciate, debate, and negotiate different points of view. Most important, our curriculum focuses on equipping students with an understanding of new models of citizenship, civic participation, and public participation made possible within today's networked learning landscape.
5. *Learning Using a Design Methodology* Our curriculum creates contexts for ongoing feedback and reflection. This approach creates opportunities for students to demonstrate and share their knowledge with teachers and peers. Across the curriculum, students act as sociotechnical engineers in the creation of playful systems—games, models, simulations, stories, and so on. Through *designing play*, students learn to think analytically and holistically, to experiment and test out theories, and to consider other people as part of the systems they create and inhabit. Game design serves as the pedagogy underlying this work.

6. *Learning with Technology and Smart Tools* Within our curriculum, students learn how to build Smartools, or "tools to think with," such as maps, online dictionaries, equations, and computer simulations, to name but a few. Through these tools, students have access to continual and transparent feedback on achievement toward learning objectives.

Table 1
Three Competency Dimensions

DIMENSION ONE Civic and Social-Emotional Learning	DIMENSION TWO Design	DIMENSION THREE Content
Apply across All Domains	Apply across All Domains	Knowledge Domain content aligns with New York state standards
▪ Teaming, learning from peers and others;	▪ Systemic thinking	▪ The Way Things Work
▪ Planning, organizing, adapting, and managing goals and priorities;	▪ Digital media tool use	▪ Being, Space, and Place
▪ Reflecting and self-assessing in action and on action;	▪ Iteration	▪ Codeworlds
▪ Persisting to overcome complex challenges;	▪ Representation	▪ Sports for the Mind
▪ Attending to diverse and global perspectives; using the world as a learning space;	▪ Communication	▪ Wellness
▪ Behaving ethically and responsibly;	▪ Intelligent resourcing for new ideas	

Table 1
(continued)

DIMENSION ONE Civic and Social-Emotional Learning	DIMENSION TWO Design	DIMENSION THREE Content
Apply across All Domains	Apply across All Domains	Knowledge Domain content aligns with New York state standards
▪ Caring about others, developing positive relationships	▪ Designing play	▪ Mission Lab
▪ Recognizing and managing emotions	▪ Designing for innovation	▪ Being Me
	▪ Participating in interest-driven communities	▪ Home Base
		▪ All other nodes