Games and the Future of Education Research

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The games, learning and society community is positioned to spark a revolution in education research. Video games emerged in the 1980s and 1990s as a radically new form of entertainment technology. Within a single generation, arcade and text-based adventure games evolved into first person shooters, simulations of world history and million-player massively-multiplayer online worlds. Games proliferated on fast Internet connections and on mobile devices. It has taken a while for research communities to catch up. At first, much of the popular rhetoric on gaming focused on the risks and potential damage of gaming. Commentators issued cautionary tales that focused on deviance, distraction and potential for sparking antisocial behaviors and for corrupting youth. Only recently has scholarly discussion begun to turn a corner to consider gaming as a powerful catalyst for learning.

Recent education research on games and gaming has struggled with self-definition. The potential of games to produce learning is no longer in much doubt. No one who has ever played, for example, *Deus Ex*, *Civilization* or the *Sims*, would question the power of immersive games as learning environments. The game environments are not only brilliant at scaffolding increasingly sophisticated play, they also provide easy access to the tantalizing experience of world-immersion. The interactive nature of gaming allows some players to actively participate in direction and outcomes of narratives, and others to create elaborate rule-based systems with emergent properties. The education research community, however, has been slow to embrace the revolutionary potential of games for learning. Instead of focusing on the unique affordances of game design and game play, many games researchers have instead focused on defining games in terms of existing education research agendas. At this beginning of this collection, Kurt Squire cites the refrain demanded of games researchers: "Where is the evidence that games work?" This question haunts video games and learning research. *(How) do games teach math? (How) can games lead to careers in science? (How*

well) can games teach students to read? It turned out that, in most cases, games proved neither as efficient, nor as effective, in reproducing the kinds of results characteristics of other kinds of instructional interventions. Thus the value of gaming as a new form of learning was stunted by the lack of evidence that games work as well as traditional methods to deliver traditional content.

The question "where is the evidence that games work?" follows from a social science theory of action that guides much contemporary research in education. This theory of action assumes that education is a matter of implementing interventions (curricula, programs, software, etc.) into learning contexts. The purpose of research is to test the quality of the interventions (e.g. the value and reliability of expected outcomes) and to develop procedures for appropriate implementation. Research methods describe the appropriate experimental and analytic procedures to describe the causal effects of interventions. Education research, in this context, considers games as generic interventions intended to teach specified content. Research methods can assess what students know prior to and after the treatment. Learning gains can then be compared with other interventions (computer adaptive learning, classroom instruction, etc.). Once adequate evidence is provided of intervention success, researchers can then move to the question of deployment at scale, and design controls for the fidelity of local implementation to ensure that the results produced under controlled settings would also be seen "in the wild." If games researchers could effectively engage in this type of social science policy research, they would finally legitimate games as viable interventions for public investment.

Seen from the perspective of contemporary education research, commercial games and gaming generate plenty of buzz but little evidence of that they produce learning. Most immersive games fail miserably when considered as mere interventions – they are not

interchangeable with other forms of learning interventions (e.g. textbooks or simulations); they do not often produce clear outcomes that can be measured outside the experience of play. Of course, some games can be designed to fit into categories that make them conducive for social science research, but these seldom afford the kinds of immersive play characteristic of console and PC commercial games.

Presumably, answering the question with evidence of effectiveness would put to rest, once and for all, the public disquiet around using entertainment technologies for education. The connection of "evidence of learning" to "public legitimation" reveals that there are larger issues at work here. Evidence would provide a scientific, objective warrant for game play, design and learning to legitimate games for public investment in education. This use of science as a rhetorical tool for public persuasion is certainly not new. Education is, after all, a serious matter, worthy of public policy and tax funding, while entertainment is a leisure activity best left to the marketplace. Using toys for learning irritates the serious-minded proponents of education – how could games, of all things, fulfill our daunting expectations for schooling as the path to national destiny and the remedy for social ills? The burden is on games researchers to provide evidence that games produce the kinds of learning we value in schools. Then games can join the ranks of curricula that "work," and could become viable resources to would extend the contemporary practices of teaching and learning in and out of schools. The future of games research, it would seem, hinges on the ability to produce and disseminate sufficiently persuasive evidence that games lead to learning.

My afterword for this ambitious, challenging and visionary collection of games-based research is to describe how and why this social science approach to education research is a profound mismatch for games-based research. Rather than define games research in terms of intervention research, instead I argue that this volume argues for a powerful new vision of

education research. The core of this new vision is contained in the insight that games provide access to participating in and creating new *worlds*. In a phenomenological sense, worlds are the *referential totalities* of tools, practices, traditions and routines in which actors make meaning of actions and interactions. All action, and all learning, takes place in the context of a world. A world includes the know-how, tools and contextual information necessary to orient both action and identity. Knowledge claims must be understood against the backdrop of a world context that make knowing possible.

In education, the world can be thought of as the learning environment, that is, the context in which learners can make meaning of new information through in relation to existing practices and constructs. The conventional approach to policy-driven education research is to bracket the world out, so to speak, and to consider the ways in which new interventions produce desired results regardless of the context. Bracketing the world out means that issues of participating in alternative worlds, and building new worlds, seldom arise in the traditional intervention research process. Traditional research methods excel at determining whether users/learners get what designers have built, but falter in understanding the agency of users/learners in constructing and engaging in worlds. Designing interventions that provide the kinds of learning that we currently expect for schools will result in the kinds of schools we currently have. If the future of learning requires us to understand how students navigate, modify and create new worlds, then we must develop new approaches to research to lead the way.

The video games research described throughout this book illustrates new approaches for games research to revitalize education research. Games allow players to engage in new worlds. Video games provide access to the kinds of worlds in which players can take on identities and interact with the environment and with others. Game worlds display many of

the features that shape everyday social interaction. Jim Gee and Betty Hayes use *(D)iscourse* to describe the rules of interaction and communication characteristics of the *Sims* game world; David Shaffer uses *epistemic frame* to describe the network of beliefs, norms and heuristics that orient actors in a professional worlds. Immersive game play leads many players to what Sasha Barab and colleagues call *transactive engagement* that allows players to use tools and social interaction in pursuit of learning goals. Engaging in new worlds, with different norms of communication and different stances on identity exploration, allows players to create the kinds of spaces necessary to reflect on practices in their "real" worlds. Games, however, go beyond the invitation to *engage* in new worlds – they also provide opportunities to *design* new worlds. This level of learner/player agency instantiates new forms of interaction and world-making. As Tom Malaby notes, putting the world-making tools in the hands of users shifts the locus of control from participation to creation. Studying how interaction unfolds through play and design in these new worlds gives rise to the kinds of skills and knowledge that will shape learning in the next century.

In the following sections, I will describe how games research will anticipate the next generation of education research in three areas: *play*, *learning* and *design*. The *play* section focuses on the wide variety of ethnographic and descriptive research practices presented in this book that were used to capture how interaction unfolds in game worlds. *Learning* addresses the new approaches offered to analyze the process and the outcomes of participation in game worlds. *Design* describes the ways in which researchers understand the world-making and world-altering practices of players in games. The chapter concludes with reflections on what education might look like once we decide to shift our research perspective from "what works" to "what's happening" and "what's possible."

Play

Play describes how players actually engage in game worlds. Play characterizes how players negotiate rule-based worlds, and how player engagement transcends the rule-based game world to evolve unanticipated forms of interaction. Research on play seeks to understand how players navigate the tensions between constraint and freedom. The value of play research comes from descriptions of how players engage with and transcend in game worlds. This careful, basic research helps us understand the social, psychological and cognitive capacities that players bring to bear in play, and also highlights the socio-cognitive practices that emerge as players carve narrative arcs through game-worlds.

Video game play highlights the tension between constraint and freedom because games are *designed experiences* (Kurt Squire). Games result from the intentional decisions of designers, and game play can thus be seen as a kind of asynchronous communication as players discern, exploit and transform the features of the play environment. Soren Johnson captures this negotiation of designer and player by asking "who decides what the game is about?" Designers of games like *Spore* and *Peggle* may base play on organizing metaphors (in this case, evolution and Pachinko) that suggest play mechanics and achievement structures, but once circulated in the world, players turn these games into explorations of creativity and chaos theory. Soren further notes that the negotiation between gameplay and design, like with most other forms of communication, requires that trust be established between the designer and the player. Players need to be able to trust that the game world will respond in satisfying ways to play, and cheats become a kind of credit that designers extend to players to fill in gaps between the underlying design metaphor and the play experience.

Conceiving of play as negotiation between the player and the rules of the system reveals a number of compelling directions for research. Richard LeMarchand and Drew

Davidson's chapter, for example, analyzes the design experience to show how developers translate play expectations into play experience. Trina Choontanom and Bonnie Nardi show how theory-crafting communities allow players recreate the mathematics designers use to allocate rewards and punishments in the course of game play. Theory-crafting can be seen as an organized method developed by players to ferret out the designed features that guide game play. Doug Clark and Mario Martinez-Garza call attention to the imperfect nature of the communication between design and play. Designers might intend to spark play (and cognition) in one direction, but play might simply float past intended learning goals. Doug and Mario note that while "players may spend the vast majority of gameplay time interacting with the core ideas as a means of navigating through the world," researchers cannot simply assume that exposure results in interaction with core ideas. Because "making the core ideas and relationships explicit rather than tacit is a much bigger challenge" in game play than in direct instruction, the communication gap present in play-worlds presents a considerable challenge for creating games to teach specific lessons.

The negotiation between design and freedom discloses the spaces in which player-centric social worlds can emerge. These emergent worlds provide rich opportunities for players to engage in knowledge-building activities on at least two levels – first to collaboratively decipher and navigate challenges built into game environments, second to extend game-play into new forms of interaction. Jim Gee and Betty Hayes' interest-based concept of *affinity spaces* describes the hybrid in-game and out-of-game communities players build to support knowledge making and sharing during play. Kurt Squire's discussion of Apolyton U illustrates how players adapt existing education practices to organize interactive on-line learning experiences. The Apolyton community co-opted the university metaphor to provide develop courses, forums, and lessons to create game-play expertise. Yasmin Kafai

and Kylie Peppler describe how embedding game worlds in social spaces can also spark the kinds of social interaction that give rise to advanced technological fluencies among adolescents. Meaningful social knowledge building opens up as members encounter real challenges in game designs that call for collaborative solutions.

Game worlds provide ideal environments to study the interaction of intended and emergent aspects of play. Building a game worlds require designers to explicitly code expectations for interaction into game features. The degree to which players faithfully implement, subvert, ignore, redesign or cheat game features can be reliably described by researchers. Researchers can trace how occasions for emergent social interaction arise directly from flaws or challenges of game design, and can follow how play helps to transform game play through the redesign and modification of salient game features. The digital context of video games affords a remarkable opportunity to track the decision paths players follow. This opportunity to trace the process of learning demonstrates how gaming can extend the practices of education research. The need for traditional education researchers to document the results of interventions can lead to the dismissal of contextual information irrelevant to understanding learning. Because of their ability to trace the paths players follow between intended and actual game play, game researchers can create models to describe how the process of actually unfolds in complex domains.

Learning

The link between intervention and effect also characterizes how games researchers think about learning. Many of the studies presented here investigate how games (can) teach the kinds of knowledge, skills and dispositions we want to result from schooling. Sasha Barab and his colleagues explicitly address the challenges of adapting game technologies to

desired learning goals, such as persuasive writing, in the *Modern Prometheus* game world. Rebecca Black and Stephanie Reich describe the sophisticated literacy practices sparked by children's participation in *Webkinz World*; Bob Coulter and his colleagues explore how learning in augmented reality games can be analyzed in terms of National Research Council dimensions of informal learning. In the out of school context, Colleen Macklin & John Sharp describe how games can spark interest in social issues.

Education research on learning has been dominated by understanding the relation of intervention to outcome creates a gap between the occasion for learning and its measurement that, as David Shaffer notes, puts a premium on the concept of transfer. Learning is what survives the intervention, and the quality of learning is typically measured according to the quantity and duration of survival. What separates games research from traditional intervention research is the careful attention to how the (virtual) world mediates the learning process. Each effort to document learning here shares a common commitment to map the rich experience that takes place in game worlds onto theories and measures of valued learning goals. Each reenacts the core education research commitment to link games (as interventions) with valued learning outcomes. Each uses frameworks such as socio-cognitive theories, communities of practice, new media literacies and informal science frameworks to resist the reduction of in-game experience to the constraints of norm-referenced, standards-based tests. Investigating game worlds as means to learning allows researchers to better understand the contextual influences on learning, and can help designers build more robust environments that lead toward specific learning outcomes. The study of transfer is not simply the ability to leap from one context to another. Rather, the contextual, data-rich nature of games research helps us understand what mediates the ability to extend strategies from one domain to another.

Games help redefine the nature of learning from outcome to process. The studies presented here show how games research help reconceptualize the gap between learning and measurement by tracing the connections of how games can best mediate activity toward existing learning goals, and by exploring the new kinds of learning that unfold in game contexts. In the following sections, I briefly address several of the contextual features raised by our authors that mediate the connection between game play and learning: the relation of identity and learning; the production process as evidence of learning; the conception of gaming as social learning; and games as a model for interactive assessment.

Identity. Game worlds highlight the tight connection between identity and learning. During short-term play, players experiment with virtual selves to navigate through the game world. Long term, players integrate games-based skills into game-related environments, that can translate into possible identities. In one example, Rob LoPiccolo's suggests that games like *Guitar Hero* "clu(e) people, particularly kids, into some of the fundamentals; here are the roles in the band, here's what a bass guitar part is like, and this is what a rhythm guitar part is like." Researchers can investigate whether features of in-game identity persist as out-of-game behaviors. Rob describes how "there are a lot of guitar and drum teachers in this country now that are seeing steady business because people started with *Guitar Hero* or *Rock Band* and then developed a taste for the real thing." Games like *Guitar Hero* can provide opportunities to observe how players gain knowledge and skills by adopting identities in virtual worlds that can transform personal roles in out-of-game contexts.

Production. Games allow researchers to consider learning as a form of *production.* The knowledge and skills learned in games typically have direct implications for successful play. The perceived value of knowledge in a game context can help researchers explore how learning environments lead players to build representations and models to guide play. Tom

Malaby shows how navigation of in-game virtual spaces is itself a form of meaningful production, especially when in-game play involves customization and consultation. Theory-crafting and soft modding provide examples of how production is an expression of knowing in game contexts. Erica Halverson's discussion of participatory media space design (described below) captures how knowing as production can reflect back on issues of design.

   Social learning. Games research demonstrates the *social* aspects of learning. Games research indicates a trajectory of increasing communicative involvement with opportunities for social learning. Jim Gee and Betty Hayes' affinity group model describes how play first sparks a need to know; then increases motivation to seek out knowledge from others, and finally creates motivation to participate in a knowledge-building community. The trajectory from individually guided learning to social interactive learning parallels the evolution of interest in affinity spaces. Games researchers have already traced this trajectory in a number of spaces (in this volume, we can see examples in *Quest Atlantis*, *Apolyton.com*, GlobalKids and the *Sims*) that retain the unique research advantages of allowing for the comparison of intended and actual learning outcomes in game worlds.

   Constance Steinkuehler and Yoonsin Oh, for example, trace the development apprenticeship relationships in massively-multiplayer gaming world. The interactive nature of the game world presses players to develop long-term collaborative teams as a condition for successful play. In game worlds where some players know much more than others, apprenticeship practices emerge as reasonable solutions to learning social practices through which relevant knowledge and skill are acquired. Constance and Yoonsin suggest that MMOGs provide a context in which apprenticeship relations emerge as a social accomplishment rather than an institutional imposition. It may well be that the scarcity of these kinds emergent learning relationships is at the heart of the learning challenge for

contemporary high school students. If access to socially legitimate learning relationships is indeed a critical problem for teens, then games researchers who uncover how games lead players to participate in meaningful social learning can begin to play a role in the necessary work of high school redesign.

Assessment. Finally, games research can point to new forms of *assessment* for learning. Games research can directly address the gap between the occasion and measurement of learning. Dan Schwartz reminds us that "looking at the choices people make in a course of actions devoted to solving problems in a certain area is a much better assessment both of what they know and of how well prepared they are for future learning" (as quoted in Gee & Hayes, this volume). Scholars such as Robert Mislevy and Valerie Shute explore how performance-based assessments can be developed to supplement, or even replace, the contemporary correlation centered assessment model. Games researchers can exploit the degree to which virtual, game-based environments are designed to make contextual information, so often tacit in conventional learning environments, open to direct investigation. Game worlds include logs that record the frequency and duration of play; discussion boards that capture player knowledge-construction and exchange interactions; modding and design tools that trace how players reconstructed play trajectories, and forums that track how audiences receive and rate game play. These forms of data access are simply not available to researchers in conventional learning environments, and can trace a much more comprehensive path of how learners progress.

Access to these kinds of data on learning will continue to lead scholarship toward the grail of using performance-based assessment to measure learning. David Shaffer's epistemic network analysis (ENA), for example, points toward the future of performance-based assessments in virtual environments. ENA demonstrates how the performance of complex

learning tasks in data-rich environments can help researchers use social network analytics to trace growth at different rates across multiple dimensions, and to compare learning to expert and novice models. Developing methods such as ENA will allow games researchers to finally provide scalable measures of learning that are true to the complexity of the contexts and processes of real-life learning.

Design

Game design is where game research has the greatest potential to transform education research. If education is concerned with the design of learning environments, then the game designers who have made the most significant and revolutionary exploration of the technologically-mediated design space should lead the way. I would like to highlight two aspects of design raised by our authors: design *for* learning and design *by* learners. I think that both areas open up rich areas for investigation that will result in new forms of learning environments for all students.

Design for *learning* addresses the principles we can derive (and communicate) for building game-based learning environments. Jim Gee's (2003) outline of principles for video game learning spaces describes the design space in which researchers work. Game designers have developed fully articulated models of scaffolding new users into compelling game worlds; have demonstrated how to adapt player choice into rich narrative environments; and have shown how to integrate just-in-time data into interfaces that guide users in complex tasks. Game designers have also shown how to balance social interaction and task completion so that players are sufficiently motivated to continue play while relying on one another for help. Nathan McKenzie's contribution illustrates the capacity of designers to generate almost limitless variations on genres that exhaust the design affordances of a given

genre and point toward new forms of play. When these games are played, designers deepen

their understanding of how to structure the game environment to motivate better play.

Taking advantage of these powerful precedent designs for virtual learning environments

should help educators create more compelling designs for education.

The researchers in this volume provide several key insights to guide design for

learning. Sasha Barab and colleagues, for example, emphasize that the learning environment

must allow for transactive engagement by the learner with the game learning goals.

Designers must connect "a sense of intentionality with user actions occurring in relation to a

situationally meaningfully goal, legitimacy with academic content becoming conceptual tools

for acting on the world, and consequentiality as user actions have effect on the virtual

world." Doug Clark and Mario Martinez-Garza relate that "gameplay that… remain(s) in the

player's "thumbs" neither pushes players to articulate the components of their thinking …

nor the overarching relationships and connections between the multiple relevant

components relevant to the phenomenon at hand." Design for learning must engage players

on two levels of representation: the play environment and the concepts to be learned.

Studying design for learning also requires researcher to investigate how designs fail to

translate into intended courses of play. Designing game content can lead to interaction that

bypasses the underlying concepts. Doug and Mario note how "few games provide structures

for externalizing and reflecting on these cycles. More often, such articulation and reflection

occurs outside the game, through discussion among players or participation in online

forums." Designers for learning must use the tools of game design, such as gradually

introducing players to game features, or designing challenges that call on players to utilize

certain capabilities, that problematize the game environment in order to create opportunities

for players to reflect on their play. Bob Coulter and his colleagues discuss whether the

opportunities for players to reflect on the relation between play representations and underlying concepts can be elicited within game contexts. "Traditional video game(s)…won't be able to activate a player's web of tacit and explicit local knowledge…While virtual environments are certainly becoming much richer and more realistic, there is still an air of artificiality and ultimately, of simplification. Even the most complex of virtual game spaces is limited to what the designer chose to place in the game, inevitably constraining choices to a set of pre-arranged options." Bob and his colleagues suggest that another plane of interaction, such as an augmented reality plane, a forum for social interaction, or a classroom space, may be necessary to trigger interaction with underlying game concepts.

Design by *learners*. Erica Halverson's discussion of participatory media space design provides an example of how the design for learning research agenda might unfold. Erica's work considers how media arts organizations organize production experiences for interested youth. She proposes three design principles necessary for student learning and for quality production: iterative production cycles of conceptualization, production and distribution; assessment benchmarks embedded throughout the production process; and the arrangement of digital tools to facilitate communication and knowledge exchange. The principles that Erica describes guide design *for* learning also apply to design *by* learners. Successful youth media arts and game development organizations (e.g. GlobalKids, GameTech) understand that learning environments must allow learners to grapple with the hard problems of design. Learning through design is the foundation of the progressive and the constructivist movements in education.

Successful game design introduces learner agency into the virtual world. Rather than passively working through problems and situations established by others, good game design

allows learners to express hypotheses about possible interaction in worlds of their own.

David Sirlin, for example, describes how the compelling game-play of *Virtua Fighter* results

from designer anticipation of the player-controlled fighting moves. Successful game design

anticipates typical and advanced player interactions in ways that reflect the abilities of good

teachers. Inviting players (peers, colleagues, strangers) into created worlds facilitates a new

level of feedback in must players come to anticipate how worlds must look from the

perspective of play.

Seeing the alteration of the game context as a form of design allows us to extend the

concept of player agency. After all, the design of a compelling game world is probably the

most advanced form of design, and the most difficult for many players to undertake. Tom

Malaby reminds us of the small adjustments players make to the world that, as de Certeau

describes, are also forms of production, and thus forms of design. Most acts of design

involve the modification, rather than the recreation, of a world. Design activities span a

continuum from changing the color of your pants when rolling a character, through soft-

modding and theory-crafting, to modding and the manipulation of game development

engines. From an education perspective, each decision players make to modify their

environment represents an idea to be tested in a game environment. Game design by players

provides an entirely new dimension in which we can use the concepts and theories of

hypothesis testing to capture how learning unfolds in the world(s).

Conclusion

What does the world of education research look like from the point of gaming? The

chapters in this volume point toward an exciting new future for researchers interested in

studying education. There is contemporary pressure for games researchers to organize their

work in terms of existing policy-driven research traditions. This may help games researchers satisfy short-term goals of legitimacy (and funding), but it will not address the larger crisis in the education research. The existing practices that dominate education research may successfully measure the outputs of interventions, but they have difficulty showing how learners navigate worlds. If we believe, as a society, that all the answers to our problems of teaching and learning have already been developed, and that improvement is simply a matter of implementing the right interventions, then our current approaches to research are probably sufficient to the task. However, if we believe that the world is changing, that information technologies are transforming teaching and learning, and that the future designs for learning and by learners have yet to be developed, then we will need tools that allow for innovation, exploration and experimentation. Games researchers can lead the way.

The games research presented here presents a genuine opportunity to reframe education research around the kinds of dynamic innovations that are reshaping the nature of teaching and learning in and out of schools. Games allow researchers and players to experiment with new worlds. Studying how players navigate, learn and design these worlds provides unprecedented access to the core psychological and social practices of teaching and learning. Grasping the design principles that govern successful game play may enable education researchers and designers to build environments that result in improved outcomes on the learning goals we currently favor. More likely, games will enable us to envision entirely new ways of organizing and measuring learning. We may be able to create meaningful assessments of, for example, systems learning, and we may be able to measure learning in the solution of some of the chronic environmental and economic issues of our times. Games researchers who continue down the paths described in this volume will lead us in the description of emerging learning environments and the translation of design

principles into new environments. As Sasha Barab and his colleagues note, the policy that led to the No Child Left Behind legislation has "done little to inspire curriculum that helps children see and desire futures that call on disciplinary content knowledge. An important focus of this (games research) work is to fill that gap, both positioning existing content in new learning platforms and expanding our understanding of what it means to be literate. All of this in a manner that creates a vision of the future that can begin today."