Centering Learning Theory in the Design and Study of Social Studies-Themed Simulation Games: A Three-part Study

by

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ABSTRACT

This dissertation takes up the topic of simulations in social studies education. Though simulations are taken up widely by social studies educators, and though they are described as best practice in social studies standards documents and teacher evaluation rubrics, the term lacks specificity. Additionally, design, research, and implementation efforts associated with social studies simulations often lack theoretical grounding and clarity. A major consequence of this lack of conceptual and theoretical clarity is curriculum violence perpetrated upon young people, particularly along racial and socioeconomic lines, as the result of poorly conceived simulations.

This dissertation is presented as three standalone manuscripts, bookended by an Introduction and a Conclusion. In the Introduction, I present an overview of the social studies simulation literature. In Chapter Two, I propose mechanics analysis, a methodological approach to systematically analyzing social studies simulations and games. In Chapter Three, I report on an empirical study using mechanics analysis to analyze three digital social studies-themed simulation games: *Offworld Trading Company, Frostpunk,* and *Surviving Mars.* In Chapter Four, I build on the previous two chapters to coordinate the salient research and theory across three field—history and social studies education, learning sciences, and games scholarship—to propose a design theory for a particular kind of simulation game: disciplinarily integrated, consequentially engaging simulation games, or DICES. Finally, I conclude with Chapter Five, in which I highlight what I view as the implications of this work as a whole, including for teachers, teacher educators, researchers, and designers.

DEDICATION

This work is dedicated to:

Ender Patricia Kessner, my sweet Ender girl. In the dark moments when all this seemed futile, your smiles and laughs kept me moving forward. I could never explain, and could never have imagined, the immense, unfathomable joy you brought to our lives. The pictures of you on the desk where I did so much writing, reading, and thinking kept me grounded. You are the best peanut, of all the peanuts. Daddy loves you.

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INTRODUCTION

Senators Chris Coons (D-DE) and John Cornyn (R-TX) recently introduced a Senate bill intended to update an American history and civics grant program under the Higher Education Act. Earlier this year, Rep. Alcee L. Hastings (D-FL) introduced a House bill amending the Elementary and Secondary Education Act of 1965 to increase the number of civics education programs. These proposed legislative actions, together with a host of additional initiatives, including a Jewish Federation-sponsored bill aimed at renewing commitment to combating antisemitism and several state's ambitions to retool civics standards of learning, represent a renewed—long-overdue—commitment to history and social studies education in the United States. Though the nation's schools were born, many argue, for the explicit purpose of preparing young people to don the mantle of citizenship, history and the social studies have long remained undervalued and under-taught in an era of high-stakes accountability based on standardized multiple-choice tests. This renewed commitment to the nation's history and social studies programs comes at a time of deep division at home and abroad, and like the Cold War-era educational initiatives that confronted the moral panic sowed by the launch of Sputnik and *A Nation at Risk* (1983), it is likely to arrive to the jingle-jangle of a heavy purse.

One likely beneficiary of what are likely to be loose purse strings for everything "innovative" and sufficiently flashy are simulations, an enactivist pedagogical strategy touted by many of the heavy hitters of U.S. history and social studies education. The National Council for the Social Studies (NCSS), for example, supports simulations for their potential to promote powerful and purposeful learning in the social studies; and the

College, Career, and Civic Life (C3) Framework touts simulations as one way to "increase the likelihood of students attaining higher levels of political understanding, commitment, and action" (p. 90). The Campaign for the Civic Mission of Schools (Gould et al., 2012) went so far as to describe simulations as one of six "proven practices" in civic learning.

Yet little has been added to the body of literature on simulations since DeLeon (2008) remarked, "the literature on simulations is practitioner-based and somewhat dated" (p. 258). Indeed, no consensus exists on even the definition of the term, often leaving researchers to talk past each other if not at cross-purposes altogether (Aldrich, 2009; Cory Wright-Maley, 2015a). In fact, the list of terms scholars treat as interchangeable with simulations is dizzying (Crookall, 2010): simulation, simulation game, role-play, role-playing simulation, reenactment, and several more. Furthermore, such a blurry line exists between simulations and a large host of other enactivist strategies that they are often confused with theatrical plays, dramatic reenactments, narrative videogames, choose-your-own-adventure PowerPoints, or even the digital equivalent of watching a line of dominos knock into each other. This lack of definitional clarity makes claims to knowledge about what simulations can do tenuous at best; that scholars all too often neglect to define the term at all makes interpreting what little empirical research exists a challenging task indeed. The work I have undertaken for this dissertation seeks to better understand how games might offer inspiration for the reimagining of social studies learning design in such a way as to emphasize disciplinary integration and consequential engagement with the real world. In particular, this work seeks to leverage the fields of learning sciences and games scholarship to rethink the design of social studies simulations so as to privilege student agency and transfer of that agency and disciplinary skills to better understand the real world, how it works, and how to (re)design it in pursuit of a more just and equitable world.

The rest of this chapter is devoted to providing readers with an introduction to simulation research in social studies education in the interest of laying the groundwork for the three standalone articles that form the body of this dissertation.

Definitions of Simulations

Learning theorists have long contended humans construct knowledge from the experiences they have in the world (Dewey, 1916, 1938; Gee, 2017; Montessori, 1912; Papert, 1980; Tyler, 1949). Nevertheless, "reality is not always the best learning environment" (Aldrich, 2006, p. 49). Real life can be dangerous and is often enough accompanied by equally real, sometimes lasting consequences. Yet it is exactly this quality of real life that makes the experiences we have in the world so powerful. Humans engage in "conversations with the world" (Gee & Gee, 2017), inquiry cycles in which we interact with our environments to form goals, consider and plan actions, predict the potential consequences of those actions, take action, receive and evaluate feedback from our environment, and revise and refine as necessary. This approach worked perfectly well when human beings were confined to small communities of hunter-gathers—the risk of large-scale catastrophe was quite limited. But as human civilization has grown and flourished, the stakes of failing to anticipate the consequences of our actions in a world growing in technological complexity and social interconnectedness have risen too high to leave it up to experimentation. The ever-growing complexity of *homo sapiens'* social and technological environment, then, presents a quandary: how best to leverage the human brain's preference for real-world learning experiences while mitigating the risks inherent in an increasingly high-risk world? One answer crops up over and over again throughout human history: simulate it.

Simulations are designed spaces intended to create synthetic experiences for learners, and many fields include some conception of simulations in their pedagogical and scholarly traditions. Papert (1980, 1987) called them *microworlds*, designed learning environments facilitating low-risk exploration of self-contained and simplified slices of real life in which learners discovered for themselves complex mathematical concepts like zero. *Participatory simulations* extended the microworlds concept to transport students to the molecular level of a virus to discover how they spread, then back up again to become biologists analyzing the datasets hiding the key to halting the infection of humanity (Colella, 2000). Simulations are also used to train state diplomats and NGO negotiators, as well as in business management training (Shaw, 2006). Sociology has used simulations for some time (Dorn, 1989), for example to acquaint participants with how society distributes rewards based on power rather than needs (Dundes & Harlow, 2005). Simulations are additionally used in international relations, comparative politics, international law, ethnic conflict, Middle East studies, national security, and international political economy (Stover, 2007). Despite the seeming ubiquity of simulations, their form and function are as diverse as the wide array of fields that employ them, which makes defining them difficult. Nevertheless, as a starting point, simulations can be lumped more or less neatly into two categories of purpose: research and pedagogy.

By research, I mean leveraging simulations as a means of testing the interaction of purposively selected variables within an intentionally constructed model in order to generate knowledge about the real world. Here an important distinction must be drawn between models and simulations. Models operate under a defined input-output framework. For example, a physicist might input the shape, mass, vector, and velocity of a space shuttle into a model of the solar system, hit play, and see how long the shuttle takes to reach Mars. The physicist, based on the feedback she interprets from the model's output, could then alter variables of her choosing in pursuit of different outcomes. Similar to simulations, models like the one described above offer opportunities to test the robustness and consistency of theories in a minimal-risk setting and do so again and again. Also like simulations, models make dangerous, cost-prohibitive, or otherwise impossible experimentation possible.

What sets simulations apart from models is their inclusion of human variables. Winham (2002) noted that simulations are an effort to "distill some aspect of [behavior] into a model that could serve a function for the social scientist equivalent [to that which] laboratory testing serves for the physical scientist" (p. 466). In this sense, simulations used for social science research seek to serve a predictive function: What happens when human agents interact with models? Social psychologists and economists often leverage laboratory gaming, which in the research sense, are essentially tightly bound simulations used to bridge abstract theory and operational analysis (Winham, 2002). Simulations, on the other hand, attempt to present a more complete picture and typically do so by including more of the variables relevant to the human decision makers included as variables. In short, research-focused simulations create knowledge about human behavior as both independent and dependent variables within purposively designed configurations of variables.

The second broad category of function into which simulations fall is that of the pedagogical. Nevertheless, further classification of the pedagogical aims of simulations are warranted, as they can be used didactically or for discovery. Didactic simulations prepare learners to respond to more-or-less predictable variables in more-or-less predictable situations. A flight simulator is a good example: novice pilots learn how to take off under clear skies, what to do differently in rainy conditions, how to respond when a gust of wind hits the tail from the port side, and so on. Each response is like a tool in the pilots' toolbox, and the flight simulator provides a low-risk environment in which to repeatedly practice using the different tools, recognizing when to use them, and doing each with ever-improving alacrity and wisdom. A more complex example is the training simulations used to prepare international negotiators. The social complexity of such simulations is increased by the inclusion of multiple human roles, each bringing with it a complex human mind, opaque goals and desires, and the unpredictable interaction thereof. Nevertheless, as with the flight simulator, the purpose of such training simulations is to provide a set of tools and an arena in which to practice without the risk of blowing up a real, high-stakes international disarmament deal.

Simulations are also used to facilitate experiential, discovery-based learning. At issue in these simulations is that learners develop, through experiential discovery, an understanding of some predetermined concept or perspective. The idea here is that, by living the concept or perspective, learners come to deeply understand the learning goals at hand. Such simulations have been used in political science since the 1960s (e.g., Guetzkow, 1959), and they have remained popular, in particular, for supporting student learning about different political perspectives (e.g., Baranowsky, 2006; Lo & Parker, 2016). Wright-Maley and Joshi (2016) designed a simulation of OPEC around the concept of cartels and competition. Parker et al. (2011) designed their simulations to help students understand more deeply the variety of perspectives and objectives at competition at the Constitutional Convention and throughout the history of the United States government.

Generally speaking, however, simulations as discussed here thus far have one important theme in common: they deal with what *is*. Research-centric simulations seek to uncover what *is* by affording an analytically observable, co-created operationalization of theory—to instantiate theory into an observable world so it can be analyzed. Pedagogy-centric simulations also seek, either through explicit training-and-practice regimens or through designed experiences, to make otherwise hard-to-see truths observable to learners.

Semantic Confusion

Though the topic of simulations received much attention between 1970 and 2008, with between 25 and 30 articles published each year on average, Bragge and colleagues' (2010) profile of simulation research during that time did not include history or social studies education as a top area of research. Despite the apparent dearth of simulation studies in these areas, the NCSS (2016) references simulations as a pedagogical strategy that supports powerful and purposeful social studies, and the *C3 Framework* names simulations as one way to "increase the likelihood of students attaining higher levels of political understanding, commitment, and action" (p. 90). The Campaign for the Civic Mission of the Schools also praised simulations, naming them one of just six "proven practices" in civic learning (Gould et al., 2012; Parker et al., 2016). Not one of these documents defined what, exactly, simulations are.

This semantic confusion has persisted in simulation scholarship for some time. Crookall (2010), in an 40th anniversary-edition editorial of *Simulation & Gaming*, noted that the "field of simulation/gaming is, to be sure, rather fuzzy, and sits uneasily in many areas" (p. 898). This point is (perhaps unintentionally) emphasized on the next page when he writes that he himself sometimes used "other terms, such as gaming, simulation, experiential learning, or exercise" (p. 899); he went on the identify a host of additional terms: serious game, computer simulation, computerized simulation, modeling, agent-based modeling, virtual reality, virtual world, game theory, role-play, case study, and debriefing. This semantic confusion is no better in the field of social studies (Wright-Maley, 2015a).

In secondary history and social studies the topic of simulations suffers from what Aldrich (2009) called the "Babel problem" (p. xxxii), and perhaps as a result, recent research in the field is limited (DiCamillo & Gradwell, 2012). Defining simulations for history and social studies education is difficult for multiple reasons. As Wright-Maley (2015a) noted, the term is used without precision in existing scholarship. Indeed, the majority of the works referenced herein neglect to define the term at all, operationally or otherwise, making it difficult even to identify where to look for research on simulations. Perhaps this is due to assumptions regarding a shared understanding of simulations. Parker and Lo (2016), for example, though neglecting to provide an operational definition, noted in their design-based implementation research study on simulations:

"the territory will not be unfamiliar to most readers; political simulations, especially, are a longstanding feature of government courses" (p. 9).

Yet Dack and colleagues (2016) noted simulations are often lumped in with a variety of related phenomena under the umbrella term, "experiential instructional techniques." Furthermore, simulations seems to be an umbrella term itself, encompassing a long list of similar terms that muddies the field: role-play (Stephens, Feinberg, & Zack, 2013), role-playing simulations, educational simulation (Aldrich, 2009), political simulation (W. C. Parker & Lo, 2016b), simulation exercise (Rantala et al., 2016), simulation games (Williams & Williams, 2007), historical simulation games (McCall, 2011), digital historical simulation games (McCall, 2012). Every decade or so, however, one or more scholars attempted to define the term with more precision. For Wright-Maley (2015a), who has done the most work recently to construct a clear and common definition for the field, social studies simulations (a) reflect reality in a structured and limited way, (b) illustrate significant dynamic events, processes, or phenomena, (c) incorporate learners in active roles through which the phenomena are revealed, and (d) are pedagogically mediated (p. 67).

Differentiating Simulations from Related Phenomena

Differentiating simulations from related phenomena has proven at least as challenging as defining simulations themselves. Setting aside the haphazard and imprecise use of terms like simulation, role-play, game, and the like, simulations are difficult to differentiate from these pedagogical tools precisely because they share important characteristics. Wright-Maley (2015a) identified three phenomena that are similar to and often confused with simulations: games, role-plays, and models. In addition to considering each of these phenomena, I also take up discussion of other related phenomena that might be confused with simulations: reacting to the past games (Carnes, 2014), reenactments (Turner, 1985), and thought experiments (e.g., Rosales & Journell, 2012; Wentworth & Schug, 1993).

Games. Games and simulations are perhaps the most difficult to differentiate, with Crookall (2010) noting a clear delineation had yet to be made. In their page-long section dedicated to simulations as a proven practice of democratic education, Gould et al. (2012) used some variation of the word *game* eight times—only four fewer times than the word *simulation*. Lo (2015) cited Squire and Barab's (2004; Squire, 2011) work with the popular commercial videogame, *Civilization III*, as an example of the history-centric bent of simulation research in social studies. Indeed, some scholars question whether games and simulations are conceptually distinct from each other at all (Tobias & Fletcher, 2012).

Wright-Maley (2015a) noted games and simulations remain difficult to separate due to their sharing many important qualities, but he nonetheless pointed to three important differences. First, games revolve around quantifiable outcomes; simulations, due to their dynamic nature, possess no delineated outcomes. Second, games provide players with goals; while simulations may provide players with goals, this is not the primary feature or function. Third, he contends games emphasize entertainment over realism, while verisimilitude remains the chief purpose of simulations. It is important to note Wright-Maley suggested these differences only half-heartedly; he contended the argument over whether games and simulations are substantively different (Young et al., 2012) or whether games are a subset of simulations (Tobias & Fletcher, 2012) persists as a function of focusing too much on form at the expense of function. In this view, a game used as a pedagogical tool to highlight real-world events, phenomena, and processes should be considered a simulation as much as any other.

Nevertheless, I contend this line of thinking leaves important conversations on the table and contributes to the lack of clarity in the field in important ways. First, it perpetuates confusion in the scholarly field regarding what constitutes a simulation, which muddies the waters of research by upholding imprecise definitions. Without a common understanding of what counts as a simulation—which includes clearly demarcating the tool from other similar tools—the field will continue to suffer from the "Babel problem" (Aldrich, 2009; Cory Wright-Maley, 2015a). As alluded to above, the Babel problem turned out to be the preeminent challenge facing the present study: though many scholars use the term, a lack of clarity concerning what each study's authors meant by simulations posed serious problems to efforts to reconstruct what might constitute the key attributes of simulations.

Definitions bear much more than just semantic weight, and they attend to (or create) challenges much more serious than definitional clarity. Definitions define form, and form in large part determines function. A version of this line of logic works in the opposite direction, as well, as when the desired function of a tool determines the adaptations we make to its use, which might be considered its *de facto* form; that is, how a designed object is actually used in the world to achieve some purpose. But form nonetheless carries with it some affordances and not others; a chair can be used for sitting, for standing, for musical chairs, or for building forts—but it probably should not be used as a drinking glass. Similarly, simulations and games, which by virtue of possessing different names and inspiring different scholarly arguments (e.g., Tobias & Fletcher, 2012; Young et al., 2012), possess different structures. As such, a closer look should be given to proposed differences, a task to which I now attend, using the three differences Wright-Maley suggested.

Outcomes. An important point regarding outcomes in games must begin with addressing the differences between two fundamentally different ways of looking at games for learning: gamification and gameful design. Though the terms have been used with a level of imprecision rivaling that of simulations, gamification generally refers to the laying of game-like structures *on top of* instruction-as-usual. Gamification leverages behaviorist assumptions about learning by bringing the bells and whistles of games to teaching and learning. In practical terms, this often looks like points, competition, and leaderboards built around trivia games and content-based surprise challenges to make drill-and-practice, rote memorization more tolerable. Jenkins, Squire, and Tan (2004) illustrated this concept with the spinach sundae: topping unpalatable learning activities with the flash and fun of something people like. Of this strategy, Jenkins and colleagues noted, “the results are not very good for you and not particularly tasty” (p. 244).

Gameful design, on the other hand, is what Gee (Gee, 2003) was getting at in his seminal work on games. In gameful design, rather than simply laying the glitz and glamour of games on top of the same old learning activities, Gee suggested looking at games’ deep structure to think more deeply about how to design schools and the teaching and learning that takes place within them. When speaking of outcomes, Gee (2003, 2005, 2013) referred to the clarity of goals partnered with clear feedback regarding players’ progress towards them, which necessarily includes clear indicators of having accomplished those goals. Furthermore, though Salen & Zimmerman (2003, 2005) include quantifiable goals in their definition of games, like Gee they did not necessarily mean points and leaderboards. They referred instead to games' inclusion of clear win states. Thus, win states might be a more appropriate criterion by which to differentiate games and simulations.

Goals and Challenges. Though noting many simulations do indeed contain goals and challenges, Wright-Maley (2015a) contended games provide goals and challenges to players, whereas simulations do not by necessity do so. Here, we confront a theoretical inconsistency concerning what it is that makes simulations valuable teaching and learning tools: experience. Humans do indeed learn from experience, but not all experiences are created equal; in other words, some experiences are better for learning than others. Gee (2017) contended +*experiences* make the best learning experiences (Lave & Wenger, 1991; Vygotsky, 1978). +*Experiences* are experiences in which learners (a) have actions to take, (b) care about the consequences of those actions, and (c) are guided by more-knowledgeable others who help learners manage their attentional economies. Next, I take each of these points in turn.

First, take-able actions do not make sense without goals, and goals do not make sense without the broader ecology in which they are considered, pursued, and achieved (or not) (Barab & Roth, 2006; Gibson, 1979). A simulation may perhaps not be designed with specific goals, per se, but the learners still have goals. Otherwise, learners would lack altogether any context within which to frame their actions. This would make the experience a poor one in terms of learning, because human beings make sense of the world and their experiences vis a vis the actions they can take within them (Bergen, 2012;

Glenberg, 1997; Lave & Wenger, 1991). Second, actions without goals lack meaningful consequences relative to a sense-making framework. Without goals to achieve or challenges to overcome, learners have no reason to care—at least not for long—about the consequences of their actions. Third, guidance requires one be guided toward something—a goal. Without a goal, guides lack the enabling constraints cueing them to how they should manage learners' attentional economies. Simulations without goals, then, would seem to lack validity as learning experiences. It is interesting to consider, however, where goals in simulations come from if they are not designed into the simulation.

Purpose. Finally, Wright-Maley (2015a) contended game designs facilitate entertainment, while the primary function of simulations remains reflecting real-world events, phenomena, and processes. This belies an assumption regarding games that sells far short both their form and function. Games designed for commercial consumption, such as the *Sid Meier's Civilization* and *Call of Duty* franchises certainly intend to entertain. And, true to Wright-Maley's suggestion that pedagogical function be weighted more heavily than form when it comes to demarcating games and simulations, each could be used as ecological objects within a broader learning ecology (e.g., Kessner, 2018; Kessner & Harris, 2021). Nevertheless, this assumption that games facilitate entertainment fails to take into consideration so-called serious games, the primary purpose of which is to educate and support informed action (Aldrich, 2009). The point here is to refrain from sliding into what I argue is too simplistic a differentiation between games and simulations. Yes, Wright-Maley conceded games used to reflect a real-world event, process, or phenomena for teaching and learning purposes count as much as a simulation as another. Nevertheless, this hedging still leaves researchers with a poor understanding of any potentially important differences that may exist between simulations, games-as-simulations, and games that are not and never were simulations.

Role-plays. Role-plays are a second phenomenon to which simulations are often compared, and Wright-Maley highlighted what he saw as the important differences between them. First, role-plays often operate under "as-if" framings; that is, "Act as if you are…" In contrast, simulations require no such roles. Second, role-plays operate on a spectrum between passive and active role playing. For example, students might be given scripts from which to read (passive), thereby heavily constraining the actions they can take as an historical figure. Or, students could be given a list of characteristics that serve as enabling constraints on the actions they take (active). Conversely, simulations require that students take on active roles that facilitate and support the underlying mechanisms of the simulation. Third, and related to pedagogical function, role-plays are used primarily to facilitate perspective recognition, while simulations' primary focus remains representing dynamic systems and processes.

Similar to the previous discussion of games as/with/for learning (Duncan, 2016), the contention that simulations do not include roles creates a tension that requires investigation. If, as many have argued, one defining characteristic of simulations is participant agency (e.g., Colella, 2000; Wright-Maley, 2015a), it becomes difficult to imagine the exclusion of roles, particularly when it comes to historical events, processes, and phenomena. In terms of explicit role-taking, in which participants "become" a particular historical or contemporary actor, the case is quite straightforward. The case of implicit roles, however, becomes less clear. Roles do not include simply particular actors, but can instead include *kinds* of people; essentially, I contend roles in simulations are always present but operate on a continuum. On the one hand, implicit roles can be made more explicit by providing participants with a list of characteristics that guide their intra-simulation behavior as, say, a robber baron- or union organizer-type of actor. On the other hand, students might be left to construct their own implicit roles as, say, the kind of person who either wants to maximize profits while minimizing costs or who wants to fight for "good" in a David-and-Goliath contest over the distribution of social goods (Gee, 2018). Roles serve a function similar to that of goals discussed above, in that roles and goals bootstrap one another. An explicit role in a simulation may dictate in some part the goals taken up by participants, while the goals that organize learning experiences facilitate the formation of roles taken up by participants or even co-constructed by participants and the mediating elements of the simulation environment.

Models. Models are static representations of real-world phenomena. Blaga (1978), Clegg (1991), and McCall (2011) all refer to simulations as models of real-world phenomena. The confusion is understandable, as models are always at work within simulations (Wright-Maley, 2015a). Nevertheless, and as discussed briefly above, models run on input variables that do not include unpredictable human agents. They certainly could, as is often done in economic modeling, include variables of anticipated human behavior, but these behaviors are included as more-or-less static variables operationalized in the model as algorithms. Models are intended to show the outcomes of interacting variables given certain assumptions in the model. Simulations, on the other hand, involve actual human decision makers.

Reacting to the Past Games, Reenactments, and Thought Experiments. Reacting to the past games, reenactments, and thought experiments are also not simulations, but they are much easier to differentiate than the phenomena outlined above. Reacting to the past games, as discussed by Carnes (2014), are semester-long activities in which students take on the roles of historical actors and subsequently participate in debates and discussions. In essence, students in reacting games are given particular historical roles, and they must research the perspective of their assigned actor in order to accurately represent their views during class activities. Carnes (2014) found students highly engaged, but the lack of flexibility in how one carries out their role necessarily constrains students' choices to the point of removing the dynamism simulations are intended to facilitate.

Reenactments, as discussed by Turner (1985), place participants in the shoes of historical actors to "develop empathetic comprehension, the feel of 'being there,' for audiences of participants who are totally immersed in the flow of events" (p. 220). Unlike in simulations or dramatizations of historical events such as film or videogames, reenactment "follows the time and space of the movements as they actually occurred in history" (p. 220). Reenactments, then, privilege verisimilitude to the extreme at the expense of dynamic decision making on the part of participants. As discussed above, the very theoretical assumptions regarding learning from experience undercut this form of experience for learning: without the opportunity to take action, learners are unlikely to learn much from the experience.

Thought experiments are an opportunity to think through how one might behave within particular scenarios. Rosales and Journell (2012) provide a good example of a thought experiment in economics. They present the scenario of a coffee shop in Urbana, Illinois, the Daily Grind. The Daily Grind offered customers their first cup of coffee at $1.50, but they offered each additional cup at only $0.50. The authors suggest scenarios like these offer students an opportunity to explore economic principles by thinking through different possibilities for why the Daily Grind might operate in such way; for example, developing naive supply- and demand-side theories like marginal cost and wavering demand. These naive theories could then be built upon with formal instruction. Like simulations, thought experiments offer an interesting object of inquiry—the scenario—within a low-risk environment. Lacking from thought experiments, however, are consequences, or in other words, feedback from the environment.

Why, When, and How Simulations Are Used

Simulations are used in a variety of ways for a diverse array of purposes. Generally, these purposes can be categorized into two broad groups, content acquisition and disciplinary thinking, with a third range of purposes belonging loosely to what I will categorize as preparation for future learning (Bransford & Schwartz, 1999).

Content Acquisition

Content acquisition is, generally speaking, a poor goal for simulations (Wright-Maley, 2019). Indeed, due to the way simulations necessary constrain the scope of events, processes, and phenomena they are intended to simulate, they are likely even poor vehicles for content transmission. Nevertheless, that students tend to remember the simulations in which they take part is often cited as a reason to implement them. It also worth noting that, while content acquisition and retention are poor *goals* for simulations, this is not to say that simulations that result in increased retention of content are necessarily poor themselves. Schweber (2003) noted one student she interviewed months later was still furious at what he perceived as an injustice that occurred during the simulation. He "fumed to [her] about the character of his mother," one of his "cherished ones" who perished in the simulation (p. 159). One of the teachers from DiCamillo and Gradwell's (2012) study reported students remembered case details from their trial simulation.

The use of simulations remains well-regarded in political science for learning about government and civic processes. Baranowski (2006) used a single-session simulation of the Congressional legislative process to highlight the means by which party majority leaders could prevent minority party members from contributing substantively to the process, non-germane amendments could be added to legislation to help or hinder passage, and the like. Parker and colleagues (e.g., Parker et al., 2011; Lo & Parker, 2016; Parker & Lo, 2016), in their seven-year DBIR intervention into AP civics classrooms, used simulations to highlight the processes by which a new government for the United States was formed amidst competing perspectives during the Constitutional Convention. Wright-Maley and Joshi (2018) also focused on processes in the form of how cartels operate in the context of OPEC.

Disciplinary Thinking

Many scholars have attempted to use simulations to facilitate and support the development of disciplinary thinking process, namely historical thinking, historical empathy, and economic reasoning. Pellegrino et al. (2012) designed a simulation around the 1919 Paris Peace Conference following World War I. In it, they sought to "foster historical thinking and empathy by calling on students to engage in the act of deliberation as experienced by contemporary actors of a particular negotiating body" (p. 146). Chapman and Woodcock (2006) also sought to facilitate students' development of historical thinking, though they focused more on cause and effect in the context of a counterfactual simulation built around the decisions faced by the Abyssinian crisis. Rosales and Journell (2012) and Wentworth and Shug (1993), meanwhile, turned their attention to simulations and related phenomena for their potential to support students' development of disciplinary thinking in economics.

Some scholars have advocated leveraging simulations to promote historical empathy. Yet true to the division in the field over the term, the authors included in this literature review fell into two opposing camps: historical empathy as perspective recognition, and historical empathy as caring (Barton & Levstik, 2004). The former reflects the original conception of historical empathy as the ability to contextualize the past and the actions of its historical actors (Wineburg, 2001; Wineburg, 1991a, 1991b). Such a conception of historical empathy seeks to prepare students to successfully reconstruct "other people's beliefs, values, goals, and attendant feelings" (Ashby & Lee, 1987, pp. 62-63). Rantala et al. (2016) suggested the rules and conventions of simulations of this sort are easy to adopt in theory, but that a risk lurks behind them: "If a participant cannot push aside his or her modern attitudes, historical empathy changes into fairy tale imagination" (p. 5). Cunningham (1984) found students had a difficult time pushing aside their presentist beliefs, more often taking on the role of moral judge and jury rather than seeking to truly "understand the past on its own terms, as in to judge historical actors and their actions within the contexts of the lives they lived" (VanSledright, 2011, p. 51).

Others suggested simulations might support students' ability to empathize with historical actors in the affective sense of the word. Bachen et al. (2012) noted that the ability to take the perspectives and consider the emotions of others is increasingly viewed as an essential underpinning of global citizenship. Consequently, their digital simulation, REAL LIVES, situated students as people from different countries, both male and female, who then had to respond to a number of scenarios. In these scenarios, students made decisions with a mind to their character's educational attainment, finances, and social standing in their home country. Stover (2007) sought to develop university students' sense of emotional empathy towards decision makers during the Cuban Missile Crisis, and DiCamillo and Gradwell (2013) defended simulations when used to develop empathy for historical actors.

Preparation for Future Learning

Students' domain-specific interest and motivation have remained stalwart rationale for implementing simulations. Pace et al. (1990) cited the motivational affordances of simulations as their rationale for implementing their Cuban Missile Crisis simulation with volunteer secondary students. Rosales and Journell (2012) argued simulations and similar phenomena made economics more interesting to students than did lecture typical of secondary economics classrooms, and Sanchez (2006) noted simulations can "enhance students' involvement beyond their mere discussion or reading" (p. 62).

Gehlbach et al. (2008) conducted the most rigorous study of student interest and motivation during simulations in their study of *GlobalEd*. The authors posited the simulation would raise student interest in social studies and motivate them to pursue ongoing learning in the subject area. Though recognizing the potential value of interest in its own right, the authors conceptualized interest as a key component of motivation more broadly and investigated four hypotheses developed from four theories of motivation. Each hypothesis used student interest in social studies as the dependent variable. First, the authors used Hidi and Renninger's (2006) four-phase model, in which interest moves from being externally to internally supported as knowledge increases, to hypothesize growth in knowledge would correlate with increased interest in social studies. Second, they used Eccles-Parsons et al.'s (1983) expectancy-value theory, which posits students value tasks based on their perception of the task's intrinsic value, attainment value, utility value, and cost, noting people are particularly attuned to self-relevant information (Symons & Johnson, 1997). Based on this, the authors hypothesized students would come to see, through the simulation, how valuable the social studies field is to navigating real-world problems, leading to an increase in their perception of the importance of social studies correlated with a rise in interest in social studies. Third, the authors hypothesized, based on Ford's (1992) principle of optimal challenge, that students would come to regard social studies as a more difficult subject area than previously thought; in this case, an increase in interest would correspond to a decrease in self-reported self-efficacy in social studies. Fourth, the authors posited the simulation would provide students increased opportunities to engage in social perspective taking (Pace et al., 1990), and as such, their interest in social studies would increase.

Gehlbach et al. (2008) found no evidence supporting the first two hypotheses, while they found a significant inverse relationship between self-efficacy and interest in social studies, and a positive relationship between students' social perspective taking and interest in social studies. The authors in fact found students in all five specialized topic areas lost interest in their subject areas, and on this basis, the authors concluded increased knowledge did not lead to increased interest, as theorized by Hidi and Renninger (2006). Nevertheless, Gehlbach et al. (2008) neglected to measure—or at least neglected to report—students' knowledge before and after the simulation, which represents a missing link in the logic of their conclusion: without proving students' knowledge indeed increased, one cannot conclude increased knowledge did not lead to increased interest.

The authors' second hypothesis, that students would develop greater interest in social studies if they came to see the utility of the tasks presented during the simulation, also failed to be confirmed. Yet the measurements used to test this hypothesis, a four-point Likert scale comparing students' perceived importance of social studies *relative to other school subjects*, fail to present open-and-shut evidence sufficient to reject this hypothesis. It is possible additional and alternative units of measurement may have told a different story.

Who Uses and Has Access to Simulations?

The literature is sparse concerning who uses and has access to simulations. The research that does exist, however, suggests simulations tend to be reserved for more privileged populations of students. In a study of 2,366 California seniors, Kahne and Middaugh (2008) found students who reported prior exposure to simulations tended to be white and planned to attend a four-year post-secondary institution. Students who planned to attend two-year colleges, two-year vocational schools, or who had no post-secondary education plans each reported successively lower exposure to simulations. In a follow-up study of 371 California students, Kahne and Middaugh (2008) found 80% of AP students reported having been exposed to simulations, while only 38% of students enrolled in College Prep government courses reported the same. This disparity could perhaps be explained by the chronological placement of the AP civics test relative to the typical school year: because AP students take the test with several week remaining in the school year, AP teachers may feel more comfortable including simulations in their curriculum in an accountability era that stresses breadth of content at the expense of depth (Girard et al., 2021).

Stephens et al.'s (2013) work represents the largest, most thorough—and one of the only—investigations into what kinds of teachers engage their students in simulations since Blaga's (1978) dissertation. Over 10,000 teachers responded to a larger survey of over 12,000 teachers from 35 states conducted by Passe and Fitchett (2013). The authors reported that teachers who emphasize "critical citizenship values in their social studies instruction" (p. 258) were more likely to report using simulations in their classrooms. Nevertheless, the specific question they asked teachers, and on which this finding rests, presents a major complication. Regarding specifically the use of simulations, the survey asked teachers, "During social studies instruction, how often do your students engage in the following: participate in role playing/simulations?" This question is problematic for several reasons, but the most serious is that it falls victim to the definitional problem discussed in length above. The question assumes that (a) respondents share a common understanding of what constitutes a simulation, (b) this understanding is the same as that of the researchers, and (c) readers share this same common understanding.

Putting a Definitional Stake in the Ground

While I do not seek necessarily to vie for definitional ground in this dissertation, I nevertheless seek to make clear the terms I use. Given the issues I identified above with the term "simulation," I will use a different term: simulation game. Thus, I have chosen to combine two related terms, simulation and game. My goal here is to leverage the strengths and affordances of each term to buttress the points at which each is weak as they relate to my goals in this dissertation. For example, a major strength of games scholarship is its definitional clarity. Suits (1978, 1984) defined a game simply as "the voluntary attempt to overcome unnecessary obstacles" (1984, p. 8). Golf offers a good example. In golf, the goal is to put the ball in the hole. While the most efficient means of doing this would be to carry the ball to the hole and place it in the hole, this is probably not fun. By adding an unnecessary obstacle—the requirement that players use a long metal stick to hit the ball into the hole—golf becomes a game when players voluntarily elect to proceed in such a way. Salen and Zimmerman (2004), drawing on Huizinga (1938), offered this definition: "a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome" (p. 80). In short, games are artificial conflicts in which players engage voluntarily to pursue goals. Players' pursuit of these goals is mediated by rules, or what players cannot do (Sicart, 2008), and their opposite, game mechanics, or what players are able to do (Johnson, 2011). Finally, games give feedback to players that make sense in relation to clear outcomes based on players' fluency with the systems of meaning that operate within game (Gee, 2003; Salen & Zimmerman, 2005). I will delve more deeply into each of these concepts throughout the following chapters, but for now, this definitional work helps outline some of the affordances for clarity on which I seek to draw. I also want to clarify that I include analog—that is, non-digital—games here.

Games are also much more commonly understood as activity systems than are simulations. By activity system, I mean the socially and materially mediated systems within which learning experiences take place (Greeno & Engeström, 2008). Thus, there exists a more substantive literature viewing games through activity theory and related theoretical perspectives. By activity theory and related theoretical perspectives, I mean viewing learning experiences in terms of goals, actions, and environmental affordances of the (learning environment) (e.g., Gee, 2003, 2017; Gibson, 1979; Glenberg, 1997; Lave & Wenger, 1991; Vygotsky, 1978). Thus, I seek to draw on perspectives on games from games scholarship to—in my view—more fruitfully frame simulations in terms of how participants engage with them to learn to know, do, and be in the world.

There are elements of simulations, however, that I wish to retain. Most notably, simulations are designed to be true-to-life to some extent, which Wright-Maley (2015a) referred to as a simulation's verisimilitude. Thus, simulations are perhaps more readily positioned as teaching and learning tools, particularly within the context of social studies education, and even more particularly in the context of formal educational settings.

Nevertheless, some literature already exists on simulation games. McCall (2011, 2012), for example, drew on Salen and Zimmerman's (2004) definition of game to define simulation games as games built on an underlying model that simulates something in the real world. This definition served McCall well in identifying games like *Civilization* and discussing their educational affordances, but the work that follows requires a deeper consideration of how games work as systems and the implications thereof for simulation (game)s. I take up this work in greater depth in the articles that follow.

Theoretical Perspective

In the work that follows, I apply a sociocognitive lens to my consideration of simulation games. By this I mean that I draw from the cognitive sciences as well as from sociocultural theory, which in recent years have been shown to have much more in common than traditionally thought (Gee, 2015b). I apply this sociocognitive lens to simulation games for the following reasons. First, there is a steady tradition in games scholarship of viewing games through theoretical lenses both cognitive (e.g., Nelson, 2007; Nelson et al., 2011) as well as sociocultural (e.g., Barab et al., 2019; Gresalfi et al., 2009). As it is my intention to draw on games scholarship for its clarity relative to social studies simulation research, adopting these perspectives is warranted. Second, education scholars and philosophers commonly accept that humans learn through experiences they have in the world, and that doing and knowing are inseparable in the learning process (e.g., Dewey, 1938; Gee, 2017; Lave & Wenger, 1991). These experiences, in which learners have actions to take, the selection of which is mediated by one's abilities, goals, and the affordances of the ecological objects present within the environment (Barab & Roth, 2006; Gibson, 1979), in fact look very much like conversations (Gee, 2015a; Gee & Gee, 2017). Because conversations are both cognitively and socially mediated (Bergen, 2012; Bruner, 1983; Gee, 2015b, 2020), adopting a sociocognitive perspective allows me to take both the social and cognitive mediation of players' interactions with and actions taken within game into account.

Previewing the Dissertation

The remainder of this dissertation is presented as three stand-alone scholarly articles, followed by a concluding chapter. In Chapter 2, I present the first article, “Mechanics Analysis: An Approach to the Systematic Analysis of Opportunities to Practice in Videogames.” This article proposes *mechanics analysis* (MA), a method of qualitative inquiry useful for examining videogames through an *opportunities to practice* lens. Opportunities to practice (OTPs) are in-game moments in which players are invited and required by the game to practice some approximation of a professional discourse (e.g., history, economic, civics, geography). Specifically, OTPs are generated as a result of a game’s *mechanics*, or the means by which players take actions in games. MA draws on an array of established methodological approaches, including discourse analysis, content analysis, interaction analysis, and (auto)ethnography to offer a qualitative compliment to existing quantitative approaches to examining learning in videogames.

In Chapter 3, I employ MA to examine OTPs in three social studies-themed digital simulation games: *Offworld Trading Company, Frostpunk,* and *Surviving Mars*. I first identified the disciplinary knowledge, skills, and concepts (DKSCs) implied within the *C3 Framework*. I generated the data for this study through 43 hours of gameplay, which I screencaptured using Windows GameBar. I then used open coding to identify OTPs using the social studies DKSCs implicated in the *C3 Framework*. I then used the discourse analysis part of MA to identify the approximations of professional discourse implicated in the data.

Finally, in Chapter 4, I propose a (design) theory of simulations, particular but not limited to social studies education. I argue a need for firmer grounding of social studies simulations in learning theory, and thus outline a framework for simulations grounded in sociocognitive perspectives on learning through experience.

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CHAPTER 2

MECHANICS ANALYSIS: AN APPROACH TO THE SYSTEMATIC ANALYSIS OF OPPORTUNITIES TO PRACTICE IN SIMULATION GAMES

Prior to the COVID-19 pandemic, scholars had already highlighted the potential benefits of games-based and games-inspired teaching and learning (e.g., Gee, 2003; Hayward & Fishman, 2020; Shaffer, 2006; Squire, 2011). When many schools moved instruction online, however, even more teachers assigned games for learning purposes (Favis, 2020). Some parents, newly appointed teachers of their children, may increasingly turn to videogames, as well.

Though games are widely accepted as effective learning environments in and of themselves (e.g., Gee, 2003; Hayward & Fishman, 2020; Ryan et al., 2006), leveraging them for educational purposes has had mixed results, with many scholars noting educational games often fail to embody the lofty disciplinary learning goals they are designed to facilitate (e.g., Jenkins et al., 2004; Gee, 2011; Stoddard et al., 2016). Thus, some contend games should be used as objects-to-think-with as part of broader teaching and learning ecologies (Holbert & Wilensky, 2019; Squire, 2011). Yet this approach increases demands on teachers' and institutions' cognitive and material resources (Jan et al., 2015). Thus, rather than leveling the playing field by providing high-quality constructivist digital learning environments, using videogames in classrooms may in fact widen existing educational inequity along racial and socioeconomic lines by amplifying existing techno-structural disparities (Toyama, 2015).

One way for education researchers to accept greater educational responsibility, therefore, is to conceptualize ways to support the development and selection of educational games that support ambitious teaching and learning goals without adding undo demands on teachers, schools, and districts. This need is particularly relevant to leveraging games to develop students' capacity for using disciplinary knowledge, skills, and concepts (DKSCs) as tools to take informed action in the world, a core mission of public schooling (e.g., Banks, 2006; Dewey, 1916).

Because knowing and doing are inseparable in the learning process (Wenger, 1999), and doing in games is facilitated through game mechanics (Johnson, 2011)—the means by which players take goal-mediated in-game actions—a crucial step in improving games as teaching and learning tools is to have on hand methodologically defensible approaches to systematically analyzing how game mechanics facilitate learning. Thus, the aims of this paper are twofold:

1. Propose *mechanics analysis* (MA), a novel method for analyzing how game mechanics create opportunities to practice using DKSCs as tools for taking informed action in simulated worlds.
2. Present an illustrative worked example (Gee, 2009) of the method.

I developed MA as an interdisciplinary method for systematically analyzing how game mechanics create (or fail to create) structurally afforded opportunities in games to practice using DKSCs as tools to take informed action in game worlds. In particular, MA focuses on leveraging principles of discourse analysis (Gee, 2014a, 2014b, 2018) to analyze game mechanics through the lens of language in order to surface otherwise implicit arguments regarding how these opportunities to practice in games center (or fail to center) the DKSCs centered in formal K-16 education. MA is used to deconstruct games down to their component parts to analyze them for two primary purposes: to critically analyze claims regarding learning in games and the theories of action by which said learning takes place, and to identify what works. In other words: to test claims, and to find inspiration in successful uses of mechanics for future designs.

First, MA can be used to highlight inconsistencies between developers' claims regarding learning in a game and the realities that emerge from the game's use of mechanics. Highlighting these inconsistencies is important, not as a means of highlighting flaws of specific games for its own sake, but rather as a way to communicate about what kinds of learning aims we think games can, should, and could facilitate. This use of MA foregrounds identifying where specific games fall short, as well as identifying needs and opportunities to improve on existing game designs.

The critical analysis of games for learning is sometimes warranted in its own right. K-16 education is replete with games touted to facilitate lofty teaching and learning goals, yet researchers have identified many instances in which these games fall short of these goals (see for example Jenkins et al., 2004; Stoddard et al., 2016). The proliferation of games that fail to follow through on the learning aims they claim to facilitate is harmful in multiple respects. It is harmful to teachers' and administrators' efforts to provide quality educative experiences to their students when, in an effort to champion the progressive constructivist pedagogies they are often lambasted for ignoring, they unwittingly embrace games that double down on behaviorist assumptions about learning. This is a waste of institutions' finite temporal and financial resources. The presence of substandard games for learning also hurts parents' efforts to supplement school-as-usual with engaging informal learning experiences at home. Unwittingly selecting games that present school subject matter as facts and procedures to be memorized reinforces many students' perceptions of school-valued knowledge as unengaging and unimportant for real life. Most importantly, in the end, substandard games hurt school-age children, and by extension, the societies in which they are to develop into fully participating citizens.

These drawbacks of substandard (use of) games, in turn, harms efforts to realize the promise and potential of games for learning to deliver on longstanding calls for engaging constructivist pedagogy that goes beyond fact recall (e.g., Dewey, 1938; Gee, 2017; Gresalfi, 2009). Not identifying substandard games as such—and having no clear systematic means of doing so and subsequently communicating about it—interferes with efforts to identify which games-related initiatives to fund and why. In combination with the aforementioned difficulty establishing clear links between games and meaningful learning in K-16 domains, the resulting confusion may have contributed to "games fatigue" among agencies previously eager to fund research and development efforts related to games for learning. Thus, the promise and potential of games for learning to make good on decades of promises to offer constructivist learning experiences to students may be greatly lessened.

But perhaps more important is the second application of MA: to identify what works to do what, why, and when. In other words, MA is intended to identify game mechanics that, in concert with other mechanics and broader contextual factors, create opportunities for players to use DKSCs as tools to do work in game worlds. Thus, MA may serve as an argumentative grammar (Sandoval, 2014) supporting game design and research in at least two ways. First, for designers, MA can serve as a kind of work-checking mechanism, a means by which designers can systematically test simple prototypes of their mechanics. Thus, MA can support designers in quickly iterating game mechanics as they seek proof of concept. Second, for researchers, MA as an argumentative grammar can aid in making communicable claims, grounded in systematic analysis, about why certain games or game designs should work (or not work) for specific learning aims in the first place. Thus, MA may add an additional tool to be leveraged in securing the footing on which interdisciplinary games research stands (Deterding, 2017).

But most ambitiously, MA is an analytic tool to support scholarship-based contributions to what we might think of as a database of game mechanics that are effective for facilitating specific learning goals. Such a database would catalog *mechanical use cases*, descriptions of episodes that illustrate through MA how the confluence of certain mechanics in and with game contexts under certain conditions create opportunities to practice using DKSCs to do work in the world. Such a database would distill close scrutiny of games and their mechanics into a list searchable by learning aims and connected to descriptions of use cases and additional resources including exemplars and worked examples. Though game design is indeed as much art as science, such a database could be used to shorten the learning curve associated with creating new games for learning and help ensure emerging designs in fact align to ambitious teaching and learning aims. I thus intend the present work as a form of invitational scholarship (Barab et al., 2009), in addition to its own contribution to games scholarship. That is, it is my hope that the ideas put forth in herein, rather than being an authoritative end to discussions on the qualitative analysis of games for learning, inspires new and additional conversations on the topic (see Gee, 2009).

Existing Approaches to Analyzing how Games Facilitate Learning

When considering existing approaches to analyzing the ways in which games facilitate learning, it is important to draw a clear distinction between (a) analyzing learning in and as a result of a game, (b) and analyzing how designed elements of a game can facilitate certain kinds of learning. This is the difference, on the one hand, of looking post-gameplay for what players have learned, and on the other hand, looking at how the design of games makes certain kinds of doings (and thus learning) possible, improbable, or impossible. This is not to say one approach is better or worse than the other. In fact, the two are often intertwined in discussion sections of scholarly papers on games for learning (e.g., Sengupta et al., 2015; Virk et al., 2015). Rather, it is to acknowledge the two approaches serve different purposes; they hold different affordances for different purposes, which highlight the value of looking for learning in different places and in different ways, which in turn necessarily leads to different kinds of claims about what games do, can do, and should be used for.

Focusing on learning outcomes is useful for examining the learning that results directly from gameplay, with far less (if any) attention devoted to the mechanisms thereof. Such approaches seek to identify post-gameplay changes in what the player has come to know or understand. This effort can be undertaken across a wide methodological spectrum. For instance, Gilbert (2019) took a qualitative interview approach to exploring the meanings students independently constructed while playing the *Assassin's Creed* series of games outside formal school contexts. Gilbert found that students who played these games developed a sense of human connection to people in the past and increased perception of multiple perspectives in history, though they also tended to miss opportunities for more critical engagement with the domain. Gilbert did not, however, seek to examine the game mechanics themselves as an explanatory contributor to these findings.

Sengupta et al. (2015) examined one player's gameplay of *SURGE Next*, looking for the players' use of the phenomenological primitives (p-prims)—small knowledge elements developed over time in response to repeated exposure to abstracts of familiar events—that make up one's sense of mechanism (diSessa, 1993) relating to Newtonian physics. Sengupta and colleagues watched recordings of gameplay and looked for p-prim use and how that use evolved throughout playing the game. At the conclusion of the study, they found that *SURGE Next* fostered and supported learners' conceptual change, and though they did not study the game's mechanics directly, they did theorize that a game's representational elements and learners' interactions with them must be conceptually salient: "That is, these interactions must involve reasoning about the relevant canonical concepts" (Sengupta et al., 2015, p. 667). Such discussions are typical of how researchers theorize about how mechanics facilitate observed results.

Another approach to looking at games is to examine their content by asking, "what is there in the game to be learned?" Stoddard et al. (2016) took this approach to analyzing *iCivics*, a popular made-for-school game about civics used widely in formal K-12 settings. They examined the content of *iCivics* and how it was presented to players via the game's structure. Stoddard and colleagues did not look at how players took action in the game, but rather how the construction and selection of cases (the content of the game) and the rules of the game created a certain ideological world (Squire, 2006) for players in which they were presented with a particular conception of civics. For example, among Stoddard et al.'s findings was that *iCivics* often presented players with oversimplifications of civics issues through closed-nature tasks, thereby framing civics as a collection of facts rather than as a complex way of seeing and acting in the world fraught with tensions. This is similar to how discourse analysts might examine games to identify how they (re)construct and make bids for certain figured worlds, shared visions of the world and how it works (Gee, 2015; see also Holland et al., 2001).

Other approaches to exploring how games facilitate learning focus less on the games themselves and more on the broader learning ecology—the context—in which they are leveraged as teaching and learning tools. Squire's (2006, 2011) work offered an early exemplar of this perspective. Using the popular turn-based strategy computer game *Civilization III* as the focal learning experience, Squire focused his intervention design and analytic efforts on how the facilitator and task-participant structures of the activity optimized opportunities for students to learn history as more than the collection of facts it is often framed as in formal school contexts.

Gee and Gee (2017) conceptualized games as pieces of what they called *distributed teaching and learning systems*. From this perspective on games as teaching and learning tools, the view of where learning happens and how games facilitate that learning is expanded well beyond the confines of the game or even its immediate environment. Rather, games are seen as connecting and interacting in rich ways with a complex world of resources (Tran, 2018) that includes the game, online spaces, social groups and interactions in and around the game, associated game-relevant texts, personal histories, and so on. In this view, games are both site and artifact of teaching and learning within a larger system.

Other researchers have leveraged heavily quantitative, psychometric approaches to examining games for learning (e.g., Kim & Shute, 2015; Shute et al., 2016). One limitation to this approach is the level of technical expertise required to conduct such examinations and to which many do not have access. This includes researchers, but also and in particular designers of games for learning, the school administrators with whom decision-making powers regarding institution-level adoption of technology reside, and the teachers who often exercise classroom-level adoption decisions and who must do the actual implementation in the context of their lessons.

But additionally, this heavily quantitative approach is limited in the number and kind of complex interactions for which its models can practically account. Games designed specifically for use in schools typically include a limited number of simple mechanics—dialogue selection, point-and-click movement, answer selection—and a limited decision space (Klein et al., 2009). Considering these limited decision spaces are often designed in consultation with domain experts, drawing inferences about how mechanics link to learning is relatively straightforward. Where quantitatively driven psychometrics becomes more challenging, however, is when many mechanics are used within more open game worlds to afford *ad hoc*, player-driven goals and interpretable notions of success; create many pathways to those many versions of success; and provide many tools—and afford many often-unpredictable combinations thereof—useful for pursuing them. Because these are the very characteristics of games that make them both engaging and excellent learning environments (Gee, 2003), quantitatively driven psychometric approaches to analyzing mechanics are thus left with a conundrum: the approach may be most effective for games that may be least engaging to players.

Furthermore, linking mechanics to learning outcomes in this way may illuminate causal effects, but it tells us little about causal processes. In other words, such analysis can tell us that Mechanic X reliably predicts Intended Learning Outcome Y, but not whether either are aligned in any meaningful way to a domain-relevant discourse. If games are to be leveraged as tools for helping students learn to know, do, and be as certain kinds of people in the world—as this paper assumes ought to be the case—the field needs a way of looking directly at game mechanics and examining the extent to which they align to these ways of knowing, doing, and being in the world.

Theoretical and Conceptual Underpinnings

In this section, I outline a sociocognitive perspective on learning through experiences had in the world. The theories and conceptual frames that follow guided my development of MA.

People learn through experiences they have in the world. It is through experiences we have in the world that we learn how to know and do as certain kinds of people (Lave & Wenger, 1991). But what's important about those experiences—what determines what we learn from them—is what we do. Thus, effective learning experiences, what Gee (2017) called +experiences, must have three characteristics. First, learners must have actions to take. Second, learners must care about the outcomes of those actions. Third, there must be some means by which learners' attentional economies are managed; that is, the learning experience must in some way help learners know what is and is not worth paying attention to.

Landscapes of Takeable Actions

But how do we decide which actions to actually take? First, it is important to note that not every action is available to everyone, even within the same experience. Decisions about what to do as part of a given experience can only be made between the actions we can actually choose to take, what I call an experience's landscape of takeable actions. One cannot simply decide to attend an expensive university or start a small business, for example; these are not takeable actions for many people whose communities are historically marginalized or who are underbanked. A more concrete example comes from the physical world, in which the bodies typical of humans make some actions—like travelling an even, paved path—are possible, while others—clearing a 15-foot gap—are not (Glenberg et al., 2013).

But tools can alter the landscape of takeable actions by changing how we interact with the world and what we are able to do as part of a given experience. Therefore, tools afford different opportunities to do things, and therefore determine in part what we learn from experiences. Thus, cognition is ecologically distributed among learner, the environment, and the tools within it which afford doing some things and not others (Gibson, 1979). In games, mechanics are the tools that determine how players take action in the game world (Gee, 2015).

Assuming an experience's landscape of takeable actions is in place, and that we understand it and its implications for our behavior, we then identify goals of interest within the environment, as well as an array of takeable actions we associate with achieving those goals. We use our memories of taking goal-mediated action in prior experiences to create mental simulations of ourselves (and/or others) taking action in the environment (Bergen, 2012; Glenberg, 1997). We imagine what will happen—how the world around us will react—when we take this or that action, and we reflect on the desirability of those outcomes. If we like what we see in this simulation we carry out in our imagination—if we achieve our goal and like how we have done so—we take our simulated actions in real life. We then reflect on the real-world outcome, how it matches up or not with our simulation, and re-plan new sets of actions or identify new goals (Seligman et al., 2016).

Conversations with the World

Gee (2015b) likened the kinds of action cycles I described in the previous section to conversations, noting how they function as a turn-taking system—albeit a primordial one based on actions rather than words—in which actor probes the world, and the world responds with feedback. Gee called them conversations with the world, describing them thusly:

> We humans have long engaged with a cycle of thinking and action that is essential our very survival (Gee, 2013). This cycle goes this way: We want to accomplish something. We form a goal. Then we act. Our action can be looked at as a probe of the world, a sort of question we put to the world. The world responds to our action. The world's response might indicate that our action was effective as a way to our goal or it might indicate that it was not. We reflect on the world's response and then we either reconsider our goal or act again in an attempt to elicit further responses from the world that will allow us eventually to accomplish our goal.
>
> This cycle is simple: form goal—act/probe—get response from world—reflect—act again with due regard for the world's response. We and the world

take turns. We repeat the cycle until we succeed or until we see we cannot succeed, in which case we get a new goal. (p. 8)

Videogames are precisely such conversations (Gee & Gee, 2017).

An indispensable element of conversations, however, is the language(s) in which they are had. What we think of canonically as conversations—those which take place verbally between two or more people—have this language element, though we label so many different versions of it all together as such as to obscure this obvious fact. Language is more than just a way to say things to each other. Language is a tool; furthermore, it is a tool for doing, not just saying (Gee, 2018). We do all sorts of work with language. We construct identities, we become and get recognized as certain kinds of people, and we use language to help (or hinder) others who are using language to do the same. We can also use language to give and withhold social goods like respect or sense of security (Gee, 2015a). In conversations with the world, the language is action. In videogames, the language is mechanics.

Game Mechanics and Language

Definitions of mechanics abound, though scholars seem generally to agree that "game mechanics are what you can do with things in a game" (Gee, 2015b, p. 42). Thus, Salen and Zimmerman (2004) defined core game mechanics as "the essential play activity players perform again and again in a game" (p. 316). Building on this definition, Plass et al. (2015) described mechanics as "the activity or sets of activities repeated by the learner throughout the game… the essential behaviors" (p. 263). Sicart (2008) described mechanics as the "methods invoked by agents, designed for interaction with the game state" (p. 2). Thus, at least in the sense that players use mechanics to do things in the game world, mechanics and language share at least one common function: doing work in the world.

But conversations are not one-sided. They are turn-taking systems between two or more conversing entities. As such, we must account for the other half of the conversation: the game world itself. That game mechanics facilitate a two-way interaction is not an entirely novel notion. Here, a close reading of Johnson's (2011) definition of game mechanics is useful:

> Ultimately, designers need to recognize that a game's theme does not determine its meaning. Instead, meaning emerges from a game's mechanics - the set of decisions and consequences unique to each one. What does a game ask of the player? What does it punish, and what does it reward? What strategies and styles does the game encourage? Answering these questions reveals what a game is actually about. (p. 33)

First, mechanics are defined as "decisions and consequences," very much flip sides of the same proverbial coin. For every decision acted upon by the player, there is a consequence offered in return by the game world. Particularly salient is Johnson's question, "What does a game *ask* of the player?" We can translate this to mean "What goals does the game offer the player, along with what tools for pursuing them?" In other words, the game communicates to the player what goals are there to be pursued, along with what tools will be more or less useful in the pursuit. Finally, in regards to punishments and rewards, and strategies and styles encouraged—this is feedback. This is how games "talk" to players in the way described earlier as conversations with the world.

Thus, in considering a double-sided view of game mechanics, I include Hunicke et al.'s (2004) broader conception of mechanics, which includes "the particular components of the game, at the level of data representation and algorithms" (p. 2). In other words, the game speaks to the player in terms of data representation and algorithms, the player hears these and in turn designs how they will respond.

Mechanics and language share other features, as well. As noted above, language is a tool by which speakers and hearers participate in a turn-taking system: the speaker speaks, the hearer responds, and they switch roles, repeating the process until the conversation is completed (Sapir, 1921). Both language and mechanics are highly situative tools. That is, they take on, give, and shift meaning depending on the context in which they are used (see Gee, 2015, 2018). Language and mechanics both operate according to recipient design. Informed by their knowledge of who the hearer is as well as a host of other contextual factors, speakers (players) design their speech (actions) to achieve specific goals (Bruner, 1983; Sacks et al., 1974). Both language and mechanics operate according to the principle of choice, which is to say (a) that the words we choose to say (and the mechanics we choose to use) both reveal something about what the speaker (player) knows and is able to do, and (b) that the words (mechanics) *not* chosen for certain work in certain situations reveals at least as much (Gee, 2018). Additionally, language and mechanics both function according to the principle of charity: hearers (games) assume that speakers (players) say what they mean and mean what they say. The principle of charity assumes that whenever speakers use language they are competently (if not coherently, or even knowingly) communicating what they know, believe, and value about themselves, the world, and others within it (Davidson, 1975; Gauker, 1986;

Gee, 2018; Quine, 1960). Considering their similarity in terms of function, it may be useful to consider mechanics and language as structurally similar, as well.

Examining mechanics as a conversation therefore requires identifying the component parts of the language players and games speak with one another: lexicon, syntax, semantics, pragmatics, *d*iscourse, and how all of these give rise to *D*iscourse. The most basic element of a language is its lexicon, the collection of individual words that can be packaged together in certain ways to construct sentences and idea units. How pieces of the lexicon can be put together to create sentences and idea units is determined by syntax, the grammatical rules that determine which words go together, in what order, and in what contexts. Semantics refers to the meanings certain words and word combinations have, though there are both literal and situational meanings. Discourse analysts use the term pragmatics to describe what people do with language, while *d*iscourse is used to draw attention to and analyze language at the level above sentences. Taken together, these elements of language give rise to what Gee (2014b) called big 'D' *D*iscourses, ways of knowing, doing, and being in the world specific to specific social groups who seek to do specific kinds of work in particular contexts.

Game Mechanics and Opportunities to Practice

So game mechanics and language are both tools for doing work in the world. As noted earlier, the tools available to us as part of learning experiences alter the takeable actions available to us, and therefore what we do as part of learning experiences, and thus what we learn. In other words, they create opportunities to learn (Greeno & Gresalfi, 2008; Gresalfi, 2009). Opportunities to learn emerge from the affordances (Gibson, 1979) for certain kinds of action as part of activity systems (Greeno & Engeström, 2014). The affordances for a learner in an activity system are composed of “the resources and practices of the system, that individual’s access to those resources and practices, and the dispositions and abilities of the individual to participate in a way that supports her or his activity and learning in some way” (Greeno & Gresalfi, 2008, p. 172). These together generate different opportunities for participation, and thus different “opportunities to learn to do” (Greeno, 2011, p. 148).

In previous work, therefore, I reframed opportunities to learn in made-for-school videogames as *opportunities to practice* (OTPs): in-game moments in which players must successfully leverage the conceptual tools of an academic *D*iscourse (e.g., historians, economists, scientists) to accomplish in-game tasks (Kessner & Harris, 2020). These OTPs are generated by the game’s mechanics, which set up a landscape of takeable actions in which “certain activities become very likely, others become possible, and still others become very improbable or impossible” (Jordan & Henderson, 1995, p. 41). OTPs are necessarily always present in games; the question is whether they align in learning games to intended learning outcomes.

Finally, the kinds of OTPs generated by game mechanics depends significantly on how the mechanics and intended learning outcomes are aligned, or integrated, within the game. Some scholars draw a distinction between game mechanics and learning mechanics, where game mechanics are “the major building blocks of *play* [emphasis added] activities,” whereas learning mechanics “describe the major building blocks of *learning* [emphasis added] activities” (Pawar et al., 2020, emphasis added). Some have further broken down game mechanics to include assessment mechanics, which generate “conditions for learners during game play… that evaluate their performance to determine mastery of the content" (Plass et al., 2015). I do not take up these distinctions for the present work for the following reasons.

First, because learning is doing, and doing in games is facilitated by mechanics, all mechanics are learning mechanics, thus making the distinction irrelevant for the purposes of the present work. Second, perhaps the preeminent value of games in regards to assessment is that gameplay itself *is* assessment. Players use game-valued skills and knowledge to act within games, and the game provides immediate feedback on their mastery of said skills and knowledge. In short, simply by virtue of successfully completing in-game tasks, players show mastery of the skills and knowledge needed for those tasks (Gee, 2003; Shute et al., 2016; Shute & Ventura, 2013). The question becomes, then, not a matter of designing assessment mechanics into games but rather one of integrating disciplinary ways of knowing, doing, and thinking directly into game problems, scenarios, and mechanics in such a way that, simply by virtue of completing an in-game task, we can draw valid inferences about student learning.

Methodological Underpinnings and Ways of Working

I have thus far contended that what we learn is inseparable from how we learn it, that learning comes from acting in the world and reflecting on the world's response to our actions, and that these cycles of interaction between actor and world constitute a conversation. Furthermore, what we do as part of learning situations is a matter of what we have the opportunity to do. Because game mechanics, as the building blocks of the conversations players have with games, determine what players can do, mechanics thus shape the opportunities players have to perform certain actions, and thus what is learned. In brief: mechanics shape learning. As a methodological approach to making sense of the opportunities players have to act in games, MA draws on multiple established methodological approaches (see Table 1).

Table 1

Methodological Approaches and Principles Underpinning Mechanics Analysis

	Data Collection	
Principle	Inspiring Approach	Relevant Citations
Videorecord gameplay (in conjunction with autoethnographic fieldwork)	Content analysis Interaction analysis	Krippendorff (2013) Jordan & Henderson (1995)
Content logging	Interaction analysis	Jordan & Henderson (1995)
Fieldnotes (voice)	(Auto)ethnographic field research	Emerson et al. (1995)
	Data Analysis	
Principle	Inspiring Approach	Relevant Citations
Memoing In-process Text Voice Integrative	(Auto)ethnographic field research	Emerson et al. (1995)
Focus on interactions	Interaction analysis	Jordan & Henderson (1995)
Structuring events "Something new" Beginnings and endings	Interaction analysis	Jordan & Henderson (1995) Bamberger & Schön (1991)
Temporal organization	Interaction analysis	Jordan & Henderson (1995)
Turn taking	Discourse analysis	Sacks et al. (1974)

Trouble and repair	Discourse analysis	Schegloff et al. (1977)
Iterative coding Lexicon Syntax Semantics Situated meaning Pragmatics *d*iscourse *D*iscourse	General qualitative research Discourse analysis	Saldaña et al. (2019) Gee (2014a, 2014b)

Birth of a MA Study: Research(ers') Questions and Study Designs

In this section, I outline what might inspire a study using the MA and how one would begin doing so.

Researchers' questions give rise to the research questions that guide a study, though they are not necessarily one and the same (Bakker, 2018). Research questions "represent the facets of inquiry the researcher most wants to explore" (Miles et al., 2019, p. 22). Research questions therefore err on the side of specificity; they tend to frame explicitly specific questions the researcher seeks to ask of the data. Researchers' questions, on the other hand, are often more preliminary; they highlight wonderings that shape the ultimate design decisions pertinent to a study. This distinction is relevant for thinking about how a MA study might begin and how identification of research questions and design of the study should proceed. In the following sections, I identify four ways in which researchers' initial questions may arise and the implications each holds for the development of formal research questions, study design, analysis, scoping, and reporting. These four possible beginnings of a MA are neither exhaustive nor necessarily intended to be considered in isolation. In other words, there may be more than these four reasons for beginning a MA, and there may be good reason to consider multiple approaches simultaneously.

Developers' Claims

One way a researcher might come to wonder about the relationship between a game's mechanics and the kinds of learning they facilitate is in response to a developer's claim. For instance, developers of explicitly learning-oriented games might claim their game facilitates higher-order disciplinary thinking and reasoning skills in a domain like history or civics. Considering longstanding difficulties associated with embedding such learning in games, such a claim might engender skepticism on the part of the researcher, and this skepticism could take two forms.

First, as was the case with a study of *iCivics* conducted by Stoddard and colleagues (Stoddard et al., 2016), researchers might direct their skepticism towards developers' conceptualization of the domain itself. Civic education is often conceptualized, and operationalized in formal school contexts, as lists of facts to know and perhaps apply in limited fashion; for example, the structures and processes of government. This is in contrast to civic education scholars' more ambitious conception of civics. For example, some scholars' work represents a more critical evaluation of who "counts" as a citizen in the United States (Ladson-Billings, 2004; King& Chandler, 2016; Vickery, 2014), noting that "Whiteness continues to be a criterion for full citizenship in the United States" (Vickery, 2017, p. 320). Others stress student discussion and deliberation of contested issues as preparation for civic participation (e.g., Hess, 2009; Kaka et al., in press; Parker, 2003) or civic advocacy and direct action oriented to social justice (Levinson, 2012; Westheimer & Kahne, 2004).

The second form of skepticism that could lead to relevant researchers' questions is what we might call skeptical optimism. In this case, researchers would recognize the kind of learning developers claim their game facilitates as particularly complex or difficult to achieve under even ideal circumstances, and researchers would thus be eager to examine how games might achieve such learning goals. Such was the case of Kessner and Harris' (2020) study of the made-for-school history-oriented videogame *Mission US*, which developers claimed helped students think like historians. Such thinking is immensely complex work, and often difficult to teach (Bain, 2000; Wineburg, 1991a, 1991b). Thus, Kessner and Harris' researcher questions centered around identifying how *Mission US*' game mechanics achieved this lofty goal.

In either case, researcher questions that arise in response to developers' claims about learning would suggest the need to formulate research questions tightly focused on particular phenomena. Consequently, the researcher should develop an *a priori* conceptual or theoretical framework useful for investigating the specific claims the researcher seeks to investigate and make methodological decisions aligned to gathering data on that framework. Generally, justifying a MA on the basis of testing developers' claims suggests a focus on one game, though it does not necessarily exclude multiple games if the same of similar claims are attached to multiple games as part of a suite (e.g., *iCivics*, Stoddard et al., 2016).

Thematic Alignment

As Johnson (2011) noted, theme is not meaning. Thus, the topical overlay of a game does not by itself indicate a game's mechanics. For instance, that many popular commercial games like *Civilization*, *Assassin's Creed*, or *Age of Empires* are crafted around an historical theme does not suggest in and of itself that these games have much to do with history or doing the work of historians. Nevertheless, a game's thematic alignment may offer a jumping-off point for developing researcher questions. Most installments of the *Civilization* series are, thematically, explicitly historical in nature. Players are positioned as leaders of historical civilizations pitted against real-life leaders of other historical civilizations. Thus, as was the case in Squire's (2006, 2011) study of *Civilization III*, wondering about its use as a tool for teaching and learning history is warranted. Additionally, a game's genre may suggest certain thematic alignments. For example, many top-down strategy games (e.g., *Civilization*, *Age of Empires*) are history- or, more broadly, social studies-themed.

Selecting a game for MA based on thematic alignment suggests narrower design decisions for the same reasons the same is true for MA based on developers' claims. If a game is selected based on thematic alignment, this suggests the researcher already has in mind the kinds of DKSCs they will look for. Whereas investigating developers' claims about learning in a game suggests a narrow focus on a handful of specific DKSCs, however, thematic alignment would include instead a "family resemblance" of DKSCs. Thus, whereas Kessner and Harris (2020) developed an analytic framework based narrowly on historical thinking and reasoning for their directed content analysis of *Mission US*, Gilbert (2019) was able to explore historical empathy in *Assassin's Creed*. Due to this potentially broader set of inquiry foci, research questions may be broad, allowing for greater flexibility in a study of a more exploratory nature. Additionally, choosing thematic or genre alignment as the justification for MA creates a logical opening in the study to include multiple games, though this decision should be made in consideration of the researcher’s broader goals for the study.

Popularity of a Game

Some games may warrant further inspection on the strength of their popularity alone. The context of this popularity matters, too. For instance, a game could be popular among school-age boys and/or girls; it could be popular among primary, secondary, or post-secondary educators; it could be popular among gamers among gamers writ large; and so on. Kessner and Pérez Cortés (2020) used this justification in their study of *Call of Duty: Modern Warfare*. Based on the immense popularity of the franchise in general and the 2019 installment in particular, the authors set out to examine the game’s mechanical landscape for what players might experience (and thus learn) in the course of gameplay.[1]

Beginning a MA on the basis of a game’s popularity implies a more exploratory study design. A game may be popular for any number of reasons, and the natural question of researchers is not so much “What makes this game popular?” but rather “What are players doing and learning through the opportunities to practice generated by this game’s mechanics?” Thus, researchers would seek to identify how the game’s mechanics create opportunities for players to practice certain DKSCs *in the context of a game that is already engaging to players* in order to (a) illuminate how the game might be leveraged as-is for teaching and learning, and/or (b) to base future game designs around the game under investigation as a model. Researchers might focus on one game, as did Kessner and Pérez Cortés (2020), or they may follow Gilbert (2019) and consider a franchise series.

Novel or Unusual Mechanics

[1] Violence and/or violent behavior was discounted from analytic consideration due to the authors’ theoretical-conceptual framework.

A researcher's curiosity may be piqued by a game's use of one or more novel or otherwise unusual mechanics. Games outside the AAA realm (the large videogame developers that develop mega-hit titles like *Call of Duty* and *Assassin's Creed*), sometimes called indie games, are well-known for innovative mechanics. In *Two Brothers*, for example, players use both analog joysticks on the PS4 controller to control two avatars independent of one another; one joystick moves one brother, while the other joystick moves the second brother. At first, this mechanic is unnatural and difficult, but over time it becomes second nature—such that later, using only one joystick is both cognitively and affectively jarring. In *Flower*, players raise and lower the entire controller in fluid motions to guide their seed avatar along wind currents; and in *Detroit: Become Human*, players frequently move the whole controller in approximations of the in-game actions their avatar performs (e.g., the unlocking of a door, or the opening of a ship's bulkhead door). In both these latter two games, developers leveraged motion-sensing controller technology to literally embody players in the games.

Founding a MA on the basis of one or more novel mechanics suggests a narrower study focused on those mechanics. Nevertheless, because mechanics never exist in isolation, researchers may begin with a narrower study design and expand beyond it on the basis of what they find in the course of data collection and concurrent analysis. Generally, a MA of games based on the novel or unusual would likely focus on one game, but should the researcher become interested in a specific type of mechanic—and assuming multiple games use that mechanic—analysis of multiple games may well be warranted.

Collecting Data for MA

I have thus far contended that players and the games they play—though games are not thinking or social creatures per se—are conversational partners. At stake in MA, then, is examining how mechanics facilitate how players and games “make sense of each others’ actions as meaningful, orderly, and projectable” (Jordan & Henderson, 1995, p. 41). Furthermore:

> Because locally sensible action is seen as the collaborative achievement of participants, our work as analysts lies precisely in specifying the ways in which participants make this orderliness and projectability apparent to each other… We look for the mechanisms through which participants assemble and employ the social and material resources inherent in their situations for getting their mutual dealings done.” (Jordan & Henderson, 1995, pp. 41-42)

Thus, the data collected and analyzed for MA are the interactions between player and game, as facilitated by the game’s mechanics.

Verifiable observation provides the best grounding for analytic knowledge of how game mechanics facilitate these interactions. Yet gameplay is an example of what Krippendorff (2013) called bygone phenomena: it is a transitory event that disappears immediately after it occurs, making verification difficult. Such phenomena presents an analytic challenge for researchers, who rely on their data remaining in a static state to support analytic efforts across phases, instances, and iterations (Krippendorff, 2013). Thus, researchers conducting MA should utilize screencapture software (e.g., QuickTime, Windows Game Bar) to record gameplay, thereby generating video data on gameplay independent of later analysis (Kaplan & Goldsen, 1965). Recording gameplay not only preserves the phenomena under investigation in their original state, doing so provides researchers with an invaluable analytic tool: the crucial ability to replay sequences from the data (Jordan & Henderson, 1995). This ability to revisit the data in a static state allows researchers to examine repeatedly particular points of interest from the data, thereby making the interactions between player and game "accessible and sensible" not only to players "but also to analysts when they observe such interaction on videotape" (Jordan & Henderson, 1995, p. 41).

MA takes a substantive departure from data collection procedures associated with approaches like content analysis (Hsieh & Shannon, 2005; Krippendorff, 2013) or interaction analysis (Jordan & Henderson, 1995), however. In such approaches, analysts approach phenomena of interest or objects of inquiry that are to some extent naturalistic in that they occur largely independent of the analyst, and analysts position themselves as impassive observers of phenomena. In contrast, researchers conducting MA must often make their own data (see Krippendorff, 2004) in order to examine the phenomena of interest. In MA it is permissible—indeed it is preferable—for the analyst to take part in the phenomena of interest as an active participant—to play the game. This is because games are immersive, deeply situative environments that work at least as much due to their effect on affective elements of learning as any other. Developing a rich understanding of the mechanisms that create opportunities for certain kinds of interactions therefore requires a form of analytic engagement beyond impassive observation, such as that afforded by autoethnography, which positions the researcher within a context as a viable and valuable data source (Leavy, 2015; Reed-Danahay, 1997; Sweet, 2017).

In the rest of this section, readers will note the blurry lines between data collection and analysis. Indeed, multiple methodological tools are built into the MA process to support concurrent analysis of the data, the importance of which cannot be overstated. Much of what takes place in games—the meanings these happenings hold for players and the meanings players make from these experiences—is dependent on so many interconnected factors that reliably making sense of it through *post hoc* analysis alone is difficult. This raises the issue of what Schatzman and Strauss (1973) called "the remembering problem" (p. 94) for researchers who must negotiate the tensions between their concurrent roles as discoverers and analysts.

To alleviate the challenges associated with relying solely on post hoc analysis, researchers should prepare an in-process memo (Emerson et al., 1995) for use in concurrent analysis prior to beginning the study. In-process memos are used to log thoughts on the research as it is happening. They are a place to identify, in a preliminary fashion, game mechanics of interest and how they interact with other mechanics and the game context to create OTPs. Thus, the in-process memo is an invaluable tool for establishing and maintaining an analytic mindset throughout, thereby aiding the analyst in achieving a balance between immersion and analysis.

The in-process memo also serves as an ongoing sensemaking tool. It is a constantly evolving analytic framework and a place to note hunches and thoughts, but it is not necessarily a place to do deep and sustained analysis. Rather, the in-process memo is a place to engage in what I will call *winding analysis*. By winding analysis, I mean writing thoughts as they spring to mind, with little regard for their merit in the moment, instead allowing insights come as they may and minimizing the time and distance they travel from brain to paper. Whenever applicable, jottings in the in-process memo should be accompanied by timestamps to help the researcher quickly and with more precision revisit the video data.

The risk of building such an analytic framework *in situ* would, of course, be building out some parts of the framework at the expense of others. Nevertheless, this is an example of how the multiple methodological tools employed within MA complement each other and mitigate possible pitfalls. While it is possible writing in-process memos could highlight some features of gameplay by blurring analysts' vision in regards to others, the presence of static-state data in the form of video of gameplay, in conjunction with the think aloud-focused voice memos described below, means the analyst can always return to the data for additional insights.

Researchers should also supplement the on-screen accounts of interactions with tools better suited to capturing the richness of those interactions. One such tool is the voice memo, drawing also on think-aloud (Ericsson & Simon, 1984). Video is not reality, nor is it an objective, faithful re-representation of it (Jordan & Henderson, 1995). Video data, particularly of immersive, highly situative experiences like games, cannot hope to capture the complex goings on of the player's mind during gameplay. Because the conversation between game and player is not one that takes place audibly, video data alone is insufficient for capturing all the relevant elements of the player's conversation with the game world—for example, what the player sees on screen in a given moment and how this influences the player's thoughts about what goals and strategies for accomplishing them are immediately relevant. Thus, voice memos are a useful tool in the MA methodological toolbox.

In the context of MA, voice memos serve dual purposes. First, to generate a record of the player's thoughts as they occur in real time. Not everything needs to go into the in-process memo/fieldnotes immediately. Traditional field researchers often confront tensions regarding whether and when to leave their immediate research site (e.g., a board room or a hospital room) to write down an insight. Thus, field researchers must "calculate the value of ideas against that of new data" (Schatzman & Strauss, 1973). While MA is certainly not traditional field research, this tension is a relevant one and worth addressing. Here, it is useful to remember the importance placed in MA on the researcher recording actual gameplay. Games are deeply situated experiences (Gee, 2003, 2015), and developing a valid understanding of the contextual meanings goals, tools, stimuli, and actions hold in the game and for the player requires being situated in those meanings oneself. Skalski et al. (2017) noted this, as well: "experienced players are most likely to approximate how content would manifest in the population of players" (p. 216). To pause to write down every thought undermines this goal of maintaining to best of the researcher's ability immersion in the experience. Voice memos thus alleviate the cognitive load on researchers to weigh the value of noting a new idea against the risk of reducing the immersive quality of the experience.

Second, to actively elicit thinking about the game from the MA perspective. This function draws inspiration from Wineburg's (1991a, 1991b) use of think alouds as a methodological tool. Used in psychology, think alouds are used to elicit the otherwise inaccessible thoughts that occur during experiences, making them available for external analysis. This is particularly important in the context of videogames in general and MA in particular, because the experiences we have in games are dependent on so many situative factors.

Finally, during data collection the researcher may find it useful to utilize point-of-interest markers. These are visual cues the researcher can insert into the screen recording of the gameplay by activating a mouse setting common to most computers that generates an animation around the cursor when a certain key (e.g., CTRL) is depressed. This is useful for drawing attention to elements of gameplay the researcher believes may warrant revisiting during the formal analysis phase, but which do not justify pausing gameplay to formally memo—for example, particular or additional instances of mechanics already identified as being of interest or otherwise important insights recorded in the audio. This allows the researcher to maintain immersion more frequently, while also helping to confront the problem of remembering.

Analyzing Data for MA

Researchers should begin by immersing themselves in the data (Tesch, 1990). They should read their in-process memo(s), looking for particular points of interest and identifying particular interactions facilitated by mechanics that warrant closer inspection. Additionally, researchers should view the video data to refamiliarize themselves with points of interest highlighted throughout the process of concurrent analysis described above.

A final note before proceeding: I am not suggesting that every analyst must do exactly and every step outlined below each time they conduct a mechanics analysis. Rather, MA is more about a way of looking at games, their mechanics, and how mechanics give rise to opportunities for players to engage in certain practices and not others, thus helping to illuminate and communicate about what games really position players to do (and therefore learn).

Mechanical Use Cases

Jordan and Henderson (1995) noted that "selectively employed video data is a particularly valuable analytic tool for the study of learning activities and work practices in complex real-world settings" (p. 50). Nevertheless, the large amount of data generated through recording multiple gameplay sessions as part of collecting data on multiple playthroughs makes the analytic process unwieldy, and thus researchers should endeavor to break their data corpus into more manageable chunks (Miles et al., 2019). One way to do this is to restructure the events in the data into *mechanical use cases* (MUCs).

MUCs are (re)constructions of gameplay episodes. They are constructed from episodes distributed across the gameplay data in which players' use of game mechanics plays out in the natural context of the game. By distributed, I mean the researcher recognizes that players use particular mechanics repeatedly but not necessarily constantly throughout the course of a game, and thus analyzing how they are used requires looking across the chronology of events, as opposed to focusing on smaller, contiguous sections of the data. This done in order to capture the mechanic(s) of interest in as many different situational contexts, and in interaction with as much of the rest of the game system, as possible.

Constructing MUCs

Jordan and Henderson (1995) noted that "chronological time provides analysts with a standardized time line for the activities they observe on tapes. Yet, people's experience is of time bunched into events," with events, or episodes, being "stretches of interaction that cohere in some manner that is meaningful to participants" (p. 57). MUCs organize distributed episodes of gameplay such that they cohere according to the phenomena under investigation. The first step in constructing a MUC is to identify relevant episodes of gameplay. To do so, the researcher would view the video and apply provisional codes (Miles et al., 2019), making note of when particular mechanics appear in the video (CAQDAS software is particularly useful here). Notably, the research(er's) questions discussed earlier may shape the particulars of this process. For example, an open-ended, exploratory MA might identify many mechanics during this stage of the analytic process, whereas a MA focused more tightly on novel mechanics may only code for the appearance of specific, predetermined mechanics.

Interactions have beginnings and endings (Bamberger & Shön, 1991). Thus, the next task for the researcher is to identify what constitutes the beginning and ending of a particular mechanical interaction. At its simplest, the beginning of a mechanical interaction is when the mechanic is first introduced to the player, or when that mechanic first becomes necessary to the player as a tool for achieving an in-game goal. Note that I do not say a mechanical interaction begins when a player uses the mechanic on screen. This may be a useful place to begin constructing the initial boundaries of a MUC, but as will be made clearer below, mechanical interactions appear in the conversation between game and player before the player's on-screen actions might explicitly suggest.

At some point the researcher will want to "close out" the MUC. By this I mean determining the final segment to be included. This will be done according to the principle of saturation, the point at which continued exploration of the data yields no new insights relevant to the current stage of analysis (cite). In simplest terms, once the researcher can identify no additional segments in the video data that show mechanics used in ways not already captured by the emerging MUC, the MUC is considered complete and ready for the next stage of analysis.

Translating the Conversation

Once the MUC is constructed, researchers begin the work of translating the on-screen symbols and the action-oriented tools available to players into interpretable "sentences." Relying on the view of gameplay as a conversation between player game, this stage of analysis draws heavily on discourse analysis (Gee, 2015). Readers should note an important distinction here between (a) drawing on discourse analysis to see mechanics and doings in a new way, and (b) actually doing a discourse analysis. The former uses principles of discourse analysis to look at and make sense of how game mechanics *as part of a game* operate to afford certain kinds of doings on the part of players, while the latter *examines the game itself* as a conversational form and seeks to identify that which is being communicated.

The first step is identifying the lexicon of the conversation, the individual "words" of the mechanical language spoken between game and player and their basic meanings (Gee, 2018). This step is about identifying mechanics at the level of input, feedback, and algorithms (Hunicke et al., 2004). Here, CAQDAS is particularly helpful both logistically and in terms of organizing the analyzed data as it accumulates. To identify the lexicon, researchers should look for symbols and other on-screen elements of feedback that communicate to the player the state of the game. Additionally, depending on the researcher's interest, it may be appropriate to identify the underlying algorithms that drive gameplay from behind the screen. The first place to start is by noting the elements that are always available, and for such elements, circling them once is enough to begin. Prime examples of lexicon include, for example, the individual symbols used in many top-down strategy games to denote various in-game resources, like lumber, coal, or happiness. One simple way forward for the researcher is to use the circling tool included in many CAQDAS programs to annotate visual data. Notes and memos should be applied to these notations.

As with other languages, individual pieces of the lexicon mean very little in isolation. The same way that saying, "dog," apropo of nothing does very little to aid hearers in their sensemaking in the course of everyday conversation, seeing the "word" for coal gives players very little information on how to proceed, what actions to plan and take next. Thus, the next step after identifying the lexicon of the game conversation is to identify its syntax, the "grammar" rules used to put some words together but not others, in certain orders but not others. To do this, the researcher should look for which mechanics co-locate (cite) with each other—that is, which are used together to construct "sentences" in the game conversation. For instance, pairing the word "dog" with a pointing gesture constructs a sentence like, "There is a dog"; and pairing the symbol for coal with an on-screen representation of lumpy black rocks constructs a game-conversation sentence something like, "There is coal here."

Equally important is how syntax does not allow for certain co-locations. In many cases, lack of co-location may be for good reason—for instance, pairing the symbol for coal with a building mechanic. Co-locating coal-related mechanics with water-related ones, on the other hand, might create opportunities to learn about their relationship in contexts like science or engineering. (Non)co-location of these mechanics highlight, then, that the game's language may not afford opportunities to interact with such concepts, a particularly useful finding if the game is designed to facilitate such learning. As with lexicon, such instances of mechanical (non)co-location can be marked and annotated on screen using CAQDAS tools.

Once the researcher has constructed the game sentences, they should examine the sentences' meaning. In linguistics, this is known as semantics, and it has two broad types: core meaning, and situational meaning. Most simply put, core meaning is "the literal or basic meaning of a word when we consider it out of any specific context of use" (Gee, 2018, p. 16). Identifying the literal meaning of a sentence, then, might be considered a task of adding up the literal meanings of the words in a sentence. A game sentence like "there is coal here" is thus deceptively straightforward, as I will demonstrate below.

Literal meaning is often not useful in conversations, not least because single words can have multiple literal meanings. Thus, core meanings represent what Gee (2018) called the *meaning potential* of words: "Core meaning is something around which people can 'riff' in actual language use, guiding the potential for extensions and nuances of all sorts" (p. 32). What determines the ultimate meanings of words and phrases is the context in which they are used. Thus, words have situational meanings. Gee (2018) used the word "coffee" to illustrate:

1a. The coffee (liquid) spilled, go get a mop and clean it up

1b. The coffee (grains or beans) spilled, go get a broom and clean it up

1c. The coffee (cans of coffee) spilled, go stack it again

1d. I pick coffee (berries on a plant) for a living

1e. I want a scoop of coffee (ice cream) (p. 32)

Readers will note that words stand in for, are representations of, things in the real world. Readers will also note that the physical form of the thing in the world represented by the word "coffee" in the sentences above invites the use of certain tools over others (i.e., a mop instead of a broom or ice cream scoop).

Thus it is also with sentences in *Frostpunk*. I will go into greater depth on *Frostpunk* below, but I offer a brief explanation here for context. *Frostpunk* is a top-down, real-time, resource-optimization game. The game takes place in the northlands of the United Kingdom following the onset of a cataclysmic new ice age. The player takes on the position of captain leading a band of 80 refugees seeking shelter around a giant coal-powered generator situated inside an ice hole. At its most basic, players must keep their citizens warm, fed, and reasonably happy.

Keeping citizens warm in *Frostpunk* requires locating coal to feed into the generator, which in turn creates heat for the survivors. When surveying the map for gatherable coal, players encounter a 'sentence' something like, "there is coal here." This sentence has different situational meanings based on the form of the thing in the game world represented by the word "coal":

1a. There is coal (bricks) here (on the ground outside the city); build a gathering post

1b. There is coal (bricks) here (accumulated at the Coal Thumper); assign workers to a gathering post near the Coal Thumper

1c. There is coal (sedimentary rock deposit) here (deep underground); build a Coal Mine

1d. There is no coal (bricks—abstract resource count) here (in storage); find some

Other elements of the context influence the situational meanings of words and phrases, too. The importance of coal in *Frostpunk* at any given time is dependent on at least two additional situational factors: the outside temperature and the insulation of buildings. The colder the temperature, the more coal is needed to generate sufficient warmth for the citizens under the player's care. The better the insulation in the buildings, the less coal is needed. Researchers should take time and care to consider the various meanings the sentences they have translated take on, how, and for whom.

Linguists use the term *d*iscourse (lower-case 'd') to refer to language at the level above words and sentences; that is, how people use language to construct meaning over longer stretches of time (Gee, 2018). Pragmatics refers to language in use—how we use language to do things. In videogames, then, we want to look at how different kinds of sentences appear (or not) repeatedly over time, and how the frequency of appearance moves players (through recipient design) to take some actions and not others. Researchers conducting MA, then, should look for patterns in how game mechanics are used over time, rather than looking more simply at isolated incidents of use. Doing so allows the researcher to begin to consider possible claims regarding when players really do in certain games. For example, in terms of *d*iscourse, a learning game in which players see primary historical source documents just once or twice in the course of gameplay probably is not really about analyzing primary historical sources. Similarly, in terms of pragmatics, if the player does not use these sources in some way to inform the in-game actions they take, the game is not about using primary sources. On the other hand, the more often such sources are presented to players, and the more often players are encouraged by the game mechanics available to them to use them in some way, the stronger the argument becomes that the game is about these things.

Finally, because the present work assumes that games for learning can and should be tools to help learners come to know, do, and be as certain kinds of people in the world, MA looks to identify the approximations of *D*iscourses facilitated by a game's mechanics. It is in identifying these approximations of *D*iscourses that we can make lucid claims regarding what games are about—and what they are not. *D*iscourses are the sets of "ways of speaking (writing), acting, interacting, valuing, dressing, using objects, tools, and technologies in specific sorts of places and at specific sorts of times in order to be recognized as enacting a socially significant identity" (Gee, 2018, p. 110). By approximations of *D*iscourses, then, I draw on Grossman et al.'s (2009) *approximations of practice* to mean opportunities to engage in practices that are more or less proximal to established *D*iscourses. Thus, game mechanics that create opportunities to practice using DKSCs in certain ways would present the DKSCs of a *D*iscourse as tools for doing work valued by that *D*iscourse, and position players to use those tools in ways that approximate how members of a *D*iscourse use them.

Researchers should note that this process of linking mechanics-facilitated in-game practices to those associated with *D*iscourses is as much art as science. It is about marshalling convincing evidence to make reasoned arguments and presenting those arguments in such a way as to make a compelling case for the claims the researcher is making. Nevertheless, analysts have at their disposal multiple points of comparison when considering the approximations of *D*iscourses afforded by opportunities to practice in games. One place to look—and perhaps an obvious one considering the focus on games for learning—is in the standards documents associated with the approximated versions of disciplinary domains taught and learned in formal K-12 education. Another place to look is in the academic literature salient to teaching and learning in particular content areas, for instance work that explicitly identifies the ways of knowing, doing, and being of professionals of the *D*iscourse of interest.

Worked Example: *Frostpunk*

This section provides a worked example (Gee, 2009) of the methodological approach I have described thus far. What follows is illustrative rather than exhaustive. A clarifying point: At issue in what follows is not whether *Frostpunk* "got it right" in regards to aligning game mechanics with disciplinary *D*iscourses; such work is evaluative, and though warranted, is not the goal of this paper. Rather, what follows is intended as technical illustration.

Frostpunk was selected for two primary reasons. First, because top-down strategy games (e.g., *Civilization*, *Surviving Mars*, *Offworld Trading Company*) often contain content relevant to disciplinary domains like economics, social studies, and STEM fields, they are sites likely to be rich in opportunities to practice using the DKSCs associated with these domains as tools to take informed action in the simulated world. Thus, *Frostpunk* was selected in accordance with the guiding principle of thematic alignment described above.

Second, *Frostpunk* is an interactive-media example of speculative fiction, a "space dedicated to investigating the world with the boundless power of human imaginations" (Wiggins, 2016, para. 4). The speculative nature of these games situates players within novel scenarios. Therefore, unconstrained by what has come before (c.f., *Civilization*), players are free to use DKSCs to solve novel challenges without the burden of doing it "right." Thus, players' use of DKSCs in such games tells us about what they are able to do and how they are able think with disciplinary tools, rather than what they know about what they "should do," which is informed more by their knowledge of what has *been* and what *is* rather than what is *possible*.

I therefore came to wonder, "What skills and ways of knowing, doing, and being in the world are presented in *Frostpunk* as being valuable at a moment when the world can be remade?" and, "How might these skills and ways of knowing, doing, and being in the world align (or not align) to school-valued approximations of *D*iscourses?" These wonderings were then formalized into research questions, which were additionally shaped by my own background in history and social studies education:

1. What is the mechanical landscape of *Frostpunk*?
2. Do *Frostpunk*'s game mechanics create opportunities for players to practice using the DKSCs associated with the social studies (history, economics, civics, geography) as tools to do work in the game world?
    a. If so, which DKSCs?
    b. And what are the characteristics of the broader contextual ecology in which these opportunities to practice exist, and how do they shape the usefulness of DKSCs to players as tools for doing work in the game world?

As discussed above, there is an important distinction between (a) drawing on the principle of discourse analysis to conduct a mechanics analysis and (b) analyzing the game itself as a communicational form. For *Frostpunk*, the latter might examine whether the game provides players the tools to remake society at all, and if so, what tools it offers and what the offering of those tools communicates about the world. For instance, if *Frostpunk* offered in-game tools for the explicit construction of social hierarchies, we might conclude the game is reinforcing existing assumptions regarding the naturalness or necessity of such hierarchies. Or, analysts might focus on the fact that the avatar citizens in *Frostpunk* all appear to be white, and thus conclude that *Frostpunk* is making a bid for (or at least assuming) a vision of the future that excludes BIPOC. Any number of such analyses may indeed be fruitful, but the mechanics analysis illustrated below is intended to foreground the structural design of *Frostpunk* in order to highlight how its mechanics create opportunities for players to practice using DKSCs as tools to do work in the game world. Thus, we proceed to identifying the game's lexicon.

Lexicon

The most basic element of a language is its lexicon, the words that are packaged together through the language's syntax to construct idea units. In *Frostpunk*, one "word" always on the screen is a six-pointed diamond, representing coal, a vital resource in the game:

[⬢] = "Coal"

Table 2 shows seven additional words in *Frostpunk*'s lexicon.

Table 2

"Words" in the lexicon of Frostpunk

"Word" spoken by game	Description
[⬢]	Symbol indicating the in-game resource, coal

[#]	Number always appearing to the right of the coal symbol
[==———]	Gauge always appearing below the coal symbol and accompanying number; when the gauge is on the left, there is more storage space available for coal, and vice versa
◈+/- [#]	Adapted symbol combination indicating the level of heat in a building. Four heat zones: Comfortable (◈+2), Livable (◈+1), Chilly (◈0), Cold (◈-1), Very Cold (◈-2), Freezing (◈-3)
Δ↑/↓	Adapted symbol indicating EITHER a positive OR negative shift in the gameworld’s temperature, with one arrow indicating an increment of 20 degrees fahrenheit
[——H-]	Adapted representation of citizens’ Hope, which appears to the player through a sliding scale always shown on the bottom of the screen. If Hope reaches zero, the player is cast out into the frozen wasteland. When Hope is high, the player is presented with more positive events in the game.
[-D——]	Adapted representation of citizens’ Discontent, which appears to the players through a sliding scale always shown on the bottom of the screen. When Discontent is high, the player is presented with more negative events, which drain resources and morale.
[EVENT]	Adapted representation of the events with which the game presents players. Events typically require the player to make difficult decisions that typically approach a 1:1 ratio of [Resource/Opportunity Cost]:[Rise/Drop in Hope and/or

Discontent]

Syntax

A game's syntax is how different "words" are combined to create "sentences" in the game. On its own, [⬢] means little. When combined with another "word," the number always located to its right, however, we get an idea unit something like:

[⬢]+[200] = "You have 200 coal."

Semantics

Literal meaning. When combined with a third "word," sentences begin to accumulate meaning. Beneath the diamond and number is a bar, the end of which can be closer to the left (indicating much storage space remaining to store coal), to the right (little remaining space), or anywhere in between. Thus, we have an idea unit something like:

[⬢]+[200]+[==———] = "You have 200 coal, and much storage space remaining."

Situated meaning. What game sentences really mean for how players choose to act, however, is grounded in the overall context of the game environment, including not just the lexicon and syntax available, but also how different combinations thereof arise throughout the flow of the game in relation to players' goals and how previous decisions have unfolded. For example, one of the primary tasks in *Frostpunk* is to keep buildings (and the people inside them) warm, with warmth indicated on a heat map the player accesses through a toggle button (◈+/- [#]). Additionally, a sliding bar on the top of the screen provides players with a weather forecast for the coming days, indicating spikes and drops in 20-degree increments (Δ↑/↓). Thus, the lexicon and semantics of the game lead to sentences and accompanying translations like those in Table 3. The last translation, in particular, illustrates how quickly these translations can become immensely rich and complex.

Table 3

Example combinations of "words" into "sentences" and their translations

Sentence Spoken by the Game to the Player	Sentence Translated by the Player
[⬢]+[200]	"You have 200 coal."
[⬢]+[200]+[==———]	"You have 200 coal, and lots of storage space remaining."
[⬢]+[200]+[◈+1]+[Δ↓↓]	"You have 200 coal, but you will need more soon, because your buildings will not be warm enough when the temperature drops another 40 degrees."
[⬢]+[200]+[◈+1]+[Δ↓↓]+[EVENT]	"You have 200 coal, but you will need more soon, because your buildings will not be warm enough when the temperature drops another 40 degrees. Furthermore, agreeing to citizens' demand to increase the heat in their homes immediately will affect your ability to heat homes when it gets even colder."

***d*iscourse and Pragmatics**

Linguists use the term *d*iscourse (lower-case 'd') to refer to language at the level above words and sentences, how people use language to construct meaning over longer stretches of time. Pragmatics refers to language in use—how we use language to do things. In videogames, then, we want to look at how different kinds of sentences appear (or not) over and over, and how that frequency of appearance moves players (through recipient design) to take some actions and not others.

In *Frostpunk*, coal production (as it relates to warmth) is the most fundamentally important task in the game—without coal, citizens freeze to death, hope falls, discontent rises, and the game is lost. Therefore, in terms of *d*iscourse, the game and player are constantly communicating about this resource. Thus, in terms of pragmatics, players repeatedly construct coal-related buildings (production, consumption, storage) and distribute citizens' labor accordingly. It is important to note, however, that all this is important only because the player is a leader of human beings. Therefore, what the player really does in *Frostpunk* relates to managing resources and distributing labor in ways that honor their community's values (at least enough to avoid being cast out of said community). Thus, we have reason to wonder whether DKSCs from the *D*iscourses associated with social studies and civics may be at play.

***D*iscourse**

*D*iscourse (capital 'D') refers to the ways of knowing, doing, and being associated with particular groups—for present purposes, those associated with academic disciplines. As noted previously, the final step in the approach I outline here is to attempt to tie what players do in a game to some larger *D*iscourse, thus culminating the systematic analysis with a resulting claim about how the game's mechanics create (or not) opportunities to practice using DKSCs to do work in the world.

Frostpunk creates opportunities to practice using the DKSCs associated with civics education, specifically those pertaining to secondary education cited in the

College, Career, & Civic Life (C3) Framework (National Council for the Social Studies, 2014), a prominent national social studies framework to guide the development of standards documents. While many of the *C3 Framework* standards applied to *Frospunk,* for this worked example, I take up the following standard: “Analyze the impact and the appropriate roles of personal interests and perspectives on the application of civic virtues, democratic principles, constitutional rights, and human rights (D2.Civ.10.9-12).”

I now refer back to the last sentence from Table 4:

Sentence Spoken by the Game to the Player	Sentence Translated by the Player
[⬢]+[200]+[◈+1]+[Δ↓↓]+[EVENT]	“You have 200 coal, but you will need more soon, because your buildings will not be warm enough when the temperature drops another 40 degrees. Furthermore, agreeing to citizens’ demand to increase the heat in their homes immediately will affect your ability to heat homes when it gets even colder.”

Encountering this game sentence, players must grapple with the personal interests of both the individual citizens and collective citizenry under their care. Players must consider what it means to be a citizen in the world they are co-building with the game: Are citizens servants of the player’s new order, or co-citizens of the collective? Indeed, the player must ask deep questions regarding their commitment to ideals of democracy and human rights, with what concepts like civic virtue, democracy, and human rights even mean in the apocalypse. Whether practiced in the real world or in digitally simulated ones, these are foundational questions (that ought to be) associated with civic education.

Conclusion: A Research Agenda and Intended Applications

The present work is conceived of as a form of invitational scholarship (Barab et al., 2009). That is, the method proposed here is an invitation to designers, scholars, and educators to contribute to the improvement of games for learning, specifically as tools in the teaching and learning toolbox used to help learners come to know, do, and be as certain kinds of people in the world. The goal of MA is not to examine individual mechanics and make claims that they always or in isolation lead to specific learning outcomes. Rather, the goal of MA as a larger research agenda is to examine mechanical use cases as confluences of mechanics with other mechanics in the context of their interaction with other game elements to provide worked examples illustrating how these confluences afford certain opportunities to practice. Over time, the hope is to establish a body of worked examples (see Gee, 2009) that illustrate successful efforts to align game mechanics with in-game opportunities for players to practice using DKSCs as tools for doing work in game worlds. Thus, claims about mechanical alignment to specific learning outcomes in games would not take the form of "Mechanic X leads to Outcome Y," but rather "Outcome Y can reliably be facilitated by Mechanic(s) X in Designed Context Z."

Designers and teachers are also intended audiences. Designers might use MA as a kind of work-checking tool to "write out in long form" the logic of how their proposed mechanics create opportunities to practice. Educators might use a short-form version of MA to evaluate and select games to support their own pedagogical goals and practice. Additionally, MA may be useful in teacher education courses for introducing preservice teachers to ways of thinking about games.

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CHAPTER 3

OPPORTUNITIES TO PRACTICE USING SOCIAL STUDIES KNOWLEDGE, SKILLS, AND CONCEPTS AS PROBLEM-SOLVING TOOLS IN VIDEOGAMES

Dewey (1916) identified the call to engage in discussion around issues of public interest a foundational purpose of democratic education. Doing so fosters a flourishing democracy, but it requires that citizens commit to finding common ground and working towards the common good (Crocco, 2008; Fung, 2005; Gibson, 2020; Nie et al., 1996; Parker, 2006, 2008, 2010). For human beings, however, finding common ground and forming common visions of a shared future require a level of trust, intersubjectivity, and shared conceptions of what counts as evidence for decision making, all of which emerge from having common experiences in the world (Gee, 2020; Harari, 2015). Yet the beginning of the 21st century saw United States citizens spending less time engaged in common activities that bridge ideological divides (Putnam, 2000), and since the advent and proliferation of social media, they seem to have reallocated their time to ideological trench warfare (Karlsen et al., 2017) and algorithmically orchestrated echo chambers (Quattrociocchi, 2017). The public schoolhouse—social studies classrooms in particular—it seems, is one of the few remaining public spaces in which citizens come together around the pressing social issues of the day (Kaka et al., 2021).

Furthermore, effective, action-oriented civic participation rests on citizens seeing the world around them as designed and (re)designable, viewing themselves as capable of exercising their own designerly agency on the world, and possessing fluency with tools appropriate for such work (see Kessner et al., 2020). The *College, Career, and Civic Life Framework for Social Studies Standards* (*C3 Framework*; National Council for the Social

Studies, 2014), a national-level framework offering guidance on the development of state social studies standards, outlines many such tools for taking designful action in and on the world. Nevertheless, viewing the world in this way does not come naturally—it requires opportunities to learn to do so, to practice doing so, and to receive feedback on situated actions taken in the context of these opportunities. Such opportunities remain atypical of many social studies classrooms, despite recent decades of scholarship championing ambitious conceptions of teaching and learning in and social studies classrooms (e.g., Bain, 2000; Banks, 2006; Barton & Levstik, 2004; Harris et al., 2019; Monte-Sano, 2010; Vickery, 2015; Wineburg, 1991a).

One teaching and learning medium that thrives in offering learners such opportunities for situated learning, practice, and reflection is videogames. In the last two decades, videogames have gained attention as teaching and learning tools across subject areas (e.g., Denham, 2018; Gee & Gee, 2017; Gee, 2003; Gresalfi et al., 2009; Holmes et al., 2017; Nelson et al., 2011). They have garnered significant attention in social studies education, as well (e.g., Gilbert, 2019; Metzger & Paxton, 2016; Squire, 2011; Stoddard et al., 2016; Wright-Maley et al., 2018). Videogames are motivating learning environments, designed to meet humans' fundamental psychological needs for autonomy, belongingness, and competence (Hayward & Fishman, 2020; Ryan et al., 2006). Well-designed videogames work in coordination with how people naturally learn anything meaningful: through experiences they have in the world in which they (a) have actions to take, (b) the consequences of which they (intrinsically) care about, while also (c) guided to parts of the experience worth paying attention to and directed away from those which are not (Gee & Gee, 2017; Gee, 2003, 2017). This, as opposed to working in opposition to how people naturally learn, as does much of formal schooling. Furthermore, game designs integrating disciplinary ways of knowing, doing, and being through conceptually and disciplinarily integrated game mechanics have shown promise in developing learners' fluency with disciplinary knowledge, skills, and concepts as tools for taking goal-mediated action in the world—that is, actions taken informed by and in pursuit of goals (Clark et al., 2015; Clark & Martinez-Garza, 2012; Sengupta et al., 2015; Sengupta & Clark, 2016). This work on disciplinarily and conceptually integrated game mechanics, however, has been done primarily in STEM subjects like math and science rather than social studies. Nevertheless, though salient research and theory suggests videogames are effective learning environments, the empirical evidence remains mixed overall (Gee, 2011), and exemplars of videogames that achieve the kinds of subject-matter learning valued in formal school settings while preserving what makes them engaging are few, particularly in social studies (see Dack et al., 2016; Stoddard et al., 2016; Wright-Maley et al., 2018).

One reason for this may lie in how we think about learning generally and about learning in games more specifically. How we think about learning shapes how the learning environments of games are designed. These designs make some learner actions possible, others improbable, and others altogether impossible (Gibson, 1979; Jordan & Henderson, 1995). Thus, because what we learn is inseparable from how we learn it (Brown et al., 1989; Gresalfi, 2009; Lave & Wenger, 1991), learning environment designs directly shape the kind of learning that can occur in videogames, which in turn affects not so much the *quality of the evidence* we gather about learning in games, but rather the *validity of the inferences* we can draw from such evidence.

This is an important point, because it directs attention to the kind of learning videogames are often enlisted to facilitate: school-based and school-valued conceptions of what counts as learning and what is worth learning. The problem with this is that school-sanctioned learning, including and perhaps even particularly in social studies, is often comprised of lists of decontextualized facts detached from anything the learner recognizes as authentic or useful (Girard et al., 2019; van Hover et al., 2010). Indeed, many "games" for learning in social studies are closer in substance to digital flashcards. Students are presented with fact-level content situated within an historical narrative and tasked with repeating that information in exchange for in-game points. Such games are akin to pipelines (Barab et al., 2019), delivering content to students in ways aligned to outdated conceptualizations of learning and knowledge as the filling of an empty vessel (Willingham, 2009). But it seems that the more effective a game is designed to support this kind of learning, the less of a game it becomes (see Kessner & Harris, 2021).

Good games that result in meaningful learning may be better conceptualized as practice spaces, populated with interesting, well-sequenced problems and useful tools for solving those problems (Gee, 2003, 2015). What players really learn in games is how to use the tools the game gives players to solve the problems presented in the problem space. The question becomes, then, "What might good social studies games, ones that both capitalize on what games do well and which engage learners in disciplinary thinking, look like?" To answer this overarching question, I selected for exploration three computer videogames thematically aligned to social studies education: *Offworld Trading Company*, *Frostpunk*, and *Surviving Mars*. I sought to answer the following research questions:

1. What opportunities to practice do the videogames *Offworld Trading Company*, *Frostpunk*, and *Surviving Mars* present to players? And, to what extent do these opportunities to practice include using the disciplinary knowledge, skills, and concepts implicated in the *C3 Framework* as tools for taking goal-mediated in-game action?
2. What game elements (e.g., game mechanics) generate these opportunities to practice?

Framing the Study

To frame this study, I draw on a sociocognitive view of learning that highlights the importance of experiences. In particular, I draw on Gee's (2015) concept of *conversations with the world*, turn-taking systems in which learners design actions in response to their environments, simulate those actions and how they anticipate the world will respond, take action, gather feedback, reflect, and act again "with due regard for the response [they] just got" (p. 6; see also Gee & Gee, 2017). As Gee noted, conversations are "co-constructed, co-designed, and performed collaboratively. Conversation is the product of 'us', not just 'I' as an isolated individual" (p. 6). In this view, players' actions in games are indeed *inter*actions *with* games. The game "speaks" to the player, telling them what is possible in the game world, what goals are worth pursuing, and suggests what actions are available to the player and which are more likely or less likely to be successful. These are what Gibson (1979) called *ecological affordances*, the actions made possible within the environment by the intersection of goals, the affordances of environmental objects, and the abilities possessed by the actor.

Most simply, games are problem spaces. They present players with problems to solve (goals) and the *toolkits* to solve them. These toolkits come as part of the *avatar*. An avatar is a specific role, or persona, players embody and through which they act within the game world. The toolkits to which players have access through their avatars are the various abilities available for doing goal-mediated work in the game. But players do not leave behind wholesale their out-of-game selves. Indeed, a triad of identities are available to players at any given time: virtual, real, and projective. The virtual identity is the [player-as-***avatar***]; the real identity is [*the* ***player***-as-avatar]; and the projective identity is the [player-***as***-avatar]. The ***italics*** placed in each identity label are meaningful, referring to the primary location of the player's identity when discussing each. In [the player-as-*avatar*], the player emphasizes the thoughts, values, beliefs, and abilities of the avatar over their own, whereas the opposite is true of [*the player*-as-avatar], in which the player's thoughts, values, beliefs, and abilities are of primary import. I am primarily concerned here with [the player-*as*-avatar], in which what the player and the avatar think, know, value, believe, and are able to do *together* matters most. Thus, players' conversation with the game world—and what they are able to do within it—are mediated by the game environment and what the player and avatar know and can do together.

Here, I am particularly interested in how the interaction between problems and toolkits generate what I call *opportunities to practice* (OTPs) (Kessner & Harris, 2021) using *disciplinary knowledge, skills, and concepts* (DKSCs) as tools for taking goal-mediated in-game actions. I use DKSC as an encapsulated term—a term that encapsulates multiple terms and comes to hold its own meaning holistically—to refer to "content" broadly defined to encompass the learnings associated with a discipline. In so doing, the term is aligned to Counsell's (2000) suggestion that separating disciplinary content from disciplinary skills present a false, distracting, and ultimately distracting dichotomy.

Drawing on Gresalfi's (2009) opportunities to learn, I define OTPs as in-game moments in which the player uses in-game tools to take goal-mediated action. Importantly, opportunities to practice are such that better, more skilled use of these tools leads to greater in-game performance, while worse, less-skilled tool use leads to worse performance. OTPs that invite and require players to use DKSCs as tools, then, are in-game moments in which the disciplinary understandings of [***player***-as-avatar] operate in collaboration with the tools available to [player-as-***avatar***] such that the actions taken by [player-***as***-avatar] approximate the authentic real-world use of the DKSCs at hand; for example, when [***player***-as-avatar] possesses a fluent understanding of the economics concept of supply and demand, and [player-as-***avatar***] possesses matching tools in the game world, [player-***as***-avatar] is able to leverage both together to do successful work in the game world in pursuit of an in-game goal.

I view the relationship between DKSCs and OTPs in videogames as emerging from a game's mechanics. *Game mechanics* are, most simply, how players take actions in games (Gee, 2015; Hunicke et al., 2004; Johnson, 2012). As an example that should be familiar to many readers, a primary game mechanic in *Super Mario World* is hitting [A] to jump. In *Oregon Trail*, players select on-screen text that communicate to the game which decisions they are making; this is also the case in the made-for-school history-oriented videogame *Mission US* (Kessner & Harris, 2021).

Literature Review

Work on videogames in social studies education has often treated the medium as an experiential means of learning content, the general assumption being that students better retain domain-relevant information when learned in an experiential context. The kind of learning such games privilege is, on the low end, fact-level content knowledge, and on the higher end, the development of insights about time periods, phenomena, and concepts. In either case, learning viewed through this lens typically focuses on the surface-level thematic content of games. For example, the made-for-school history-oriented game, *Mission US*, includes a great deal of substantive historical concepts, primarily vocabulary words like redcoats, patriots, and Sons of Liberty (Kessner & Harris, 2021). The logic of such games is that students learn about these concepts by interacting with them in the context of the game's historical narrative.

Squire's (2011) work using *Civilization III* in an afterschool program represents another approach to using videogames for learning in the social studies. Squire used the game as one piece of the broader teaching and learning ecology among many others, including texts, student interaction, reflection and debriefing activities, and himself as the teacher. Squire focused on the opportunities gameplay, in conjunction with just-in-time lectures and feedback provided in response to students' questions and challenges that emerged throughout the learning experience. Games like *Civilization* are quite effective at creating opportunities to develop deeper insights into historical, economic, political, and geographical phenomena, as well as meta-historical concepts like cause and effect and change and continuity over time (see van Boxtel & van Drie, 2018; van Drie & van Boxtel, 2008).

Significant attention has been paid in social studies to videogames as objects of inquiry, treating the games themselves as historical representations and interpretations, which can be interrogated. As Kapell and Elliott noted, the "process of selection, assembly, and presentation… means that the history that emerges would depend on: (1) Which facts are chosen, and (2) how they are put together again" (p. 5). McCall (2011, 2012, 2020) focused his attention on how game elements come together to represent historical narratives, using videogames as entrées into using historical evidence to interrogate contemporary artifacts relevant to what Nordgren (2016) called "doing things with history."

Other work has focused on what is learned in or from videogames. Gilbert (2019), for example, examined the correlation between previous experience playing the *Assassin's Creed* series and the development of historical empathy. Peterson et al. (2013) suggested games offer players the opportunity to interact with historical artifacts in context (e.g., trebuchet) to learn more about them (substantive content knowledge). They contended that, by working with a set of variables within a set of rules, both reasonably authentic to a discipline, players develop a deeper understanding of time periods, concepts, phenomena, and the historical actors (contextualization).

Research considering videogames as sites to practice domain-relevant skills, however, is scarce. Such games (e.g., *Jo Wilder and the Capitol Case*), in which game mechanics are conceptually and/or disciplinarily integrated into gameplay—meaning players take in-game actions through game mechanics that approximate or replicate concepts and tools from relevant disciplines—are more common in math and science (e.g., Clark et al., 2015; Shute, 2011).

Methods

Here I provide an overview of the methods, going into greater detail in the sections that follow. To answer my research questions, I did the following. I played several hours of *Offworld Trading Company, Frostpunk*, and *Surviving Mars*. I recorded gameplay, recorded voice memos, and utilized memoing as a means of concurrent analysis (Emerson et al., 1995). I analyzed the *C3 Framework* standards in civics, economics, geography, and history to identify the DKSCs underpinning the learning goals.

Aided by the concurrent analysis, I uploaded the video data into the computer-assisted qualitative data analysis program MAXQDA and broke the data into chunks based on where OTPs could be found. I then analyzed these chunks as pieces of conversation between player and game to identify the game elements that worked together to shape the problem space that provided players with OTPs. I drew on Gee's (2015) unified discourse analysis by viewing gameplay as a conversation, in which the "conversational partners are the player and the game" (p. 77).

The Games

Offworld Trading Company is a fast-paced top-down real-time strategy game taking place on Mars sometime in the future. By top-down I mean that players' point of view is from on high, sometimes also referred to as a god view. By real-time I mean that the game progresses directly in step with players' actions, as opposed to, for example, turn-based games, in which the game effectively pauses while players plan their next actions. *Age of Empires* is an example of the former, *Civilization* an example of the latter. The game's premise is based on Petranek's (2015) *How We'll Live on Mars*, including many of the technological details therein, but in particular the chapter discussing [neoliberalism on Mars]. Players win the game by buying out the other players, which is done by purchasing shares of their company stock and ultimately completing a hostile takeover. Players earn the money necessary to buy out their competition by gathering and selling resources, the prices of which are displayed on a market tracker on the left side of the screen. Each game takes place on a different randomly generated map, so terrain and resources are never the same twice. Therefore, the market to which players react is never the same; nor is the geography of the map influencing starting market conditions as well as how the market is likely to unfold.

Frostpunk takes place in a dystopian-future United Kingdom following an unexplained natural disaster that brought on a new ice age (though not explicit, this event is likely a commentary on the global climate crisis). *Frostpunk* is also a RTS game of sorts, though markedly different from *Offworld Trading Company* and other games of the genre like the *Civilization* or *Age of Empires* series in that players play against abstractions, not other players or the computer-as-player(s). Instead, players play against the elements and events like uprising, theft, and food shortages. The player is positioned in the role of Captain to 80 fellow survivors who have relocated from London to an old coal generator somewhere in the northlands. The player must keep the survivors alive by organizing the community's labor towards tasks like gathering resources, committing to some philosophy of social organization, constructing sufficient housing and other buildings, and the like. Players win by outlasting the events with which the game confronts them, which means they must make leadership decisions that lead to the acquisition of adequate resources necessary for community survival while maintaining

Hope and Discontent, two of the primary feedback mechanisms in the game. If Hope drops too low, and Discontent rises too high, the player will be exiled and thus lose the game.

Surviving Mars is also a RTS game, taking place on Mars in a not-so-distant future. The game narrative, as well as the game's mechanics (e.g., calling supply pods, cargo shuttles, and passenger shuttles from Earth; building moisture vaporators), are based on the real science of colonizing Mars as described in the book, *How We'll Live on Mars* (Petranek, 2015). Players take on the role of a god-like avatar (see Gee, 2015) at the helm of the colonization effort, from the early beginnings of selecting a landing site and orchestrating the efforts of drones to establish the colony and prepare it for human settlement, to later stages of the game which involves mostly maintaining the settlement and terraforming Mars. There is no clear win state, per se—rather, players compete against the Martian environment and the logistical realities of establishing and maintaining a human settlement on Mars.

I selected these games for the following reasons. First, I hypothesized each of these games invited players, by virtue of the problem spaces they presented to players and the toolkits the games provided players to solve those problems, to use DKSCs as tools to take informed, goal-mediated in-game action. *Offworld Trading Company, Frostpunk*, and *Surviving Mars* are all in the top-down strategy genre, meaning players view the gameworld through a so-called "god view" and make strategic decisions to facilitate in-game success. Such games are often thematically aligned to social studies. The *Civilization* series, for example, includes elements of history, economics, and forms of government (see Squire, 2011).

Second, these games are interactive, new-media examples of speculative fiction (see Toliver, 2019). That is, they all take place in imaginative versions of a future not yet come to pass. Therefore, players are not constrained by what has factually come before, nor by what is factually possible vis a vis contemporary techno-political realities. Thus, in such games, players are free to identify, analyze, and take action within problem spaces unencumbered by what "has happened" or "should happen." In other words, players are free to use DKSCs—provided a level of fluency—to frame and take any actions the games' mechanics allow, thus, I contend, offers a more authentic setting in which to assess learners' understanding of DKSCs and how they are or can be used in the world.

Data Generation Procedures

To generate the data needed to explore the extent to which these games invited and required players to use DKSCs as tools for taking informed, goal-mediated in-game actions, I immersed myself in the data by playing the games (Aarseth, 2003; Foster et al., 2011). I use the term "data generation" to acknowledge that the data used for this study did not exist prior to my interaction with it in the form of gameplay, screencaptures, think aloud, voice memos, and in-process memos. I generated a total of 42 hours, 38 minutes, and 12 seconds (or 42:38:12) of gameplay data in the initial phase of the study, including 15:43:07 for *Surviving Mars*, 14:18:22 for *Frostpunk*, and 12:36:43 for *Offworld Trading Company*. For *Surviving Mars* and *Offworld Trading Company*, these numbers include 4:23:24 and 3:15:27 of scripted tutorials, respectively; *Frostpunk*'s tutorials are embedded within standard gameplay. For *Offworld Trading Company*, the 12:36:43 also included 3:35:17 of scripted practice challenges.

Tesch (1990) suggested immersing oneself in the data facilitates researchers developing a depth of familiarity with the data so as to make patterns, insights, and their meanings more readily apparent than would be the case if analyzing data in pieces without the context of the whole. Additionally, Skalski and et al. (2017) noted that "experienced players are most likely to approximate how content would manifest in the population of players" (p. 216). Furthermore, videogames are deeply situative experiences, with meaning depending heavily on a confluence of complex factors and their relationship to each other (Gee, 2003). By playing the games myself, I developed a deeper, situated understanding of how the games work, which I contend is essential to facilitate validity in the analysis phase.

Gameplay is an example of what Krippendorff (2013) called a bygone phenomena: the moment the phenomena takes place, it is gone, unavailable for further analysis. Videogames are "unlike traditional media" and "must be played in real time and simultaneously recorded in order to be captured and archived for later analysis" (Skalski et al., 2017, p. 224). Thus, to facilitate further analysis, gameplay must be archived. This was achieved by screencapturing gameplay with the Windows Game Bar.

To capture the thinking that takes place during gameplay, however, an archive of what takes place on the screen is insufficient. Inspired by Wineburg's (1991a, 1991b) use of the think aloud protocol, I recorded my own thinking through the onboard feature in Windows Game Bar as I played the games. This approach represented both affordances and constraints in terms of data generation and analysis. The most obvious affordance was having a record of real-time thought processes available for later analyses.

One constraint to this approach was that it to some extent undercut immersion. Traditional think alouds are conducted with participants, with researchers often reminding them to voice their thoughts. As both participant and researcher, this option was unavailable. To alleviate this constraint, I set up a system by which I would frequently pause the game to talk through what I was seeing in the game, including the problems I had identified, the solutions I was considering, and how I thought the game might respond to those solutions. While this may in some ways have undermined my goal of immersion, I contend this constraint was minimal, because immersion, as I see it, is more about being immersed in the problem space than it is about time. Furthermore, as I accumulated more play time, I moved closer to achieving saturation, the point at which I no longer encountered new phenomena. Thus, the more I played the games, the fewer new insights I gleaned, and the less frequently I paused the game.

I also engaged in integrative memoing throughout the data generation process (Emerson et al., 1995), in which I noted commonalities identified in the in-process memos associated with each game.

Analysis

Memoing often takes place in the liminal space between data collection/generation and analysis. The memos (Emerson et al., 1995) I maintained throughout the data generation process created the foundation of concurrent analysis. I maintained in-process memos as I played, in which I recorded initial thoughts on what I saw in the game and/or my own behavior. Playing the games on a separate gaming PC, I wrote in-process memos on my laptop, which was placed next to the PC keyboard. The physical proximity of the in-process memos thus made switch from gameplay to memoing quick and easy while also serving as a physical reminder to memo. As with the above, this may have undermined efforts to maintain immersion, though I contend the benefit in terms of increased methodological rigor outweighed these costs. I also wrote what Emerson et al. called initial memos. Writing in-process memos inevitably leads the researcher to more in-depth thoughts on "discrete phenomena, topics, or categories" (p. 143). I would therefore write initial memos on these ideas using italics or the comments function of my word processor to distinguish them during later stages of analysis. As I developed a clearer sense of the ideas I wanted to pursue in the data, I wrote memos integrating analytic points across the data corpus.

Analyzing the DKSCs represented in the *C3 Framework* (the Social Studies, 2014) first required identifying them. I analyzed the *C3 Framework* standards in civics, economics, geography, and history to identify the DKSCs underpinning the learning goals stated therein. First, I examined the strands to identify the themes and concepts unifying them across the three sets of grade levels (K-2, 3-5, 6-8, 9-12). Next, I identified the DKSCs relevant to each strand.

When I say I identified DKSCs, I do not mean that I broke the *C3 Framework* strands into discrete pieces according to monolithic categories knowledge, skills, and concepts. Rather, I used the term DKSC as a way of referring to content broadly conceived as the things identified within the *C3 Framework* as important to learn. I share Counsell's (2000) perspective on this issue of demarcating between components of social studies content: knowledge, concepts, and skills work together recursively—that is, they work synergistically—and separating them from one another in efforts to attend to them in isolation in neither warranted nor productive.

Take, for example, *nationalism*, which can be viewed through a knowledge, skill, or concept lens. Nationalism as knowledge would encompass knowing *what* nationalism is, or knowing *that* nationalism is an "ideology based on the premise that the individual's loyalty and devotion to the nation-state surpass other individual or group interests" (Britannica, n.d.). Additionally, nationalism as knowledge would include knowing that nationalism constituted a significant cause of World War I and the rise of Nazi Germany. Nationalism as a concept includes understanding *how* nationalism works in the historical and contemporary world; for instance, understanding that nationalism subverts individual identity and replaces it with a new intersubjectivity built around a shared story of national exceptionalism (Harari, 2015). Nationalism viewed through the lens of skill, however, might include constructing historical arguments about how nationalism arose in Europe and dominated European politics throughout history; or drawing on history to argue in favor of or in opposition to claims that the United States of America has become increasingly nationalist in the 21st century and what implications this might hold for the future of the nation-state. Note that nationalism itself does not constitute a skill, but rather that it could be used as the focal point of skill use or skill development. I note, as well, still using nationalism as an example, that DKSCs in one domain are not isolated from those of others. Rather, I view DKSCs in the best case as being interdisciplinarily intertwined (see Thornton & Barton, 2010; Shreiner et al., 2021).

Aided by concurrent analysis, I then broke the video data into chunks based on where OTPs could be found. For example, while reviewing the video data for *Offworld Trading Company*, I identified an instance of gameplay in which the player must think in terms of marginal cost and marginal benefit to inform their choosing between multiple possible locations for a metal mine to gather aluminum. In *Offworld Trading Company*, one primary game mechanic is placing resource-extracting/producing buildings on tiles. In this episode of the data, there were three viable locations, each of which varied in distance from the player's headquarters (HQ). Because greater distance places a greater demand on fuel consumption to transport resources to the HQ, the player should, all things being equal, choose the closest available location to minimize costs associated with fuel consumption. Several additional factors inform such decisions in the game, as will be detailed in the findings section, but for simplicity's sake I will focus on one here. Each tile containing raw resources for extraction varies: low, medium, and high, yielding one, 1.5, and two units per second, respectively. Therefore, when placing buildings, the player will optimize their likelihood of success by considering the marginal costs and benefits of each placement. For example, a metal mine yielding two aluminum per second but costing 0.5 fuel may be a suboptimal choice versus one yielding 1.5 aluminum at a cost of 0.1 fuel. To capture such episodes for closer analysis, I clipped the video to include the beginning—when the decision-making process began—and end—when the metal mine was placed—of this problem. I completed this process until I reached saturation, or when I stopped seeing new problems in the data.

I began the coding process by open coding the episodes as OTPs where I identified DKSCs in use. I then assessed the strength of each OTP. That is, I evaluated the extent to which players need to use the salient DKSCs to solve the problem. This is not to say that players necessarily must understand *that* they are using DKSCs, nor that players necessarily must be able to articulate their actions through such a lens. Rather, I assessed OTP strength by considering how closely the OTP required the *kind of thinking* that would represent DKSC use. For example, when determining whether to place a metal mine on an aluminum deposit yielding two aluminum per second on a tile requiring .31 fuel per second to facilitate transport, or on an aluminum deposit yielding 1.5 aluminum per second on a tile requiring .22 fuel per second to facilitate transport, reaching the optimal decision requires thinking about tradeoffs—or more technically, thinking in the economics terms of marginal cost/benefit and opportunity cost. Because selecting the optimal choice in this scenario directly affects players' immediate and long-term in-game success (maximizing aluminum production and consequent profit while minimizing costs associated with fuel use), and because planfully making the optimal choice requires thinking about (an approximation of) marginal cost and marginal benefit, such OTPs were coded as strong regarding using the DKSCs of marginal cost and marginal benefit as tools for taking informed in-game actions.

When writing the vignettes that follow, I watched and rewatched the episodes of gameplay they describe, sometimes transcribing salient quotes from the audio into the vignette.

Findings

The following research questions drove this study:

1. What opportunities to practice do the videogames *Offworld Trading Company*, *Frostpunk*, and *Surviving Mars* present to players? And, to what extent do these opportunities to practice include using the disciplinary knowledge, skills, and concepts implicated in the *C3 Framework* as tools for taking goal-mediated in-game action?

2. What game elements (e.g., game mechanics) generated these opportunities to practice?

In this section, I begin by presenting an overview of the OTPs identified in the three games. I then present three vignettes of gameplay, including a narrative analysis to facilitate making sense of what these vignettes show in terms of DKSCs use.

Readers will remember that I looked for opportunities these games present players to practice using DKSCs to plan and take in-game actions, as well as the game elements that constructed the problem spaces that afforded this tool use. As such, though it may certainly be the case *Offworld Trading Company*, *Frostpunk*, and *Surviving Mars* are useful for introducing content to learners with the intent of preparing them for future learning in social studies, this was not the focus of this study. Rather, as I have conceptualized them, OTPs must invite and require players' use of DKSCs as tools for identifying, understanding, and solving problems in such a way that better or worse use of these tools leads directly to better or worse in-game outcomes for the player.

Overview

Taking the three games together as a unified sample, I identified many strong economics OTPs; fewer, and slightly weaker geography OTPs; very few, and very weak civics OTPs; and no history OTPs. Table 1 offers a closer look at OTP frequency and strength in the three games taken separately.

Table 1.

Frequency and strength of opportunities to practice using disciplinary knowledge, skills, and concepts as tools for taking goal-mediated in-game actions in Offworld Trading Company, Frostpunk, *and* Surviving Mars.

	OTP frequency	OTP strength

Offworld Trading Company		
Civics	N/A	N/A
Economics	Very high	Very strong
Geography	High	Strong
History	N/A	N/A
Frostpunk		
Civics	Very high	Moderate[1]
Economics	High	Strong
Geography	Low	Very weak
History	N/A	N/A
Surviving Mars		
Civics	Low	Very weak
Economics	Low	Weak
Geography	High	Weak
History	N/A	N/A

[1]This is more complicated than it first appears, a discussion of which is included below in the subsection specific to *Frostpunk*.

Offworld Trading Company

Offworld Trading Company was the best of the three games in terms of exemplifying OTPs. As *Offworld Trading Company* is a game explicitly grounded in economics, I expected to find many such opportunities to practice using economics-relevant DKSCs. I also expected to find some level of geography DKSCs in *Offworld Trading Company*, because each game takes place on maps in which geographical features are prominent. I also expected to find approximations of historical thinking in *Offworld Trading Company*, namely second-order concepts like cause and effect and change and continuity over time. Because *Offworld Trading Company* is explicitly premised on a neoliberal conception of economics as a zero-sum game of competition, I did not anticipate finding strong civics-relevant opportunities to practice.

Consistent with these expectations, I identified many strong OTPs for economics in *Offworld Trading Company*, fewer and slightly weaker ones for geography, and no meaningful ones for civics. Contrary to my expectations, I identified no history-relevant OTPs concurrent with the how the *C3 Framework* frames history.

Frostpunk

Frostpunk is premised on the formation of a new society, and as such, I expected to identify many civics-relevant OTPs related to deep questions in the domain, e.g., citizenship, power, inclusion, political structures. Additionally, because players shape their city to some extent in response to geographical features in and around their city, I anticipated identifying geography-relevant OTPs. Because the decisions players make throughout the game possess tradeoffs, I expected to find economics-relevant OTPs. Nevertheless, I expected these economics OTPs to be weak relative to a game like *Offworld Trading Company*, because the game does not include a market, or the ability to buy, sell, or trade goods, as many other RTS games do. I also expected to find history-relevant OTPs, because the actions players take directly correlate to how the game unfolds.

The civics OTPs I identified in *Frostpunk* were weaker than I had expected. As noted in the above table, this is a nuanced point. On the one hand, *Frostpunk* frequently presents players with decisions related to foundational ideas of civics and government; for example, is a society best built upon incentives for prosocial behavior, or upon disincentives for antisocial behavior? Is the player's responsibility as leader of this new society to develop a society designed for maximal inclusion (at the risk of potentially undermining the city's chances for survival), or is it to maximize protection for those already there? On the other hand, the strength of what would otherwise be clear civics OTPs are potentially undermined by the game's mechanics surrounding these choices: *Frostpunk* presents players with this-or-that decisions, and because one of the core mechanics of the game involves explication of each possible choice's consequences. For example, when informed food thieves have been caught, players can choose to (a) banish them, (b) let them go, or (c) lock them up. Players are told in no uncertain terms what the respective consequences will be for gameplay: (a) discontent will rise, hope will fall, and three citizens will never be seen again; (b) discontent will rise, hope will fall; (c) discontent will fall, hope will rise. Thus, because OTPs require players to use DKSCs to identify problems and plan, simulate, take, and reflect on actions in response to those problems, these were not coded as OTPs. In short, by explicitly presenting players with prefabricated dilemmas and explicitly identifying outcomes, the game does not require players to do the identification, planning, and simulating I contend is necessary to rise to the level of an OTP.

Still, dismissing such decisions out of hand because of the game mechanics may neglect to take into consideration the nature of games, in which it matters just as much who players are trying to be within the bounds of the game. As I played, I noted I felt uncomfortable making some decisions, such as turning away sick or injured refugees, because I did not want to be the kind of person who would do so—even in this fictional world. Additionally complicating the identification of civics OTPs here is the conception of civics as a discipline in the same vein as economics, geography, or history. Civics, at least as outlined in the *C3 Framework*, is less about ways of thinking or tools for doing than it is about ways of valuing within a pluralist representative democracy premised upon inclusion and diversity. As such, the kinds of decisions presented to players in *Frostpunk*, particularly those made directly contrary to the likelihood of in-game success as afforded by the game's mechanics, may in fact count as civics OTPs.

Regarding economics, *Frostpunk* invites and requires the kind of economic thinking associated with identifying, considering, and managing tradeoffs, but the lack of any mechanics that could be viewed as framing a market limited many of the DKSCs represented in the *C3 Framework*. Regarding geography, the location of resources on the limited map played an important role in influencing players' decisions about building placement. Nevertheless, a lack of viable alternatives created a "See resource, go to resource" framing of the problem space, thus obviating the use of geography DKSCs to take goal-mediated in-game actions. Additionally, while players can choose to research certain technologies and take certain actions in response to the need to travel great distances on the broader map beyond the city, these decisions came down simply to issues of distance, and not anything more complex. I identified no history DKSCs that aligned to the conception of history as framed within the *C3 Framework*.

Surviving Mars

Like *Frostpunk*, *Surviving Mars* is premised on the formation of a new society. As such, I expected to find OTPs related to civics. Because a main mechanic in *Surviving Mars* involves leveraging Earth-side funding to supply the colony with resources from Earth, I expected to find economics OTPs. I also expected to find geography OTPs, because the game map incorporates physical features of the Martian landscape (e.g., craters, canyons, areas more or less prone to natural disasters like meteors or cold waves).

Contrary to my expectations, my analysis of the data identified few meaningful OTPs associated with any social studies discipline. Though the game offers players a mechanic by which to select and/or exclude prospective colonists based on specializations (e.g., botanist, scientist, engineer), perks (e.g., composed, empath, workaholic), and flaws (e.g., alcoholic, chronic condition, lazy), the complexity of the game makes identifying and reflecting on the outcomes of these choices difficult if not impossible. Regarding economics OTPs, the seemingly endless supply of funding negated the consequences of choices that might otherwise represent OTPs related to cost-benefit, opportunity cost, and marginal cost and marginal benefit. Geography OTPs were frequent—players must orchestrate how their settlement unfolds according to where resources are located. Nevertheless, these OTPs were weak due to two factors. First, as discussed above in the context of economics, the seemingly endless supply of funds and shuttles made pursuing a self-sufficient settlement unnecessary, if not altogether undesirable. Second, the location of resources influenced player behavior in much the same way it did in *Frostpunk*: locate resource, go to resource—the lack of viable alternatives obviated the need to use geography DKSCs as tools to identify and frame the problem and subsequently identify, plan, simulate, act on, and reflect on solutions. I identified no history DKSCs that aligned to the conception of history as framed within the *C3 Framework*.

Vignettes

A comprehensive accounting of the gameplay that led to the findings reported herein is not possible in this medium. Thus, in what follows I present three vignettes from the data, each intended to present readers with (a) a snapshot of an episode of gameplay,

(b) the OTPs illustrated therein, (c) their strength, (d) which game mechanics work to generate those OTPs, (e) which DKSCs are needed as tools to solve the problem embedded in the OTP, and (f) the strands of the *C3 Framework* to which the OTPs align.

The first two vignettes come from data generated during gameplay of *Offworld Trading Company*. I present two vignettes for *Offworld Trading Company*, in contrast to the one presented for *Frostpunk*, because it is the stronger game in terms of OTPs. I present no vignettes for *Surviving Mars*, because analysis of the data revealed few OTPs of significant strength related to teaching and learning social studies as put forth by the *C3 Framework* . Both *Offworld Trading Company* vignettes represent several core game mechanics and the DKSC use associated with them, meaning that the mechanics—and thus the thinking—are presented frequently throughout the game. Nevertheless, a persistent challenge in reporting qualitative data on gameplay of any good videogame is that the immense number of things going on in a game makes it quite difficult to explain any scenario, what it means to players, and what their consequent actions mean. The trouble is that being too succinct presents the major risk that readers will not understand the presentation of the data, given that, without playing the game themselves, they will not understand the context necessary for grasping the situated meaning of the details presented in the data. On the other hand, too much detail risks readers losing the forest through the trees—to say nothing of the constraints associated with word count. In what follows I have attempted to strike a delicate balance between helping the reader better understand the context in which the events presented in the data take place and being clear and concise. I decided to lead with the first *Offworld Trading Company* vignette because it aids in illustrating many of the relevant details regarding *Offworld Trading Company* gameplay, aiding the reader in making sense of the second vignette.

Vignette 1

This vignette begins just after the player has placed their HQ, and the first decision the player takes up is what to do with the three land claims with which they start the game—what buildings to place and where to place them. Land claims are used to claim ownership of a map tile (and access to the resources upon it). Land claims are a finite resource: once they are spent, they cannot be unspent. In other words, claims are permanent and non-transferrable. These early choices are particularly important, because suboptimal decisions lead to inefficient use of resources, slowing the player's progress and hampering their ability to keep pace with the competition. In *Offworld Trading Company*, trouble often becomes clear only once the inertia of one's decisions is too great to overcome. Thus, building selection and placement—a core means by which players take goal-mediated action in *Offworld Trading Company* —is directly and tightly tied to in-game success. Furthermore, the problem space presented to the player invites and requires the use of many of DKSCs represented in the *C3 Framework* (see Table 2), including 80% of economics DKSCs and 83.3% of geography DKSCs (see Figure 1).

Table 2.

DKSCs from the *C3 Framework* used as tools for taking goal-mediated action in Vignette 1.

Economics - Economic decision making	
C3 Framework strand	DKSC
D2.Eco.1	Scarcity Supply and demand Cost-benefit Incentives

D2.Eco.2	Cost-benefit Incentives Marginal cost Marginal benefit
Economics - Exchange and markets	
D2.Eco.3	Capital Incentives Market
D2.Eco.4	Competition Supply-demand-price-quantity
D2.Eco.5	Currency Transactional costs Competition Supply-demand-price-quantity
D2.Eco.6	Capital investment Supply-demand-price-quantity
D2.Eco.7	Cost-benefit Production costs
D2.Eco.8	External cost-benefit Market outcomes
Economics - The national economy	
D2.Eco.10	Interest rates Influence of spending and production on market conditions
D2.Eco.13	Capital goods Productivity and capital goods
Economics - The global economy	
D2.Eco.14	Comparative advantage Marginal cost Marginal benefit Competition
D2.Eco.15	Economic interdependence
Geography - Geographic representation: Spatial views of the world	
D2.Geo.1	Reading maps as decision-making tools How maps influence decisions and goals
D2.Geo.2	How place shapes decisions and goals How place shapes economies
D2.Geo.3	Cultural and environmental characteristics of place
Geography - Human-environment interaction: Place, regions, and culture	
D2.Geo.4	How “culture” shapes choices and adaptations Reciprocal interaction between human and physical systems
D2.Geo.6	How environment shapes population distribution
Geography - Human population: Spatial patterns and movements	

D2.Geo.7	Push and pull factors
D2.Geo.8	Relationship between environment and human needs How location and use of resources relate to human movement and settlement
D2.Geo.9	Relationship between physical environment and economic activity
Geography - Global interconnectedness: Changing spatial patterns	
D2.Geo.11	How consumption of products connects people across space How use of scarce resources contribute to conflict

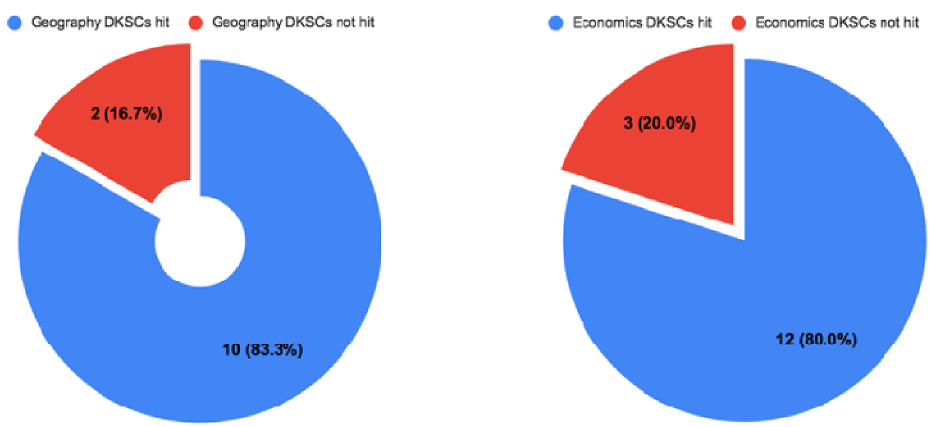

Figure 1. Percentage of economics and geography DKSCs hit through gameplay reported in Vignette 1.

In this episode of gameplay, we examine the player's decision to place, and where, an aluminum mine. The player is playing as Reclamation Industries, which for present purposes means the player uses aluminum, carbon, and glass as their primary building materials. These resources are used for leveling up the HQ and are thus typically higher priority for players playing as this faction, because accumulating these resources quickly means keeping pace with or, ideally, outpacing the competition in terms of entry into and activity in the market, giving the player a distinct advantage. Because leveling up the HQ also gives the player additional claims on which to build new buildings, leveling up quickly creates a second advantage: more resource- and goods-producing buildings sooner. In short: more profit and thus greater in-game success.

Building selection and placement on the map is a primary way players take action in *Offworld Trading Company*. Buildings like metal mines, water pumps, and elemental quarries are used to extract raw resources from deposits indicated on the map, which can be sold for profit at the current market price, used to construct more buildings or upgrade the HQ, or used as capital goods to make secondary goods. Other buildings like glass kilns, electronics factories, chemicals factories, steel mills, and greenhouses use these resources to produce higher-revenue goods needed for upgrading the HQ and selling on the market. For example, a glass kiln consumes 0.2 power, 0.25 oxygen, and 1.0 silicon to create 0.5 glass per second, which, depending on market conditions, is usually a more valuable secondary good than the aforementioned capital goods.

In this episode of gameplay, aluminum is plentiful, meaning there are several high-density aluminum hexes and that concentrations of aluminum deposits are distributed evenly across the map (see Figure 2). The player has placed their HQ on top of one of these fields, consequently collecting 55 aluminum from the deposits directly beneath. The problem posed to players here can be phrased thus: Where is the best location for an aluminum mine?

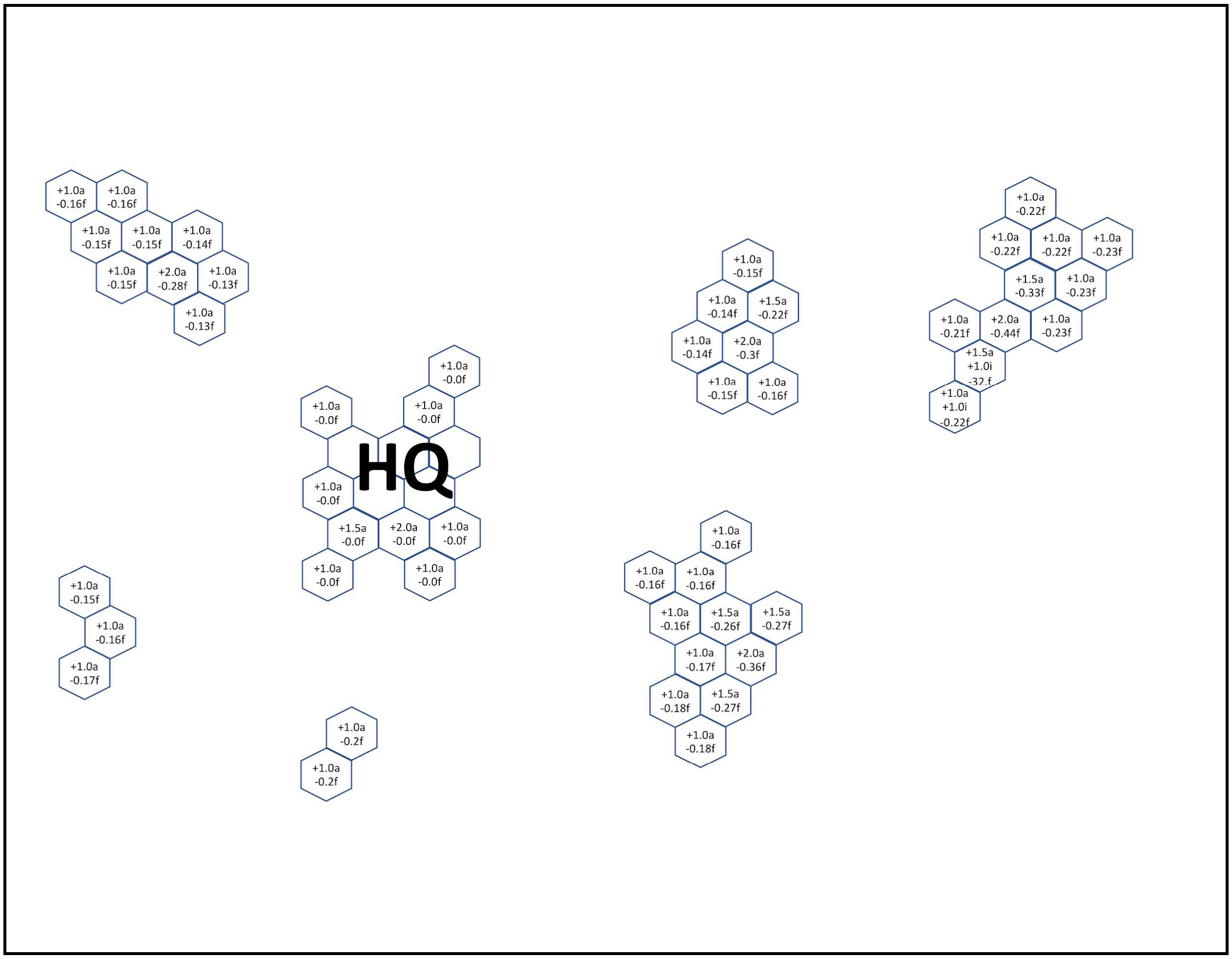

Figure 2. Map of aluminum locations (not to scale).

Several sets of factors inform this decision, or what counts as the "best" location for any given building. Indeed, these sets of factors inform decisions regarding building selection and placement of any kind at all stages of the game. I break these sets of factors into three categories: general; market conditions, which is in turn broken into current and anticipated; and geography. The partition of these factors into categories is largely artificial but is nonetheless helpful. Readers should note that many factors from across the categories I present operate recursively with each other; that is, most or all in-game decisions are informed by many of these factors at once, and different factors take on different weights according to the unique confluence of variables associated with each skirmish game, including map geography; the location, distribution, and density of resources; beginning and unfolding market conditions; and player and AI choices in response to these and many other emergent conditions.

The first set of factors is general in nature. The most rudimentary factor informing placement of an aluminum mine (or any other resource-gathering structure) is the density of the resource deposit. Raw materials are represented on the map by cubes (metals; green for aluminum, red for iron), cylinders (blue for water), and tetrahedrons (elements; yellow for silicon, black for carbon). There are three levels of density: low, medium, and high. Low density is represented by one of the above symbols on its own in the middle of a hex, and medium and high densities are represented by two and three of these symbols, respectively, stacked atop one another. Low, medium, and high densities yield 1.0, 1.5, and 2.0 of the resource per second, respectively. With this information on its own, the task of maximizing aluminum production would be a simple one: locate a hex with three green cubes and place a metal mine there. Of course, were it so simple, it would be unlikely any meaningful OTPs would exist here.

Players also receive various bonuses and perks that inform how they view optimal building placement, depending on which of the four factions the player decides to play as. All factions receive adjacency bonuses by placing two buildings of the same type on conjoined hexes, generating a 50% bonus to both buildings' production levels without increasing consumption of capital goods. For example, placing two glass kilns on conjoined hexes yields a total of 1.5 glass/second, whereas placing them apart from one another yields just 1.0 glass/second. Similarly, placing the same building on three adjacent hexes creates a 75% production bonus. Again using glass kilns as an example, this would result in 2.626 glass/second. Thus, the player quickly comes to see the game map in terms of triads: groups of three conjoined hexes (see Figure 3).

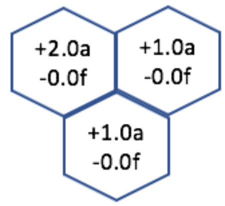

Figure 3. Hex triads.

Some factions have additional bonus conditions that may inform players' decisions regarding building placement. The Robotics faction receives production bonuses for placing buildings next to power-generating buildings (solar panels, wind turbines, geothermal plants) and buildings that produce related capital goods (e.g., glass kiln next to a silicon mine). The Scientific faction can place secondary goods-producing buildings directly on deposits of input resources (e.g., glass kilns on silicon deposits). In any case, these mechanics change how players (should) see the hexes: rather than hundreds of individual hexes—or in the present case of placing an aluminum mine, 52 individual aluminum hexes—the player sees groups of hexes, because together they hold a different situated meaning than hexes on their own.

Thus, the player's previously simple task of maximizing aluminum production has become somewhat more complex. Rather than simply locating a single high-yield aluminum hex and placing a metal mine atop it, the problem presented to the player can now be phrased something like this: identify the triad of aluminum hexes that together represent optimal aluminum production (see Figure 4).

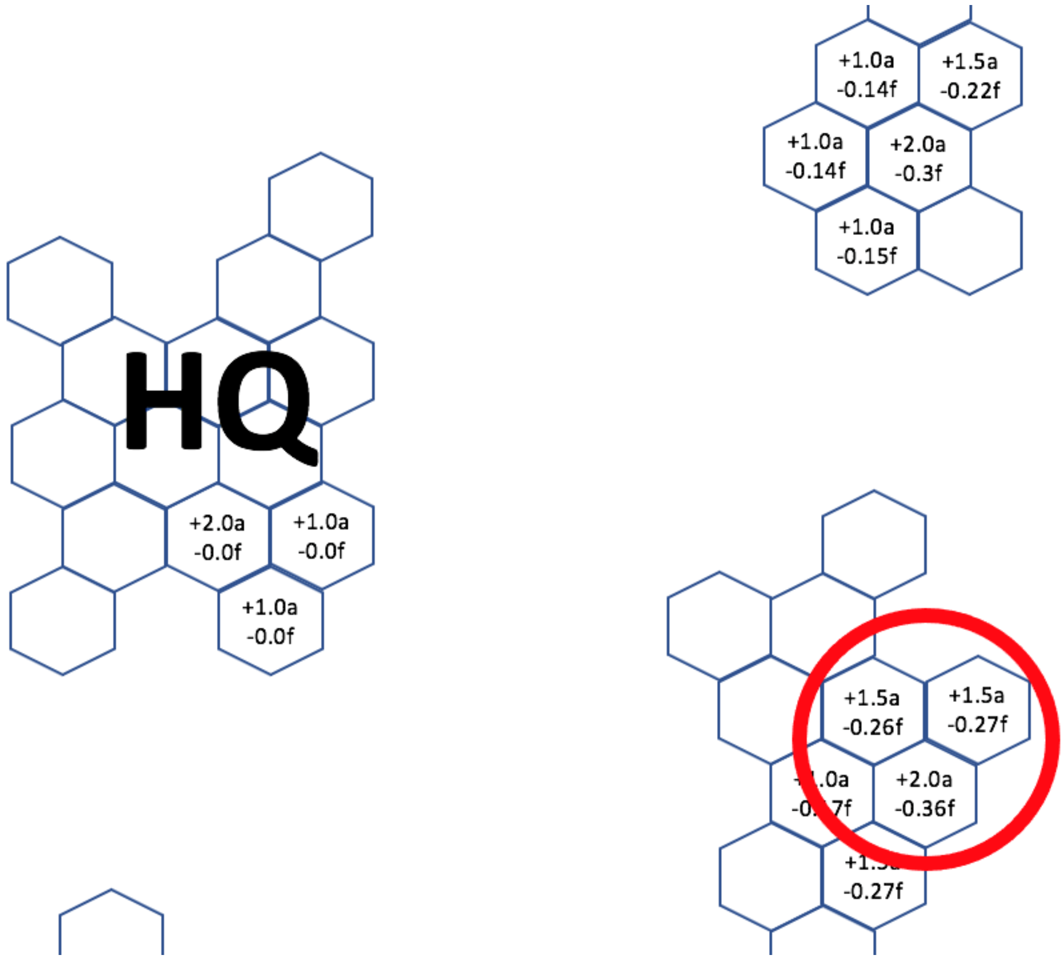

Figure 4. Optimally productive aluminum hex triad.

Based on these factors, the player should identify the hex triads shown in Figure 4 do a shorthand version of the calculations outlined earlier, identify the triad highlighted in Figure 4 as the optimally productive triad, and place a metal mine on one of those hexes. Indeed, this is often a strong strategy for producing goods quickly. Nevertheless, this is still only part of the story.

The next set of factors regards market conditions. Each game in *Offworld Trading Company* takes place within a randomly generated set of market conditions. Typically, one or two goods have a high starting price ranging between $100 to $200; several begin around $40-$60, and others have a starting price around $10 or $20. The market contains 13 goods in total. Some of these—power, oxygen, fuel, aluminum, iron, carbon, and silicon—are what economists call capital goods: goods that are used in the production of other goods. These other goods—food, steel, chemicals, glass, and electronics—are used for a variety of purposes: maintaining life support, upgrading the HQ, building advanced high-revenue buildings, and selling for profit on the market. Successful players reference market conditions to inform their decisions about what buildings to place, when, and where, because failing to do so fails to optimize the use of scarce resources and almost assures in-game failure.

Additionally, players do well to consider the market in two ways: current and anticipated market conditions. Current market conditions are just that: the price of, supply of, and demand for given goods at the time the player is making any decision. This includes capital and non-capital goods alike. Table 3 shows the prices of all 13 goods at the time the decision portrayed in this vignette was made.

Table 3.

Starting prices in *Offworld Trading Company* Skirmish Game 26

Goods	Price
Power	$20
Water	$40
Food	$120
Oxygen	$40
Fuel	$20
Aluminum	$40

Iron	$10
Steel	$60
Carbon	$40
Silicon	$20
Chemicals	$80
Glass	$80
Electronics	$50

The starting prices of both capital and secondary goods should inform players' strategy. One strategy players might employ to get a fast start is maximizing production of high-price secondary goods and selling them on the market. Players would then seek to upgrade their HQ with cash rather than resources. Nevertheless, this strategy relies on substantial net profit, and the cost of associated capital goods must therefore be taken into account. Based on the market prices for SG26 in isolation, the contenders for this strategy are food, chemicals, and glass. Food costs power and water to produce, and thus may represent a good option in the present scenario due to their low prices. Chemicals (power, fuel, carbon) and glass (power, oxygen, silicon) might be good options but for the fact they are produced in half units (0.5), thus doubling the cost of their inputs. Thus, based on starting prices, producing one unit of food, chemicals, or glass generates a net-worth asset of $36, $26, and $16 per second, respectively.

Economic concepts like supply and demand and opportunity cost also come into play when planning and taking in-game actions. Surveying a map like the one shown in Figure 2 would show there is a high supply of quality aluminum deposits. Additionally, awareness of other players' resource needs—the fact that every faction uses aluminum as base building material—and the knowledge that the production of high-price secondary goods like electronics require aluminum mean there is also high demand. In the present case of placing aluminum mines, the high supply and high demand suggest aluminum may not be a pressing need. This in turn suggests a steep opportunity cost associated with placing an aluminum mine in lieu of a different building. While this opportunity cost might be offset by a lower supply, such is not the case here.

Nevertheless, achieving success in *Offworld Trading Company* requires a more nuanced view of these economic concepts than is represented by traditional textbook explanations. The geographical considerations with which *Offworld Trading Company* players contend are outlined in greater depth below, but I will mention them here, as they are relevant to illustrating the nuanced understandings to which I have referred. Strictly speaking, the supply of aluminum on the map shown in Figure X is high: there are many aluminum deposits, and many of them are high-yield. Nevertheless, what is less high is the supply of (high-yield) aluminum deposits sufficiently close to the HQ. Transporting goods in *Offworld Trading Company* uses fuel direct proportionate to distance traveled. Thus, players do not frame the supply part of the problem space as, "What is the supply of aluminum on the map?" but rather, "What is the supply of aluminum on the map *that is close enough to minimize associated fuel costs*?" The difference is nuanced, but substantive. The answer to the former question is something like, "The supply is so high it is not worth worrying about right now," while the answer to the latter is, "The supply of high-yield aluminum deposits that eliminates all associated fuel costs to me is one, the supply of high-yield deposits that come with high associated fuel costs is two, and the supply of high-yield deposits that come with borderline prohibitive associated fuel costs is one." Thus, the opportunity cost of failing to claim that one tile is in fact much greater than it might at first appear.

Success in *Offworld Trading Company* is also based on anticipating future market conditions. One way of anticipating future market conditions is by drawing on previous experience with the game. As I discussed above, claiming hex triads is one strategy for maximizing production in many cases. Seasoned *Offworld Trading Company* players, however, likely know two things pertinent to placing aluminum mines. First, a single aluminum mine placed on a high-yield hex is almost always productive enough to support a player throughout an entire game, including through HQ level ups, the construction of new buildings, and the creation of secondary goods like electronics. Thus, placing two aluminum mines, let alone three in a triad, would likely flood the market with surplus supply. This, in turn, would devalue the player's investment of building materials and land claims, itself the scarcest—and thus arguably the most valuable—resource in *Offworld Trading Company*. Though players always have the option of demolishing an existing building to free up a land claim, the claim is non-transferrable from the original hex on which the claim was placed. Furthermore, aluminum hexes do not support other metal mines, elemental quarries, or water pumps, and it is not guaranteed any given aluminum hex would be an optimal or even satisfactory location for other buildings; e.g., solar panels and wind turbines are more productive on some hexes than others, and the price of, say, glass might not justify the cost of shipping it from a glass kiln placed on an old aluminum mine, depending on fuel price and the distance from the hex to the HQ. Therefore, reusing an aluminum hex in this way in unlikely to lead to optimal gameplay. Thus, the mechanics of *Offworld Trading Company* in this case generate OTPs salient to several DKSCs embedded within the *C3 Framework*, including: opportunity cost, supply and demand, and marginal cost/benefit.

Second, aluminum is rarely in short supply or high demand, largely because every faction uses aluminum as a basic building material. Every player, therefore, typically produces aluminum throughout a game, driving supply up, demand down, and lowering the price. As with the previous, the long-term implications of the many opportunity costs associated with placing more than one or two aluminum mines often makes building aluminum mines in triads a suboptimal strategy.

Incentives, debt, and supply and demand also comes into play in anticipating future market conditions and using that information to inform choices about which building(s) to place, when, and where. Returning to the above option to produce food ($120) in quantities sufficient to pursue a cash-heavy upgrade strategy, this may be a suboptimal strategy when taking incentives, debt, and supply and demand into account. In this scenario, all the players in the game use food as life support. Thus, food demand should initially be high. Nevertheless, with the high price, the fact that players should avoid going into too much debt too quickly, and that every unit of food not produced by a given player is profit for the competition, all players are incentivized to produce food. Should this happen, supply would likely outpace demand, driving down price and devaluing the player's investment (of glass to produce greenhouse farms, in particular) in food production. Therefore, the player has reason to believe the food market is too volatile to invest in too heavily, hence the player's decision to focus on the relatively safer option of investing in one their primary building materials, aluminum, a resource useful to the player regardless of market conditions.

Players also have several ways of acting directly on the market to actively shape future market conditions to their benefit. One way players can do this is by buying or selling goods. Buying goods artificially drives demand, increasing price, while selling goods lowers price by creating surplus supply. This is, however, a largely ineffective long term strategy, as the market tends to quickly return to equilibrium. What is interesting, however, is that the low utility of this strategy actually makes a strong learning opportunity: players quickly learn that a free market will always return to equilibrium. Similarly, players can use an advanced building called the Hacker Array to send false signals to the market to drive up or down the price of a chosen good. Again, these spikes and dips tend not to be permanent, but can be useful in generating short-term profits or putting competitors at a disadvantage. Players can also anticipate market conditions based on their reading of the geography, which itself is a major influence on players' decision making in *Offworld Trading Company*.

Geography plays a significant role in how players think about their options. One major consideration players must take into account regarding geography is the distance (measured in hex tiles) from their HQ to other hex tiles. This is for two reasons. First, resources are transported from goods-generating hexes to the HQ via shuttles, which burn fuel. Fuel, like the other goods in the market, fluctuates in price according to market conditions, including supply and demand. Thus, players should take the price (current and anticipated) of fuel into account when placing any building that consumes fuel. This includes transport costs as a function of distance traveled as well as in terms of capital goods cost (e.g., producing chemicals). Second, constructing buildings requires that a shuttle travel to that location to begin construction. Again, shuttles require fuel.

Additionally, shuttles travel at a constant speed, meaning the player should take travel time, which increases in proportion to distance, into account when considering construction time of a new building. The weight of goods being transported also affects fuel cost proportional to distance travelled. Thus, while a high-density deposit is objectively superior to medium- or low-density deposits taking yield as an isolated variable, high-density deposits increase fuel consumption. Thus, a lower-density deposit may be preferable depending on the amount of fuel required, particularly because fuel prices tend to rise quickly and remain high throughout games.

Another consideration regarding geography in *Offworld Trading Company* is deposit distribution. As noted above, game maps are randomly generated. Consequently, the distribution of a given resource may be fairly balanced, with fields of resources distributed evenly across the map, or it could be quite uneven, with fewer fields concentrated in isolated areas. A map with plentiful and evenly distributed iron, for example, would have little impact on players' choice of faction; whereas one with little iron concentrated in an isolated location would benefit players playing as Reclamation Industries, a faction that does not use iron or its secondary good, steel, in construction. Additionally, players of any faction could capitalize on such a geography by anticipating that a low natural supply of iron would create a market equilibrium in which the price of iron and its associated goods and activities was high. Player might act on this by landing on a lone iron field (thereby blocking other players from the field for a time while also collecting any iron beneath the HQ) and claiming as many iron hexes as possible, thereby lowering the supply of iron, increasing demand, and creating a monopoly.

Deposit density is also randomly generated for each map. As noted above, high-density deposits produce twice as much of a resource as low-density ones. High-density deposits are typically in short supply relative to lower-density ones, and many *Offworld Trading Company* maps feature only one or a few such deposits for a given resource. Returning to the case of iron, a resource all factions but Reclamation Industries requires to upgrade the HQ, a dearth of high-yield iron deposits translates to low supply relative to demand and would therefore suggest rising prices as the game proceeds. Finding a way to capitalize on this expected market condition would be a strong strategy.

The player ultimately chooses the high-density aluminum mine directly connected to their HQ, a decision informed by a careful consideration of several factors included in the economics and geography strands of the *C3 Framework* (see Table X). The thinking process involved in planning and taking informed in-game actions in *Offworld Trading Company* is clearly complex, even for seemingly simple decisions like whether and where to place an aluminum. What makes this process all the more interesting is that it is conducted quite quickly. It is important to note that, while this particular scenario may, on the surface, appear obvious, it nevertheless remains a representative illustration of the many similar problems to which players frequently attend in *Offworld Trading Company*.

Vignette 2

In this second vignette from *Offworld Trading Company* I describe an episode from SG27 in which the player uses DKSCs pertaining to geography and economics to make sense of the problem space and plan effective short-, intermediate-, and long-term strategies. A quick survey of the SG27 map reveals portions of the map covered in dry ice. Dry ice tiles contain oxygen and carbon, which players can extract by placing solar condensers (+0.5, +0.5), though these operate only during daylight hours.

In the course of uncovering parts of the map, the player identifies dry ice tiles also containing silicon. Such tiles provide particular incentive to select the Scientific faction, whose buildings obviate the need to commit land claims to the purposes of resource extraction by drawing directly on a tile's raw materials to produce goods, regardless of resource density. The cost of capital goods is thus significantly mitigated for the Scientific faction as long as their secondary goods-producing buildings are placed upon tiles containing one or more of the input resources. As glass prices are high ($153) to begin this game, this is an enticing HQ placement. The Scientific faction can place glass kilns on these hexes to produce a high-price good while drawing directly on the silicon and oxygen on the tile, thereby incurring neither (a) the cash cost of auto-purchasing these raw materials, nor (b) the opportunity cost of placing separate buildings to obtain silicon or oxygen. Furthermore, by placing a Scientific HQ in such a way that one of the contiguous silicon/dry ice tiles is connected to the HQ, the player can construct two glass kilns on these tiles, simultaneously bypassing the high cost of fuel ($80) for the time being by obviating transport costs and capitalizing on the high price of glass by collecting two capital resources with one building placement, thereby making capital costs negligible.

The player then plans the following strategy: Maximize liquid capital by producing and selling glass at the cost of power (-0.2p*$22=$4.4/s) and use that liquid capital to quickly upgrade the HQ. Nevertheless, the player has taken a significant risk in locating their HQ far from other needed resources to capitalize on the silicon/dry ice tiles and the high price of glass.

Here, the player is playing a delicate game. Though leveraging a combination of geography and economics DKSCs to inform their strategy, the risks are high. On the one hand, the player is exploiting the unique affordances of a region's geography—the rare presence of silicon and oxygen on the same tiles—informed by economics concepts like vertical integration and comparative advantage. As I describe next, however, the player is also aware of the substantial risks they have taken: their HQ is now located prohibitively far from the other resource deposits essential for avoiding debt and securing in-game success, including water (used for life support and producing fuel), iron (for steel production), and aluminum (a primary building material, and also a component in electronics production). Transporting goods across such distances will force the player to incur massive fuel costs, an already pricey resource. Furthermore, based on the player's reading of the rocky terrain and erratic distribution of resources on the map, they deduce the price is likely to climb in response to rising demand as each of the other players face similar geographical challenges.

A critical component of the player's strategy, therefore, is taking advantage of the Patent Lab, an advanced building available at HQ Level 2. The Patent Lab allows the player to use chemicals or cash to research technological innovations providing various benefits. In this case, the player is keen to patent the Teleportation technology, which moves goods and resources produced anywhere on the map instantaneously to the player's stockpile, thereby eliminating reliance on fuel for transport. The Patent Lab operates on a strict first-to-market basis: once patents are researched, other players may not acquire those technologies. In addition to the DKSCs described above, we see here another way in which the player uses DKSCs from both geography and economics to plan and take in-game actions. In addition to the ability of secondary goods-producing buildings to draw raw materials directly from their underlying tiles, the Scientific faction has two additional bonuses: their Patent Lab works 20% faster, and they begin the game with a Goon Squad, a Black Market ability used to defend against competitors' efforts to sabotage other players' buildings. By choosing to play as the Scientific faction in response to the map's geography, rushing to HQ Level 2 to build a Patent Lab, protecting it with a Goon Squad, and researching Teleportation with all haste—temporarily ignoring other significant needs to do so—the player is making calculated decisions based on their reading of the problem space, which is informed by geography and economics DKSCs.

With a strategy planned, the player places a glass kiln on hex X at a cost of $1.3k. This brings the player's liquid capital, which began at $2k, down to $730, insufficient to place a second glass kiln. Here, the player must decide how to proceed. The remaining silicon/dry ice tile is the only one remaining on the map, and it is also critical to the player's strategy. The player could wait to sell enough glass to afford another kiln, or they could liquidate assets on hand. The player decides not to risk losing the critical tile, selling all of their 20 glass on hand for $3,055 and building a second glass kiln at a cost of $2.8k, leaving the player with $953 of liquid capital.

This decision illustrates how much economic thinking is invited by the mechanics of *Offworld Trading Company*. The player needs glass to upgrade the HQ, so any glass sold makes upgrading the HQ more expensive—notable, considering the high price of glass. Nevertheless, selling the glass now to increase glass production allows the player to double down on their early investment. With two glass kilns in operation, it would take only 20 seconds to replenish the stockpile. With the 50% production bonus granted by the adjacent placement, it would take 13.5 seconds. Thereafter, based on the price of glass at the time the second kiln was placed ($151), the player will generate $226.50 in revenue per second, or $222.10 profit per second after accounting for power consumption (-0.2p*$22=$4.4/s).

This decision was made with marginal cost/benefit and opportunity cost in mind. The Scientific faction requires two other goods to upgrade their HQ: aluminum ($14) and steel ($70). Thus, in conjunction with the scarcity of land claims available to the player, each glass kiln they elected to place cost them the opportunity to accumulate aluminum or steel by placing either an aluminum mine or a steel mill. In this case, carrying out the exact calculations that would support this decision are unnecessary; rather, it is sufficient to “eyeball” it by running the follow rough calculations:

1.5 glass/s*$151≈$225/s
-[negligible power cost]
-0 fuel cost
-0 oxygen cost
-0 silicon cost
≈$225/s

+2.0 aluminum/s*$14=$28/s
-[negligible power cost]
-[long distance]*[expensive fuel]
= <$28/s

+0.5 steel/s*$70=$35/s
-[negligible power cost]
-[long distance]*[expensive fuel]
= <$35/s

In short: the opportunity costs associated with producing glass instead of other materials are justified, at least in terms of liquid capital. The landscape of opportunities before the player shifts in response to these decisions, however, to which I turn now.

Having placed the second glass kiln, the player has one remaining land claim. An unused land claim is a significant opportunity cost in itself, though not necessarily a poor decision altogether. The player considers placing a steel mill on a high-density iron deposit far to the north at a cost of 20 iron and $0. The steel mill in this location would produce 0.5 steel ($70*0.5=$35) per second at a cost of 0.3 power (0.3*$22=$6.6) and 0.08 fuel (0.08*$80=$6.4). It is worth noting the player's consideration of a high-density deposit as a site for the steel mill, rather than a lower-density deposit; the Scientific faction, after all, receives no advantage for placing secondary goods-producing buildings on higher-density deposits. The player is aware, however, that claiming a higher-density deposit removes that deposit from play for the competition. The thinking here is that removing a high-density iron deposit from play lowers the supply of iron in the game, which should, if even in a small way, affect the steel market in the player's favor by lowering supply and driving up the price of a resource the player will be producing. This is a minor, but nonetheless notable, move in terms of long term strategy. The player moves on to assess other options.

The player next considers building an electrolysis reactor, which uses water to create oxygen ($20) and fuel ($80). Though in some ways an enticing option considering the high price of fuel, without the requisite building materials, liquid capital, or sufficient goods on hand to liquidate, the cash cost ($2.9k) of this option is out of reach.

Furthermore, without nearby water tiles on which to place the building, the player would incur either fuel costs transporting from such a tile or the cost of purchasing water.

The player then considers placing an aluminum mine on a high-density deposit far to the northwest at no cost. This option would produce 2.0 aluminum ($28) per second at a cost of 0.1 power (0.1*$22=$2.2) and 0.08 fuel (0.8*$80=$64). The player also considers an aluminum mine on a medium-density deposit considerably closer to the HQ, again at no cash cost, producing 1.5 aluminum ($21) per second at a cost of 0.1 power and 0.24 fuel ($19.2). Of note is that, in the course of looking for additional aluminum deposit options, the player sees—but ignores—another medium-density deposit as well as several low-density deposits between the two options described above.

This indicates that the player has internalized the geographical consideration of distance in economic terms as it is embodied in the underlying model governing *Offworld Trading Company*. It also reveals the player has internalized a foundational aspect of economics thinking: comparing two or more options in terms of marginal cost-benefit. In considering these two medium-density aluminum deposits, the player quickly notes how they are the same and how they are different; they the same in aluminum yield, but different in fuel cost. Thus, the similarities of the two hexes can be disregarded—their benefit is the same—to focus on their differences—the costs. Thus, any decision between the two aluminum hexes would be a simple one: choose the hex with the lower cost, because everything else is equal.

The player then hovers their mouse over the glass kiln tab in the construction display to make sure building another—lack of additional silicon+dry ice tiles notwithstanding—is not an option. As this is indeed not an option, the player again considers the first aluminum deposit option, noting that, “Yeah… that doesn’t make any sense, because aluminum’s cheap right now, so I’m going to construct a steel mill,” which they do at the location previously described.

While waiting for their strategy to take shape, the player uses the lull in the game’s demands on their attention to explore the map in greater detail and formulate their options going forward. The player locates dry ice tiles holding aluminum deposits, noting these tiles would be nearly ideal for electronics factories, which use aluminum, carbon, and silicon to produce a reliably high-priced mid- to late-game resource. Here we see the player already planning ahead to diversify their revenue stream. The player recognizes an important fact about economics here: relying on a single revenue stream is a poor long-term strategy for at least two reasons. First, producing enough glass to generate revenue sufficient for keeping pace with the competition as the game carries on would flood the market with surplus supply, thereby lowering the price, necessitating greater production, in turn further devaluing the good, and so on. Second, relying too heavily on a single revenue stream is risky, constrains players’ agility in terms of responding to unanticipated market shifts.

Vignette 3

Here I present scenes from *Frostpunk*. I use this vignette to accomplish two things. I show how the game mechanic by which players make society-level decisions significantly weakens opportunities to practice using civics DKSCs to plan, simulate, take, and reflect on in-game actions. I also highlight a scenario in which the game presents players with problem-solution sets that invite the use of economics and geography DKSCs.

Early in *Frostpunk*'s main storyline, "A New Home," the player is introduced to the Book of Laws when the following message appears on the player's screen:

A Word of Advice
Critical shortage: The number of sick is rising and we don't have enough materials to build a Medical Post. Perhaps a short burst of effort could help us gather the necessary resources?

The Book of Laws is one of the primary mechanics of *Frostpunk*. It is organized much like the technology trees in other RTS games like *Age of Empires II* or the *Civilization* series. Initially, a small number of options are available, but depending on the early choices players make, new options become available. The Book of Laws is used as a macro-level lever to shape the society the player co-constructs with the game. Additionally, the laws players sign impact, for good or ill, how the game world unfolds, as noted in one of the loading screens: "Remember, every law will have unforeseen consequences at some point." It is important to note that laws cannot be unsigned, and that any laws passed over for another law on the same branch cannot be signed later. For example—and relevant to what follows—the Child Labour laws cannot be unsigned later in favor of providing child shelters.

Upon opening the Book of Laws this first time, the player is shown the Emergency Shift law, including a narratively situated description of the law, as well as the positive and negative consequences associated with passing it:

Emergency Shift
Sometimes we have to concentrate on the task at hand at the cost of everything else, or die.
+ NEW ABILITY: you can force workers in any facility to work for the next 24 hours - using the Emergency Shift will raise discontent - discontent will rise slightly

A number of other laws are also available for passage by the player, including a law regarding how the player's burgeoning new society will attend to its children to which the game draws explicit attention when it present players with the following message:

> A Word of Advice
>
> Workers needed: There's so much to do and not enough hands to do it. A quick way of addressing this problem is to put our children to work.

Fifteen of the 80 citizens with whom the player begins this scenario are children, who are identified as "PROHIBITED" labor, meaning they cannot be assigned to work tasks in the city. Or, in terms of the meaning they hold in the game as abstractions, children cost resources to keep warm and fed, but do not contribute to the city's ability to function, let alone thrive; in simplest microeconomics terms, the children of *Frostpunk* are a liability. The player may elect not to attend to this issue right now (or ever), or to pass one of the following laws:

Child Labour - Safe Jobs	Child Shelters
There aren't enough hands to do all the work. We'll allow children to be employed in sage workplaces, like Cookhouses or Hothouses	Children will be safer if they stay in child shelters during the day - and they won't cause any mischief!
+ children can work in safe workplaces - hope will fall slightly - child workers can be injured in accidents	+ NEW BUILDING: Child Shelter + hope will rise + providing all children with a place in a shelter gives a permanent hope bonus - you will have to build a Child Shelter

Players may view these option sets through three lenses—and in fact would be well-served viewing them through at least two of them simultaneous. First, economics. Passing the Child Labour - Safe Jobs law—again, in economics terms—transforms the city's children from liabilities to assets: they become coal- and food-producing workers, not just consumers. Passing the Child Shelters law doubles down on the liability represented by the city's children: not only do the children continue to consume coal and food while producing neither, but building Child Shelters represents an additional cost in resources with no return on investment.

The second lens through which players may analyze this problem space is what I will call a Machiavellian gamer logic. If hope falls to zero, or if discontent is maxed out, the player loses the game. Thus, whatever wood and steel it would cost to build the child shelters may be a small price for a hope bonus. Or, a slight drop in hope may be a small price to pay for 15 additional workers as the city scrambles desperately to gather the resources necessary to survive the new ice age.

Both the economics and gamer lenses apply to a longer view of this decision, as well. Every law that is possible to pass within the currently available law tree (another becomes available later in the game) is visible, as are their titles—their description, and what they would actually do in terms of gameplay, however, remains unavailable. Players can see that signing the Child Labour - Safe Jobs law leads to an additional law further down the law branch: Child Labour - All Jobs. Players surmise passing this law adds children to the general workforce, not just safe jobs. Leading from the Child Shelter law, on the other hand, are two laws: Medic Apprentices, Engineer Apprentices. From their names alone, players can deduce that passing the Child Shelter law, while prolonging and even increasing the liability children represent to the city, may in fact lead to children becoming an asset in the medical and technology aspects of the game. Thus, through an economics lens, the question becomes something like, "What are the marginal costs and benefits of the opportunity costs associated with (a) not including children in the safe-jobs workforce and, later, the general workforce, compared to (b) not benefitting from children's participation in the medical and technology aspects of the game?" Or, in other words, is it more valuable to have children in the workforce now and going forward, or to invest in them as appreciating assets?

This set of decisions can also be viewed through a civics lens, leading in the present case to questions like, "Will the society I create be one in which citizens are forced to work extra or extended shifts? Will it be one in which children will be considered laborers?" Whether these and similar decisions count as opportunities to practice is attended to in greater detail in what follows.

Frostpunk compels players to frame questions like these frequently throughout the game. At the game's first major turning point, for example, a man stumbles into the city with news another settlement, Winterhome, has fallen. Whatever hope the player has managed to instill in the city's citizens plummets, and a new faction arises in the city: The Londoners. The Londoners believe London could not possibly have fallen, and that the best chance for survival is to return there. Through public speeches denouncing the player and other forms of public resistance, they subvert the player's efforts to maintain a sense of order in the city. To respond to this new set of challenges, t game requires the player to choose one of two paths to give the survivors common purpose: Order, or Faith. Choosing Order will reveal the Order Book of Laws, which includes building watchtowers, guard stations, prisons, propaganda centers, and even requiring a pledge of loyalty. Choosing Faith opens the Faith Book of Laws, which includes building churches, field kitchens, and ultimately makes possible the passing of a law establishing the player themself as a new religion. This raises a question foundational to civics: "Is it best to disincentivize asocial behavior through rule of law (and its enforcement) or to incentivize prosocial behavior through common belief and common cause?" I note this is a false dichotomy, and it is additionally notable both books of laws are taken to the absolute extreme (i.e., a pledge of loyalty or establishing a religion with the player at its head), but analysis of such is beyond the scope of the study reported here.

As the game continues, and as the state of the outside world becomes ever less hospitable, *Frostpunk* presents players with moral quandaries. For example, in Game 5, the player faces the following decision and associated consequences:

Exile Colony
Dying Exiles

Some of [the] exiles are still alive, just barely. We could try to bring them to our city, although they might die on the way. One of the dying held a diary to his chest. We read the last entry: "Exiled from Tesla City, with food and fuel running out, we sent the strongest among us to search for help. They're our last hope." We're afraid this refers to these poor Yankees we buried.	
Escort the exiles to the city	+7 children +19 workers +35 engineers
Leave the exiles to their fate	Nothing changes
Rob the exiles of their supplies	+Supplies - Some exiles may die

The above is an example of why it is difficult to label much of what players respond to in *Frostpunk*—as well as the other games—as civics OTPs. In short, the game's mechanics do not tie civic dispositions directly to in-game success or failure. I contend the first option, to escort the exiles to the city, is best aligned to civics as represented in the *C3 Framework*. Nevertheless, any of the three options are equally likely to lead to in-game success, depending on the game state at the time the decision is made, and solely for practical, not ideological, reasons. For example, from a Machivellian perspective, selecting the first option makes sense if the city either is in need of additional workers or if it could benefit from them. If the city is barely making it with a surplus of workers but is at a resource deficit, option two—or even option three—are preferable. The key here is that the game mechanics do not factor into the player's success or failure whether they behaved as good citizens—merely whether the cold mathematical logic of inputs and outputs are well-aligned to the game's win state.

Problems like the following that demand the player's immediate attention are also common:

Trouble with Londoners
Watch members beaten

Captain, members of the Neighborhood Watch who were removing the Londoners' slogans have been assaulted! We should do something to protect our people.	
Send guards to secure the streets	+ Hope will rise
Order guards to strike back	+ Discontent will fall
I don't want to escalate this	- Hope will fall

On the one hand, it seems obvious that ordering the guards to strike back, is poorly aligned with the *C3 Framework*'s representation of civics dispositions. On the other, sending guards to secure the streets is not much better, and neither is refusing to addressing it.

I want to highlight here the game mechanic that makes identifying civics OTPs in *Frostpunk* such a tricky business, putting aside for the moment warranted concerns about the extremist, dichotomous nature of many of the choices. The game explicitly tell players the consequences of the choices up for consideration. For example, sending guards to secure the streets will raise hope, a good outcome in the game. The nature of OTPs, however, is that the practice is grounded not necessarily in making the correct decision, but rather in using DKSCs as tools for scoping possible solutions, simulating the anticipated outcomes of those solutions, reflecting on actual outcomes, and replanning as necessary—the world does not come with a "this, then that" interface.

On the other hand, it also matters who the player is trying to be in the game. This is particularly important in reference to a point I raised earlier: that civics is not necessarily a discipline in the same sense as economics or history. While it is relatively clear when one uses the economics concept of opportunity cost to frame a problem of scarce resource optimization, and while it is additionally clear how doing so affect in-game success, it appears to be less clear for civics—unless we take into account the added win state conditions players add themselves. For example, while playing the game, I found myself uncomfortable with the idea of shaping a society—even a fictional one—that would turn away people in desperate need, even if the economics of the decision clearly favored doing so.

In listening to the discomfort, I altered the win state of the game in a very real way. Instead of, "Keep enough people warm and fed enough that they do not exile you from the city," the win state of the game became, "Keep enough people warm and fed enough that they do not exile you from the city, *while maintaining your value system*." Viewed in this way, the civics OTPs in *Frostpunk* become more plentiful and stronger.

Discussion

Though not explicitly stated as a research question, I turn now to what I view as the game elements most constraining OTPs across the three games and the implications these have for teaching, learning, and design.

In *Offworld Trading Company*, the fast pace of gameplay was the most limiting game element, because it severely hampers the amount of thought players are able to put into their decisions. Even as an accomplished novice in economics in particular, I still found myself most productively engaged in economic thinking when I could pause the game to plan my actions and simulate how the game would respond. This raises interesting questions about whether and how games like *Offworld Trading Company* might be leveraged in the classroom, or what classroom-ready iterations of *Offworld Trading Company*-like games might look like.

Offworld Trading Company itself could be leveraged as one element of a broader teaching and learning ecology (Squire, 2011). For example, teachers could play skirmish games on a classroom projector, pausing frequently to work with students to frame problems, ideate solutions and anticipate their outcomes, and gather feedback using social studies DKSCs as interpretive and planning tools. Rather than using the game itself as an assessment tool, teachers could use student talk around the game as formative assessment. Or, with an eye to summative assessment, teachers could use the map editor to generate maps designed to evaluate students' capacities to use DKSCs to frame and act in response to situated problems. I want to note two important points about this potential for assessment. First, it should be the actions students take and the thinking they use to justify those actions that should form the basis of any such assessment—not in-game success or failure, per se. Second, one of the preeminently valuable things about games is that they do not punish failure—rather, they frame failure as learning opportunities. Thus, any game used as an assessment should facilitate trial and error and multiple attempts, not one-off opportunities to fail.

The game element most constraining civics OTPs in *Frostpunk* is that the game tells players what will happen, which makes OTPs quite weak. Interestingly, in *Surviving Mars*, the opposite seems to be the case: any possible civics OTPs were obscured by intractable complexity, making much of what I contend constitutes OTPs practically infeasible at best. This raises the question of what an appropriate level of complexity in simulation games designed to generate OTPs might be.

There seems to be an inverse relationship between DKSC specificity and the prevalence of OTPs. For example, economics DKSCs more general in nature (e.g., opportunity cost, marginal cost/benefit) were present in all three games, while those pertaining more specifically to national economies or institutions (e.g., interest rates, non-profits) appeared less frequently. This may be one of the reasons so few civics OTPs were identified. In the *C3 Framework*, civics is framed with some degree of specificity—specific to the United States in many cases, but also to particular notions of, for example, civic deliberation (e.g., school and [local] community settings) and what counts as worth knowing (e.g., ideas and principles contained in the United States' founding documents). Because the conceptualization of OTPs is privileged upon using that which we learn in school to do work in the world, this raises questions regarding how useable (c.f., use*ful*) school-sanctioned curricula are in the world; and/or, on the opposite side of the coin, how simulation games like the ones reported on in the present study might be designed to better align to presenting students with civics OTPs.

I want to take care to note that I am not necessarily suggesting games like these be placed widely into classrooms, as was a common misinterpretation of and reaction to Gee's (2003) seminal work on games for learning. Rather, I am suggesting these games—in particular how they construct problems and problem spaces in which certain tools are useful—be viewed as *inspiration* for designing classroom activities and learning environments. For example, RTS games seem to be quite good for economics education, and the formula appears to be simple:

- Create problem spaces that require optimization
- Constrain what the player can do by creating scarcity so there are many possible actions players can take, but limit how many actions they can take. This creates tradeoffs—essentially the heart of economics (Wentworth & Schug, 1993)
- Provide variable elements that shape the problem space in different ways. For example, the randomly generated maps in *Offworld Trading Company* means players are always encountering new and different problems, though not necessarily novel ones in terms of deep structure
- Give players tools and toolkits that afford many possible actions sufficiently different from each other

Furthermore, incorporating geography into such games seems fairly simple as well, from a design perspective, especially if done alongside economics, as the two disciplines seem to enjoy an easy marriage: design the above-described problem spaces to include geography. *Offworld Trading Company*, for example, engages players in many of the geography DKSCs identified in the *C3 Framework*, and it does so by constraining players' activity to a visual representation of a place (i.e., a map) and including on- and behind-the-screen mechanics (Hunicke et al., 2004) that give these representations in-game meaning.

Working history and civics in, however, seems a more difficult proposition. We do not yet have the research available to tell us what good opportunities to practice history and civics DKSCs might look like in games. Future research on this topic is needed. Nevertheless, it is possible that how these disciplines are framed in standards documents, in schools, and in the public eye may constrain their usefulness in games. Both history and civics are often taught and learned in formal settings as endless pages of facts. The *C3 Framework* itself seems not to include major areas of history (e.g., specific events, people, or phenomena). It is little wonder that games, based almost entirely on taking situated action, find it difficult—not compelling, at any rate—to incorporate these disciplines so conceptualized into engaging games.

And yet, history remains one of the most popular sources of inspiration for media, from books to movies to games, from documentaries to science fiction to high fantasy. The *Civilization* and *Age of Empires* series are both based on relatively accurate and in-depth representations of the past compared to versions students encounter in classrooms, and each has enjoyed great success monetarily and in terms of longevity and the presence of a committed gaming community. On the darker side, the misuses and abuses of history have played a consistent role throughout human history in the rise and propagation of alt-right nationalism, racist ideologies, and dictators (MacMillan, 2010; Nordgren, 2016).

Here, as we consider the idea of using games as inspiration for the design of learning experiences in the social studies, it is important to note some important points about why OTPs may be easier to identify in the context of games than in the context of typical classrooms, as is my contention. First, games are all about consequential engagement (Gresalfi et al., 2009; Gresalfi & Barab, 2011). Humans learn through doing, and claims to knowledge are strongest through doing, as well. When playing a game, players learn about and to use tools in direct reference to an interesting problem. This reveals a truth about human learning rarely recognized in formal school settings: that information (the primary good in which schools claim to deal) is a tool for taking action in the world, and like any tool, it has meaning only (a) relation to a task to which it is suited, and (b) when the user possesses the skills use it appropriately (Gee, 2015). To design for DKSC use in schools, then, requires interesting problems in the context of which learners can develop fluency with the tools appropriate for the job.

Also of note is that, in games, decisions matter. The OTPs outlined in the preceding pages were not isolated from context, consequences, nor feedback. When games are done well, players are invested in them. Likewise, when learning experiences are done well, learners are invested in them. As Gee (2017) noted, in good learning experiences we can identify +experiences: experiences in which learners (a) have actions to take, (b) care about the outcomes of those actions, and (c) are guided to some extent in what to pay attention to. In a school subject as rich and complex as social studies, the tools of which countless professionals put to work each day to do work that matters, it is inconceivable how common it is to find classrooms devoid of learners presented with real actions to take beyond worksheets and studying for multiple-choice tests, how little many students care about the outcomes associated with completing those worksheets (not that they should), and how much attentional economy management is simply PowerPoint slides and sheets of vocabulary words.

With this in mind, I turn now to implications for teachers and teacher educators. Games are well known for their power to engage, whether school-age learners or adults. Nevertheless, engagement in and of itself is an insufficient rationale for using games for learning, either as learning experiences or as inspiration for learning design (Wright-Maley et al., 2018). Teachers may benefit from using the OTP framework to ask fundamentally different questions about their own and others' learning designs, for example, "What work are students being given the opportunity to do as a result of this learning design?" and, "What tools is this learning design highlighting as useful, for what, and how?"

Teacher educators, meanwhile, should take up two tasks. First, teachers are generally and broadly speaking poorly prepared to use games and simulations in their classrooms, often leading to ineffective pedagogy at best, or the perpetration of curriculum violence at worst (Dack et al., 2016; Totten, 2000; Wright-Maley, 2015). One reason for this may be that few teacher candidates are exposed to games-based or -inspired pedagogies as part of their teacher preparation. As teacher educators, we bear responsibility for preparing future teachers to think more critically about what games are good for—and particularly where they can go very wrong, as in the case of simulating difficult histories. Second, teacher educators may take up the underlying call of the present work: to think in terms of OTPs, and help teacher candidates develop the capacity to think in these terms, as well.

Limitations

I now highlight four limitations of this study and identify next steps for future research. This study depended to an extent on my operationalization of the *C3 Framework* into DKSCs. First, while I bring a nontrivial level of expertise to this work, I am neither an economist, a geographer, a political scientist, nor a professional historian. Thus, a replication study including such professionals as participant-researchers is warranted to improve validity and reliability of the findings reported above. In other words: future studies might include professionals both as researchers in identifying DKSCs in the *C3 Framework* and as participants playing the game. Second, while I am not a member of one of the above professional discourses, as a social studies teacher-scholar and former secondary social studies teacher, I came to these games equipped with much greater content knowledge than I suspect could be said of the typical K-12 or even post-secondary student. Future work looking at K-20 learners in context is warranted. Third, I constituted a sample size of one for this study. Future studies including larger and more representative samples of participants would greatly increase the validity of the claims made herein. As one example, though I framed this study within a sociocognitive lens, one might argue a participant pool of one is necessarily light on the social aspect and heavy on the cognitive. Though I stand by the sociocognitive framing and metaphorical use of conversation that guided this study, future studies would do well to examine the ways in which social interaction between multiple human participants mediate the processes described herein. Finally, I did not examine the ideological worlds presented to players through these games (Squire, 2011). For example, *Frostpunk* presents the future world as one devoid of people of color, and *Offworld Trading*

Company is steeped in neoliberal assumptions of zero-sum economics games. While the former may be (generously) framed as oversights during the design process, it (a) speaks to well-documented issues of representation in the games industry, and, more importantly, (b) highlights how such apparently simple design decisions uphold white supremacy in the form of normalizing the presence of white folks and the absence of Black, Indigenous People of Color in the futures videogames and science fiction help us collectively imagine.

Nevertheless, the findings I have reported here are notable in that they offer a concrete examination of social studies-themed videogames through a conceptual lens firmly grounded in learning theory, particularly as applied to learning through experiences in the world. Findings show that at least two commercial off-the-shelf videogames—*Offworld Trading Company* and *Frostpunk*—do an admirable job of positioning players to use social studies knowledge, skills, and concepts as tools for taking goal-mediated action. These findings suggest there is additional room in social studies education to leverage videogames as practice spaces in which students come to learn more about their own abilities to take action in the world, as well as the value of the social studies for providing conceptual tools for doing so effectively.

Conclusion

I set out in this study to examine three digital social studies-themed simulation games—*Offworld Trading Company, Frostpunk,* and *Surviving Mars*. I looked specifically for opportunities the games presented to players to practice using the disciplinary knowledge, skills, and concepts implicated in the *College, Career, and Civic Life (C3) Framework for Social Studies Standards* as tools for taking goal-mediated action. I also looked for elements of gameplay that positioned players to do this work. Of the three games, *Offworld Trading Company* presented the most and strongest OTPs, though these were limited mainly to economics and geography. *Frostpunk* included similar economics and geography OTPs, though they were significantly weaker and less frequent. *Frostpunk* also presented OTPs relevant to civics, though these are highly dependent on the broader learning ecosystem in which the game might be leveraged for educational purposes. *Surviving Mars* presented exceptionally few and weak OTPs overall.

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CHAPTER 4

TOWARDS A (DESIGN) THEORY OF SOCIAL STUDIES SIMULATION GAMES

In this article I coordinate the salient research and theory from three fields—history and social studies education, learning sciences, and games studies—to advance an argument about the value of grounding social studies simulation research more firmly in learning theory.

Simulations, typically defined broadly in the literature as experiential learning activities in which learners encounter domain-relevant events, concepts, process, and phenomena (e.g., Dack et al., 2016; Wright-Maley, 2015a), have been used in formal social studies education settings since at least the 1950s (e.g., Guetzkow, 1959). Social studies teachers leverage simulations as tools of active learning pedagogy under several rationale, including their affordances for motivation and students interest, and their apparent alignment to constructivist assumptions about teaching and learning that underpin progressive perspectives on education. Indeed, standards documents and frameworks explicitly tout simulations as best practice in social studies education (e.g., Gould et al., 2012; National Council for the Social Studies, 2016). Furthermore, teacher preparation rubrics from the National Institute for Excellence in Teaching (2020) describe "simulations and game-like activities" as indicators of "exemplary teaching" (p. 6).

Nevertheless, it remains unclear exactly what simulations are in social studies education, what learning aims they are intended to facilitate, for whom, or how. Furthermore, and more to the heart of the present work, it remains unclear what social studies simulations can be expected to do well and the mechanisms by which they might do so. In other words, the field of social studies education lacks clarity concerning what good simulations look like, what they do well, and how they do it. Additionally, despite sustained and even growing interest in high-agency learning environments like simulations among young people across demographics (Entertainment Software Association, 2020), research suggests access to simulations remains inequitably distributed along racial and socioeconomic lines (Kahne & Middaugh, 2008; Lo, 2017). Yet we know teachers do use simulations and other closely related pedagogical tools in the social studies classroom (Passe & Fitchett, 2013), a fact that is particularly problematic in the context of difficult histories (Totten, 2000; cf., Schweber, 2003).

I propose a significant issue at hand is that the field lacks a coherent theory of simulations in social studies education. If simulations constitute a constructivist pedagogical approach in which learners are provided experiences useful in constructing deeper understanding of a domain—that is, if simulations are meant to facilitate learning through experience—then close attention to the design of these experiences is warranted. Nevertheless, social studies simulations remain understudied from a design perspective, particularly from the perspective of learning theory as it relates to learning through experience. This gap in the literature is notable, as knowing and doing are inseparable in the learning process, and the design of any learning experience necessarily makes some forms of doing—and therefore learning—possible while making others improbable or altogether impossible (Barab et al., 2010; Gresalfi et al., 2009; Jordan & Henderson, 1995). In short, simulation design directly and necessarily influences what students can learn by participating in simulations, but clear and coherent guidance around simulation design is scant.

I suggest a coherent design theory of simulations may contribute to the social studies education field in several ways. First, a more thorough understanding of simulations as a pedagogical approach would benefit learners. Second, grounding simulations more firmly in learning theory may make clearer the learning aims and contexts to which simulations are particularly well suited, thereby preserving scarce cognitive and institutional resources associated with their design and implementation (e.g., planning energy, planning time, instructional minutes). Additionally, a better understanding of social studies simulations may make access to simulations more equitable by demystifying the design process—it would no longer be something that just particularly creative teachers do (and/or teachers who are able/willing to take pedagogical risks)

In what follows, I first review the literature on social studies simulations. I then argue for a shift in thinking about the purposes towards which simulations are leveraged in social studies education. In particular, I contend simulations designed for learning *about* social studies events, concepts, processes, and phenomena is just one way of using simulations, the goals of which are in fact not so different from those of more traditional forms of teaching and learning in the social studies, but which do indeed have their place in a broader social studies curriculum. Nevertheless, I contend a vision of social studies simulations aligned more tightly to learning theory highlights another avenue for the medium: facilitating learners coming to know, do, and be as certain kinds of people in the world. Aligned to this vision, I then interweave discussion of learning theory—drawn from learning sciences and games scholarship—with implications for social studies simulations research and design. I conclude by outlining critical attributes of simulations aligned to this vision.

Methods of Inquiry

This study was driven methodologically by literature review *principles*. I stress the word principles here to highlight the non-systematic nature of the review undergirding the present work (c.f., Alexander, 2020; Booth et al., 2016). Indeed, initial attempts to conduct a systematic literature of social studies simulations proved untenable. For instance, searching for literature related to social studies simulations runs aground of definitional challenges. Literature on “simulations” is as likely to use any of a large number of similar terms: simulations, games, simulation games, role-plays, experiential learning activity, theatrical activity, and many more (Crookall, 2010; Dack et al., 2016; Wright-Maley, 2015a). Running a search with the term “simulation,” for example, failed to call up relevant work, such as Levy’s (2018) study of a Model United Nations club. Additionally, “social studies” includes a wide array of disciplines (e.g., economics, history, political science, geography, psychology, civics) that converge at the K-12 level. Thus, using “social studies” as a search term failed to call up Parker and colleagues’ (Parker et al., 2011) design-based implementation research study on simulations, because, rather than “social studies,” their title and keywords included “AP Government.” The search term, “history,” is particularly difficult to search, as its use calls forth an untenable number of non-relevant results.

Literature reviews are as much an art as science, and in reality, is often iterative and non-linear (Alexander, 2020). Thus, while in what follows I attempt to offer clarity for readers by delineating between my data collection and analysis procedures as they pertained to the salient theory and research on (a) social studies simulations, and (b) games and learning sciences, I want to highlight the recursive nature of these inquiries. That is, I did not collect literature in concretely separate stages, and nor did I analyze it in such a fashion. Rather, I engaged in concurrent analysis of the literature through the application of a theoretical lens informed by games and learning sciences scholarship. In regards to the "collection" of salient research and theory associated with the former, I did not attempt to "(re)discover" seminal works to align methodologically to best practices of systematic literature reviews. For example, my own substantive career experience in the field of games for learning and learning sciences obviated the need to search for Gee's (2003) seminal work in the field. In this way, the review I conducted is more aligned to the kind Moje (2007) conducted than to those advocated by methods scholars (e.g., Alexander, 2020; Booth et al., 2016).

To familiarize myself with the salient research on social studies simulations, I conducted searches of databases like ERIC and PROQUEST, using search terms like "social studies simulations," "social studies simulation games," and "history simulations." One publication, in particular, was especially relevant: Wright-Maley's (2015a) own literature review on the topic. Additionally, a colleague familiar with my interest in social studies simulations had contributed a chapter to Wright-Maley's (2019) edited book on the topic. Mining the bibliographies of these two resources sped up the literature search process considerably (Booth et al., 2016). I then catalogued each citation in a spreadsheet.

With an initial data corpus in place, I then began scanning the publications included in the spreadsheet. For each publication, I took note of the definitions used, disciplinary focus (e.g., civics, economics, history), grade level, theoretical framework when explicitly noted or sufficiently implicated, and the methods of inquiry when applicable. I note for readers that for many entries I was unable to include definitions. This was due to what appeared to be a common assumption of a shared understanding of simulations. I was also unable in many instances to note theoretical frameworks or modes of inquiry, due largely to the practitioner focus of much of the literature. Nevertheless, as I proceeded with my scanning of the literature, I made note on the spreadsheet of the pieces likely to be relevant to the present work. I then mined the bibliographies of those pieces for additional relevant publications. Finally, I consulted with colleagues in the field to identify any seminal or otherwise pertinent works I had not identified as part of the above-described process, what Booth et al. (2016) called expert checks.

Another reason I do not claim systematicity for this review is that I did not search the learning sciences or games literature separately to identify the interpretive lens that forms the foundation of the present work. I identified from my own substantive experience in the games scholarship and learning sciences fields seminal (e.g., Gee, 2003; Lave & Wenger, 1991) and otherwise relevant works (e.g., Barab et al., 2011; Bergen, 2012; Gee, 2015, 2017; Gee & Gee, 2017; Gibson, 1979; Greeno & Gresalfi, 2008; Gresalfi et al., 2009; Seligman et al., 2016). I used concept mapping to organize the salient concepts and approaches identified in the literature, with a particular eye to the ways in which they could speak social studies simulations.

Simulations in Social Studies

Defining Simulations

For present purposes, I define social studies simulations as learning experiences designed to approximate and afford participation within some slice of the real world to which learners would otherwise not enjoy access. This is, admittedly, a vague definition. I consider this definition the lowest common denominator for simulations, a pedagogical activity that is put to many and widely variable uses across several disciplines, including mathematics (Papert, 1980), science (Colella, 2000), and social studies disciplines like economics (Rosales & Journell, 2012), and history (Williams & Williams, 2007). This definition is intended to serve as a starting point, and building upon it is an explicit goal of the present work. Nevertheless, this definition contains what one might identify as the critical attributes of a simulation broadly: they are (a) intended to facilitate learning, (b) designed to approximate something (or some part of something) from the real world, and (c) they afford active participation on the part of the learner in whatever event, concept, process, or phenomena the simulation is designed to approximate.

Though simulations have been used in formal social studies education setting since at least the 1950s (e.g., Guetzkow, 1959), an agreed-upon definition has as yet eluded the field. As Wright-Maley (2015a) noted, little has been added to the body of literature on simulations since DeLeon (2008) remarked, "the literature on simulations is practitioner-based and somewhat dated" (p. 258). With no consensus even on a definition of the term, researchers, designers, and practitioners alike are often left to talk past each other if not at cross-purposes altogether. Aldrich (2009) described this as the "Babel problem" in simulations research. Indeed, the list of terms scholars treat as interchangeable with simulations is dizzying; for example, simulation, simulation game, role-play, role-playing simulation, reenactment, and many, many more (Crookall, 2010).

Furthermore, such a blurry line exists between simulations and a large host of other experiential strategies that they are often confused with theatrical plays, dramatic reenactments, narrative videogames, choose-your-own-adventure PowerPoints, or even the digital equivalent of watching a line of dominos knock into each other (Wright-Maley, 2015a). This lack of definitional clarity makes claims to knowledge about what simulations can do tenuous at best; that scholars all too often neglect to define the term at all makes interpreting the scant empirical research a challenging task indeed.

Who Uses and Experiences Simulations in Social Studies Education?

The literature is sparse concerning who uses and has access to simulations. The research that does exist, however, suggests simulations tend to be reserved for more privileged populations of students. In a study of 2,366 California seniors, Kahne and Middaugh (2008) found students who reported prior exposure to simulations tended to be white and planned to attend a four-year post-secondary institution. Students who planned to attend two-year colleges, two-year vocational schools, or who had no post-secondary education plans each reported successively lower exposure to simulations. In a follow-up study of 371 California students, Kahne and Middaugh (2008) found 80% of AP students reported having been exposed to simulations, while only 38% of students enrolled in College Prep government courses reported the same. This disparity could perhaps be explained by the chronological placement of the AP civics test relative to the typical school year: because AP students take the test with several week remaining in the school year, AP teachers may feel more comfortable including simulations in their curriculum in an accountability era that stresses breadth of content at the expense of depth (Girard et al., 2019).

Stephens et al.'s (2013) survey work represents the largest, most thorough—and one of the only—investigations into what kinds of teachers engage their students in simulations since Blaga's (1978) dissertation. 10,269 teachers responded to a larger survey of over 12,000 teachers from 35 states conducted by Passe & Fitchett (2013). The authors reported that teachers who emphasize "critical citizenship values in their social studies instruction" (p. 258) were more likely to report using simulations in their classrooms. Nevertheless, the specific question they asked teachers, and on which this finding rests, presents a major complication. Regarding specifically the use of simulations, the survey asked teachers, "During social studies instruction, how often do your students engage in the following: participate in role playing/simulations?" This question is problematic for several reasons, but the most serious is that it falls victim to the definitional problem discussed in length above. The question assumes that (a) respondents share a common understanding of what constitutes a simulation, (b) this understanding is the same as that of the researchers, and (c) readers share this same common understanding.

Affordances of Simulations

A common justification for using simulations in the social studies classroom is their focus on active, participatory learning. As Wright-Maley and Joshi (2016) wrote, "The simulation lets students live their learning, which creates an effective touchstone enabling teachers to explore these concepts further" (p. 168). Lo (2015) situated her study of a simulations-based Advanced Placement government curriculum within Lave and Wenger's (1991) communities of practice framework, thereby positioning the study's analytic lens upon learners' development through active participation in and engagement with the practices of political science (see also Parker et al., 2011). Girard (2019) suggested social studies simulations are powerful pedagogical vehicles with the potential to make learning in the social studies more authentic and relevant to students by offering concrete experiences of otherwise abstract, disembodied concepts.

Simulations possess motivational affordances atypical of more traditional modes of teaching and learning in the social studies. Gehlbach et al. (2008), for example, examined the potential of simulations to bolster interest within a middle school social studies classroom. Citing the challenging nature of the activity and students' increased propensity to engage in social perspective taking, they found that students became more interested in social studies after participating in the *GlobalEd* simulation

Indeed, the potential for simulations to bolster students' domain-specific interest and motivation have remained stalwart rationale for implementing simulations. Pace et al. (1990) cited the motivational affordances of simulations as their rationale for implementing their Cuban Missile Crisis simulation with volunteer secondary students. Participants in Stoddard et al.'s (2019) study of *Purple State*, a virtual internship built around the epistemic frame of strategic communications consultant, reported viewing the experience as "an authentic and motivating alternative to common classroom experiences" (p. 35). Rosales and Journell (2012) argued simulations and similar pedagogical approaches made economics more interesting to students than did the lecture-based instruction typical of secondary economics classrooms. Sanchez (2006) noted simulations can "enhance students' involvement beyond their mere discussion or reading" (p. 62). Nevertheless, increases in students' interest following simulations may be short-lived, requiring additional follow-up activities to maintain (Lo & Tierney, 2017).

Another rationale undergirding the use of social studies simulations is that students remember them (DiCamillo & Gradwell, 2012; Schweber, 2003). Simulations may also be particularly good for learning about concepts and processes (Parker et al., 2011; Wright-Maley & Joshi, 2016). Indeed, participants' performance on a transfer activity as part of Parker et al.'s (2011) study suggests simulations may support transfer of learning across contexts. Simulations have also shown promise as approaches aimed at disciplinary thinking in the social studies, including historical thinking (Chapman & Woodcock, 2006; Pellegrino et al., 2012), economic reasoning (Rosales & Journell, 2012; Wentworth & Schug, 1993), and historical empathy (Bachen et al., 2012; Cunningham, 1984; DiCamillo & Gradwell, 2013; Rantala et al., 2016; Stover, 2007).

Constraints and Challenges

Simulations remain poorly understood in the context of social studies education. Simulations are confused with and often described interchangeably as role-plays, reenactments, and games (Dack et al., 2016; Wright-Maley, 2015a; see also Crookall, 2010). The persistence of this confusion may be attributable to the fact that, in absence of a clear definition of simulations, let alone an applicable theory to organize understanding and action around the approach, practitioners appear to place an uncritical emphasis on activity in their own understanding of simulations as a form of experiential pedagogy, leading to poorly conceived and poorly facilitated learning experiences. For example, in their study of 438 lessons, Dack et al. (2016) observed that teachers generally failed to capitalize on the potential benefits of experiential instructional approaches. Twelve of 14 lessons identified as experiential exercises (a) lacked a clear instructional purpose related to content; (b) did reflect an instructional purpose, but it was ultimately thwarted by the activity's unanticipated dynamism; or (c) encouraged the development of significant misconceptions about the content. Of the two remaining lessons that did not represent these concerns, one appeared to leverage the approach in support of factual recall as opposed to critical thinking.

Simulations require increased cognitive and institutional resources, compared with more traditional approaches. Teaching with simulations often requires teachers fundamentally reconsider or even confront the habitus of their field—essentially what is commonly accepted as "counting" as teaching—and their participation within it (Wright-Maley, 2015b). As Wright-Maley (2019) noted, "social studies has evolved with a glacial torpor across several decades," with "the predominant activities of the classroom [remaining] lecturing, notetaking, and testing" (p. 4; see Cuban, 1982, 2016; Russell, 2010). Additionally, teachers often remain reticent to consider alternative approaches to classroom management, which Wright-Maley (2019) suggesting social studies teacher in particular tend to exercise overt control over students in their classrooms.

Developing workable simulations also requires increased planning time to adequately consider and design what Wright-Maley (2019) called a simulation's choice architecture, as well as to avoid an uneven distribution of labor among participants may alter what is learned and by whom (Girard, 2019). The cognitive load of designing a simulation is greater than preparing lecture notes or reading from a textbook, and possibly also more than more recent approaches to social studies education like project-based and inquiry learning. Additionally, simulations are rarely covered in social studies teacher preparation. Thus, it is possible simulations are typically the purview of individual teachers with greater creative drive, teachers who are willing and able to take risks, or both.

The problems resulting from the lack of understanding surrounding simulations in social studies education contexts is amplified when simulations are used to teach difficult histories. Gross and Terra (2018) defined difficult history as “periods that reverberate in the present and surface fundamental disagreements over who we are and what values we hold” (p. 52). Examples of such difficult histories include the Holocaust, the forcible relocation and enslavement of Africans, and genocides perpetrated upon indigenous peoples.

Of the difficult histories included in social studies standards documents in the United States, my review of the literature suggests the Holocaust may be one of the most taught through simulations. Though reflection on why this may be the case is warranted, it is not my focus here. Nevertheless, what is clear from my survey of the relevant literature is that scholarly treatment of Holocaust simulations greatly overshadows that of African enslavement, Jim Crow, or forcible relocation of Indigenous peoples in the United States. A clue to why this may be the case lies in Gross and Terra’s (2018) explanation that difficult histories may be difficult for different people in different contexts, but that one of the distinguishing features of a difficult history in so far as it represents a pedagogical challenge in schools is that difficult histories run counter to the patriotic narratives embedded throughout history and social studies curricula. The Holocaust itself, when classroom treatment thereof fails to include American reaction to it, does not contradict nationalist narratives of American exceptionalism, fairness, and justice the way lynching and systematic institutional oppression do.

In any case, simulations are indeed used to teach the Holocaust (Maitles & Cowan, 1999; Schweber, 2003). Schweber (2003), for example, reported on one teacher's facilitation of a Holocaust simulation focused on 1930s Germany. Schweber noted that the simulation situated students to make difficult choices that held intrasimulation consequences for them and the "cherished ones" they elected to bring with them into the simulated world. Simulations of difficult histories done well, Schweber contended, do more good than ill, giving students an affective experience that stuck with students long after the closing moments of the simulation. Lindquist (2011) argued that simulations are directly inconsistent with the objectives of appropriate Holocaust education, and the Holocaust Memorial Museum warns explicitly against their use.

Totten (2000), however, was vehement in his critique of simulating the Holocaust. Responding to the argument that simulations are a powerful way to help students get a sense of what it was like to experience historical traumas, he responded, "to suggest that one can approximate even a scintilla of what its victims went through is sheer folly" (p. 2). Noting, too, that many view simulations as opportunities to glean insights into historical events and time periods otherwise not available through traditional teaching and learning, and that they tap into the affective domain, Totten (2002) responded, "there are ample resources available—such as primary documents, first-person accounts of survivors and liberators, very readable secondary resources, and powerful and accurate documentaries—that are highly engaging, thought-provoking, and memorable," going on to suggest that "if none of these materials engage students then it is incumbent upon teachers to reevaluate whether their students are mature enough to study this history" (p. 3).

Many argue the simulation of difficult histories presents too many risks to justify any potential benefits stemming from enactivist pedagogy. Wright-Maley (Wright-Maley, 2014) noted simulations run the risk of trivializing difficult histories because they are by definition simplified representations of real phenomena. Dack et al. (2016) observed just this trivialization in their observation of a role-play in which students, playing the role of plantation owners, proclaimed other students to be their slaves to the giggling of their peers. Totten (2000) referred to such representations as “game-like activities” (p. 5) that present an “absurdly watered-down version of the situation” (p. 6) and render study of such difficult histories “anti-intellectual” and “disingenuous” (p. 5). Totten (2000) and Dack et al. (2016) both additionally noted such enactivist pedagogical strategies can reinforce negative stereotypes and be downright ahistorical. Additionally, such activities can easily degenerate into play time bereft of real thinking, leading students to remember the excitement of the play to the exclusion of the real historical events they are intended to convey (Totten, 2000). Simulation can also leave students feeling that they understand the horrors and injustices of historical victims (Totten, 2000), which is impossible and therefore fundamentally trivializes such difficult histories (Dack et al., 2016). Totten and Feinberg (1995) drew an important distinction between using simulations to facilitate perspective taking, on the one hand, and using simulations to have students “experience” what it was like to be victimized/terrorized, on the other. Ben-Peretz (2003) echoed this sentiment, wondering whether vicarious experiences of difficult histories are at all transferable.

Scholarly treatment of classroom simulations of the abduction, forcible relocation, and enslavement of Black and Indigenous People of Color by white European settlers is more difficult to locate. This is not to say, however, that such simulations are not used in social studies classrooms. Indeed, popular press outlets are replete with accounts of such simulations resulting in the perpetration of curriculum violence (Ighodaro & Wiggan, 2010) upon young people (e.g., Schwartz, 2019). The lack of empirical study of such simulations may be the result of academe's code of ethics and associated institutional review process through which proposed studies must pass: knowingly and intentionally subjecting participants to historicized trauma is unethical, and studies seeking to facilitate such interventions should not clear the review process. Additionally, I suggest researchers finding themselves observing curriculum violence are ethically obligated to intervene. In the former case, the empirical study of such a simulation would not take place; in the latter, it would end prematurely.

In short, the use of simulations requires significant commitment of scarce cognitive and institutional resources, yet committing such resources remains far from a guarantee that the simulation goes smoothly, results in the intended learning, or does not cause psychological or emotional harm to students in the form of curriculum violence.

In Need of Theoretical Grounding

Of primary relevance to the aims of the present work, however, is the gap in the extant social studies simulation literature concerning theory and design principles. As I have noted already, the existing literature is often practitioner-based, leaving a small pool of empirical work on which to draw. What literature there is typically focuses on reporting outcomes of simulation activities. Yet in these studies there is little in the way of a theory of learning as it might apply to simulations. This is not to say the extant literature lacks the theoretical framing typical of empirical research. Girard (2019), as one example, leveraged the instructional triangle (Cohen et al., 2003) and communities of practice (Lave & Wenger, 1991) frameworks in his study of curricular relationships in simulations. Rather, I highlight that significant theoretical rationale grounded in learning theory for how simulations embody processes of learning through experience has remained atypical of social studies simulation research.

Why is theory important? To answer this question, I draw on Gee's (2005) discussion of the topic. Theories tell us why something should work, what that should look like, and where we should look to see it happening. Without theory, replicating something that works is difficult, because we do not know why it is working. Just as important, and as is often the case with social studies simulations, lacking a theory obscures why something does not work. In absence of a theory of social studies simulations, designers are left to build new simulations from scratch, unable to build quickly upon others' experiences and designs due to a lack of design language to facilitate such communication. Lacking a theory of why a given simulation is supposed to work, teachers and facilitators may emphasize ancillary elements of the learning experience at the expense of those that do the real teaching and learning work. Without a design theory of simulations, the field is left to waste energy and resources haphazardly studying the same things over and over again, but without the value of scientific replication because the efforts remain isolated from one another. In short, theories help direct our attention to component pieces of a phenomenon and draw links to the effects they have. Theories also direct our attention to what does not work. Most importantly, theories give us ways to think about the *how* and *why* of both.

Additionally, identification of design principles is also generally missing from the extant literature on social studies simulations. This is understandable, considering the role theory plays in design: without clear, explicit theories informing our ideas about what a tool should be used for, how it works, and where we should look to see it working, it is difficult to draw clear connections between design elements of a learning experience and the outcomes thereof. Nevertheless, some progress has been made, with some scholars recommending or otherwise describing design considerations in the course of their work. These recommendations range from broad to specific in nature.

In a review of the literature on social studies simulations, Wright-Maley (2015a) offered a four-criteria definition: (a) verisimilitude, or the extent to which a simulation is sufficiently and accurately aligned to real-world events, concepts, processes, or phenomena; (b) dynamism, or the capacity of the simulation to unfold in multiple, unpredictable ways; (c) active human agents, meaning students' actions influence how the simulation unfolds; and (d) pedagogical mediation, or the active facilitation of the simulation on the part of a teacher.

Parker et al. (2011) offered design recommendations of a more specific nature. In addition, the four principles I outline next—projects as the spine of the course, depth through looping, engagement first, and role-taking and -dropping—are the closest we have to tried-and-tested design principles in light of their continued use and testing over the course of a seven-year design-based research project (e.g., Lo & Parker, 2016; Parker et al., 2011; Parker et al., 2018; Parker & Lo, 2016a, 2016b, 2016c; Valencia & Parker, 2015).

- Simulations as the spine of the course: Parker and colleagues (2011) designed their Advanced Placement Government curriculum around simulations as the "spine of the course" (p. 538). In this course design, the authors "invert[ed] the typical course organization where projects, if any, are treated as special add-ons or end-of-course capstones—valuable activities done *after* reading and remembering has been done, *after* 'background' information has been acquired" (p. 538). Instead,, "challenging projects provided the spine of the course, not the appendages; that is, the entrée, not the dessert; the main show, not the side show: the core of the teaching and learning regime" (p. 538). In other words, students encountered the concepts and processes that comprise the government curriculum first and foremost through the simulations. Content was embedded within the simulations, and understanding was both developed through the experiences and was also required in order to participate within them.
- Depth through looping: Simulations were designed not as one-off opportunities to learn major concepts and processes, but rather as the foundation of a long-term curricular design in which students repeatedly encountered essential questions and core disciplinary knowledge, skills, and concepts of the domain.
- Engagement first: Learners were presented with a problem first, and asked to solve it with their existing funds of knowledge. In the course of their attempt to solve the problem, learners come to realize for themselves they need something they do not currently possess, some tool or information needed to solve the problem (Schwartz & Bransford, 1998). In Vygotsky's (1978) terms, engaging learners in this way creates a need: a need to learn new information or to develop

new fluency with some tool or other in order to solve a problem the learner is invested in solving. As I will highlight in greater depth later, this concept is similar to one of the learning principles Gee (2003) identified in well-designed videogames: performance before competence.

- Role-taking and role-dropping: In their discussion of role-taking and role-dropping, (Lo & Parker, 2016) discussed the roles they asked learners to take up and why:

  Designed to help students have authentic political experiences through simulations, this government curriculum asks students to consider plural perspectives, via role-playing in simulations, as a way to deliberate contentious political issues in an increasingly polarized polity (p. 97)

In short, Parker and Lo sought to develop in students an enlightened political engagement, or knowledgeable civic action (Parker, 2003), by having having them adopt roles, which "provide students with opportunities to take on perspectives that may be different from their own, or to try on different positions if they do not already have one" (p. 99). What is different here from the part roles play in other simulations is that students were regularly invited into political autonomy moments (PAMs), in which they would drop their assumed roles, which carried with them ideological and epistemological overtones, to consider their own stance on the issue at hand in the simulations. Taking up and dropping roles in this way, the authors suggested, facilitates students' consideration of multiple sides of an issue as they engage in the process of forming and reforming their own political viewpoints. This unique use of roles in simulations warrants further research, but it may buttress students' ability to transfer knowledge and skills learned during simulations to their real-world lives.

Stoddard and colleagues' (2019) offer at least one additional design principle for consideration: epistemic frames.

- Epistemic framing means building a problem space and associated task-participant structures (together constituting a learning experience) around disciplinary "methods for justification and explanation, and forms of representation"; these learning experiences are in turn "orchestrated with strategies for identifying questions, gathering information, and evaluating results, as well as self-identification as a person who engages in such forms of thinking and ways of acting" (Shaffer, 2006b, p. 228; Shaffer, 2006). Prior research suggests such epistemic framing is a mechanism for transfer of learning from learning contexts to real-world application (Shaffer, 2006).

Less discussed overall in the literature on social studies simulations is the role of mediating materials and social practices. The design of a learning environment makes some actions and behaviors—and therefore, some kinds of learning—more or less likely. Some actions are possible within a given environment or experience, while others are improbable, and others are altogether impossible (Jordan & Henderson, 1995). Thus far in this section, I have presented salient research pointing to possible design principles for social studies simulations that warrant further investigation. Nonetheless, these possible principles have remained somewhat abstract. That social studies simulations should approximate with some level of closeness real-world events, concepts, process, or phenomena, or that the problem space presented within the simulation should leverage epistemic frames, on their own tell us fairly little about how such designs are accomplished in the material and social worlds.

Re-envisioning Social Studies Simulations

Despite scholars' and practitioners' positioning of social studies simulations as learner-centered activities grounded in activity and as constructivist approaches to teaching and learning (Dack et al., 2016; Lo, 2017; Wright-Maley, 2015b); Wright-Maley & Joshi, 2016), I contend this assumption warrants deeper consideration. Due to their focus on active rather than passive learning, simulations are considered improvements upon business as usual in the social studies classroom (e.g., lecture, note taking, multiple-choice tests). Nevertheless, I contend the "active" nature of learning through simulations remains an insufficient justification—on its own—for committing the increased cognitive and institutional resources required to design and facilitate simulations (e.g., teachers' creative efforts, planning time, instructional minutes).

I contend many examples of social studies simulations, even those considered to be good examples, indeed pursue the same purposes that drive traditional social studies instruction: learning *about* events, concepts, processes, and phenomena. True, the kind of active learning accomplished through simulations is better than the passive learning on display in many traditional social studies classrooms: they seem afford the creation of lasting memories, and they may be more enjoyable for students. Nevertheless, as Kohn (2006) noted of rubrics: it is "hardly sufficient to recommend a given approach on the basis of its being better than old-fashioned [approaches]" (p. 12). In other words, learning *about* something in the social studies classroom—events, concepts, processes, phenomena—remains an insufficient goal in social studies education, whether pursued through lecture-notes-test designs or through experiential approaches like simulations.

“Powerful teaching and learning in the social studies,” as advocated by the National Council for the Social Studies (2016, p. 180), goes beyond knowing about events, concepts, processes, and phenomena. It requires not just that young citizens know and understand the past and the present, but that they develop fluency with the conceptual and disciplinary tools of the social studies to (re)design the world around them (see Kessner et al., 2020). This is in line with the National Research Council’s (2012) view of deep learning, which requires that students be able to apply what they have learned in novel contexts.

I contend the field should come to understand social studies simulations as a pedagogical approach that facilitates young people’s coming to know, do, and be as certain kind of people in the world. By this I mean that simulations may be uniquely useful tools—if designed appropriately—for developing young people’s ability to see how the disciplinary knowledge, skills, and concepts they learn in the social studies classroom can be used to design and redesign their local, national, and global communities in pursuit of a more just, equitable, and sustainable world. Borrowing from Barton and Levstik’s (2004) notion of history for the common good, I envision simulations—well-designed simulations—as a pedagogical tool with invaluable potential as part of what I will call social studies for the common good.

In the next section, I draw on research and theory from the learning sciences and games scholarship to highlight ways in which social studies simulations might be more firmly grounded in learning theory, a critical initial step in building on this vision of social studies simulations for the common good.

Learning through Experience

In this section, I highlight perspectives on learning I view as particularly salient to the present work of grounding social studies simulation research more firmly in learning theory. I begin with an overview of my perspective on learning: what counts as learning, what it is for, and how it happens. I bring the following assumptions to this work. Learning about something for its own sake is not (or should not be) the purpose of public education. This is not to say that such learning is useless. Indeed, learning something for its own sake can be enjoyable and personally satisfying. But, unless the discourse of and around public schooling shifts significantly so as to include personal happiness as a preeminent aim, such learning remains insufficient. Instead, meaningful education in the 21st century should center learning to know, do, and be in the world as certain kinds of people (Gee, 2015a). It should be about “trying on” different identities and coming to understand how they work in the world, what kind of work they can do. Such learners become committed testers (Gee, 2017) of the world around them, who use their prior experiences in the world to imagine themselves acting in the world, and who gather feedback from the world. Public school should provide young people with such experiences.

Learning, Memory, and Action

Fundamentally about making memories, particularly those stored in long-term memory. But what are memories for? Considering this question more deeply in the context of social studies education and social studies simulations is important, because it casts a new lens on questions about what simulations might be good for, how they ought to work, and how they might be designed to support deep learning and powerful and purposeful teaching and learning in the domain.

Memories are for taking action (Glenberg, 1997; Seligman et al., 2016). To have learned is to be able to do. Knowledge is competency (Wenger, 1999). Learning—the making of memories—is good in so far as the memories to which it leads is useful for planning and simulating takeable actions. The best way to do this is for the experiences we have which lead to memories approximate as closely as possible the situations in which those memories will be useful as meaning- and decision-making tools later. Memory is about much more than recalling the past. Memory is used to make sense of the present and to imagine the future. Memory is used to make sense of the present, plan our actions within it, and imagine the outcomes of those actions. When we plan actions, our memories of prior experience inform our thinking about what is possible, and we use these memories to create mental simulations of ourselves acting in the world and of how the world is likely to respond to those actions (Bergen, 2012; Seligman et al., 2016).

Learning, then, is about developing the well of experiences on which we draw to run these mental simulations. Furthermore, effective teaching and learning results in a collection of memories that are well-organized, well-integrated, and well-connected. Research shows that these kinds of well-organized experiences stored in long-term memory prepare people to think, solve problems, and plan better for future actions (Barsalou, 1999); Eichenbaum, 2008; (Ericsson & Kintsch, 1995). As Gee (2017) noted, "this helps facilitate the search for useful patterns and subpatterns, the formation of useful generalizations, and the search for evidence for what to believe and act on" (p. 14).

+Experiences

That human beings learn from experience is a belief that has been held in one form or another for millenia. Indeed, the preference of the human brain for experiences in the world has remained a consistent rationale supporting the use of simulations in social studies education. Nevertheless, this is not to say all experiences are created equal; nor that designed experiences (like those offered to learners in formal education settings) always or necessarily facilitate the learning outcomes they are intended to facilitate. Indeed, it is my basic contention that every experience is a learning experience: something is learned, though what is learned is the result of a complex and difficult-to-predict process. Most deep human learning is rooted in specific kinds of experiences, what Gee (2017) called *+experiences*. +Experiences are learning experiences in which (a) learners have actions to take; (b) learners care about the outcomes of these actions; and (c) learners' attention is well-managed by one or more facets of the learning ecology in which the experience is situated.

Takeable Actions

Why are takeable actions important? Having actions to take is the foundation of so-called active learning. It is through doing—action—that we learn and can make claims to knowing. Indeed, as Wenger (1999) contended, "knowledge is a matter of competence with respect to valued enterprises," and "of participating in the pursuit of such enterprises, that is, of engagement in the world" (p. 4). It is through probing the learning environment and the problems it presents that we learn how the world works—or, more precisely, the segment of it represented by the learning experience at hand—and the meaning it holds for our place in it (Gee, 2017). Takeable actions give learners a reason to pay attention to the various elements of the learning experience.

But how do learners decide what actions to take? Takeable actions are mediated by the goals and expectations we bring to an experience (Glenberg, 1997). These goals and expectations organize the experience at the time it occurs, and, as a result of this organization, the resulting learning becomes more readily retrievable by and useful to the learner later (Gee, 2017). These goals and expectations are themselves mediated and informed by the roles we inhabit, as well as those inhabited by others within the experience. In a Model United Nations simulation, for example, the goals that drive participants' actions, and within which one's own actions and those of others are given meaning, are directly shaped by roles (see, for example, Levy, 2018). Climate crisis-related goals are very different from the perspective of a leader of a small island nation, compared with a large nation with a developing economy, which may both depart substantively from the goals of a large, economically developed nation with a high standard of living.

Takeable actions are also mediated by the tools available to learners and learners' fluency with those tools (Greeno & Engeström, 2014). When humans survey their environment for takeable goal-mediated actions, one of the things they do is look for affordances. Affordances are what things in the environment are good or useful for, based on one's abilities (Gibson, 1979). Assuming one has the ability to wield a screwdriver, a screwdriver possesses an affordance for hanging pictures. One could twist a screw into the wall, or one could use the butt end to hammer it in; the screwdriver possesses affordances for both actions, though one fluent in using a screwdriver would likely perform the former action. Regardless, the screwdriver does not possess the affordance of being food for humans, because humans do not possess what Gee (2015) called the effective ability to metabolize the materials of a screwdriver into sustenance. Part and parcel of learning through experience is aligning one's effective abilities with environmental affordances to pursue goals (Gee, 2015; Glenberg, 1997).

Gee (2015) draws on the concept of *avatars* in videogames to offer a way of thinking about these relationships. An avatar is the in-game embodiment of a player in the game world; in other words, an avatar is who the player is in the game. Avatars come with toolkits, the effective ability pairings that shape what players can do within the game environment. Avatars are packages that afford and shape what players, or learners, can do in a (learning) environment. They come with roles and abilities that shape goals and the actions that can be taken in pursuit of those goals. Faced with a problem or challenge, who the avatar is in the game and what they can do in large part determines what can be done in response. The classic game *Super Mario World* offers a simple example. Because Mario can jump, the boxes on the screen become platforms used to move from left to right across the screen. If Mario could not jump, the player would have little reason to register the presence of the boxes and would proceed through the game in some different way.

A Model United Nations simulation offers a more sophisticated and relevant example. In Model UN, participants take on the avatars of nations, which include goals and abilities. The simulation includes dossiers of objectives and information, which offer affordances for meaning making and action, provided the participants are able to read the materials. Thus, the presence of these materials and the ability to make sense of them, together with goals mediated by roles—in other words, the avatar—necessarily shapes how learners plan and take actions and make sense of feedback from the simulated world.

There is also a question of when learners should have actions to take; that is, at what point in the learning experience? Research tells us meaningful learning requires a need to learn new information and skills (Schwartz & Bransford, 1998; Vygotsky, 1978). Without a need, some task to which learners can apply their new knowledge, learning remains abstract and disembodied from its meaningful use in the world. It is the use to which we may put new learning that allows us to organize that new learning in preparation for future goal-mediated action (Gee, 2015b, 2017; Glenberg, 1997). Thus, learners should be given a problem or task to begin learning. Gee (2003) described this principle in the context of videogames as performance before competence, and it possesses affordances for both motivation and learning.

Caring

Why is caring important? First, we pay attention to what we care about. Research shows that learners perform better on post-test measures of learning following experiences in which they have actions to take, the outcomes of which they care about (Cosmides, 1989); Cosmides et al., 2010). In other words, when they have actions to take and care about the outcomes of those actions, learners appear quite smart; and the inverse is also true (Gee, 2017).

Second, when humans care about something, they process what they learn both cognitively and affectively. Affective processing is, on its own, deeply impactful of learning (Damasio, 1999); Immordino-Yang & Damasio, 2007; Vea, 2020). Dual-process experiences, furthermore, are stored in long-term memory "in a way that is deeper, better organized, and better integrated with other knowledge" (Gee, 2017, p. 13). This better "storage," in turn, makes these memories more readily available and useful to learners in organizing and making meaning of future experiences.

Third, outcomes mean feedback, which research has extensively shown to matter deeply for learning across modes and disciplines (Wiggins, 2012). How, though, do learners make meaning of feedback? Simple: by assessing the extent to which our actions were successful in attaining our goal. This is what Gresalfi and Barnes (2012) described as *consequential feedback*, which is feedback that is

> "embedded in the context ([disciplinary] or narrative) with which a student is engaging, and allows the student to see how their solution to a problem plays out in the context. In this way, consequential feedback provides students with information about their reasoning" (p. 403)

Attentional Economy Management

In any learning experience, there is much to pay attention to. Novices to a domain, in particular, struggle to know what is worth paying attention to and what is not (Gee, 2017). Thus, learners' attention must be well-managed by one or more elements of the learning experience, whether a component of the learning design, a teacher, or both. Failure to effectively manage learners' attentional economies can lead to learners becoming overwhelmed, failing to accomplish their goals and those of the learning experience. Furthermore, poor attentional economy management increases the likelihood learners will learn the wrong thing—or even nothing at all—from the learning experience (Barsalou, 2009; Gee, 2004).

What facilitates the management of learners' attentional economies? This can happen through human-based pedagogical mediation (i.e., a teacher, mentor, or parent), but it can also take place at the design level. Videogames are particularly good at managing players' attention. Videogames provide players with clear goals to pursue, as well as appropriate tools for taking goal-mediated action (Gee, 2003, 2015). Videogames also leverage visual cues and markers to help direct players' attention to aspects of the experience important to pay attention to (Nelson, 2007). For example, in social studies-themed strategy games (e.g., *Civilization*, *Age of Empires*) (see Squire, 2011), players make use of visual elements such as resource counts and progress bars to make sense of the current state of the game, which they in turn use to organize goals and plan goal-mediated action.

Again, I suggest the value of goals and roles is evident here: Roles help shape the goals towards which participants work in simulations. These goals offer some level of scaffolding for participants as they seek to make sense of the environment and plan and take goal-mediated action, and then reflect on the effectiveness of their actions relative to achieving their goals.

Conversations with the World

I contend simulations may be fruitfully thought of as conversations learners have with the simulated world. *Conversations with the world* are turn-taking systems in which learners interact dialogically with their environments (Gee, 2015). They comprise a "cycle of thinking and action that is essential to our very survival" (Gee & Gee, 2017, p. 7). This cycle proceeds as follows.

Learners survey their environment and form goals, the identification and selection of which is mediated by their own abilities and the affordances represented within the environment (e.g., available tools for taking action) (Barab & Roth, 2006; Gibson, 1979). Learners then plan actions. Humans have developed a powerful capacity to conduct simulations in their heads, using previous experiences to build these simulations (Seligman et al., 2016). Humans can imagine what might happen if they act in a certain way. If the mentally simulated outcome—how the world responds—is favorable, we act. This action is a probe into/of the world, "a sort of question we put to the world" (Gee & Gee, 2017, p. 7). Following our action, the world responds, indicating the effectiveness of our action. We then reflect on the world's response. Finally, based on the extent to which the world's response indicates our action was effective in achieving our goal(s), we re-plan new actions or act again to elicit further responses from the world. In either case, the cycle of thinking and action begins anew. To sum up, conversations with the world proceed as follows: Form goal—plan action—simulate—act/probe—get response—reflect—act again "with due regard for the world's response" (Gee & Gee, 2017, p. 8).

Why liken engagement in simulations to conversations? Or, in other words, why use conversation as a metaphor for simulation design, as I do here? Conversations are a basic part of the human experience, something all humans know how to do in one way or another. Conversation also possesses the elements of +experiences discussed earlier. In conversations, speakers and hearers have actions to take, and they care about the outcomes. We design what we say in anticipation of how the hearer will respond (Bruner, 1983). How we design what we say and the reactions we expect are informed by several factors; for example, who we see ourselves to be, who we take ourselves to be to the hearer, who we take the hearer to be to ourselves and to themselves, our owns and the hearer's goals, and many other contextual factors that shape the meaning made through conversations. Well-designed speech aids us in reaching our goals, and poorly designed speech undermines them. To design speech well in pursuit of goals requires thinking deeply—although not necessarily consciously—about the situation and the many relevant contextual factors included within it. The aim of well-designed simulations should be to facilitate just this kind of active participation within a domain-relevant learning experience.

Thinking of simulations as conversations also highlights the value of aligning simulations more closely with well-designed games. Games as experiences depart substantively from other learning experiences in that they "talk back" to learners in ways that more traditional teaching and learning modes do not (e.g., books). As Gee and Gee (2017) explained:

> Through give and take in conversation, or through acting in the world and having the world "talk back," we can test our theories or understandings of other people and the world. We can reflect on the consequences of our interactions and envision alternatives (p. 2).

It is precisely this theory testing and envisioning of alternatives, I contend, for which simulations should be used in social studies education.

Consequential Engagement

What should these "conversations" be about? Banks (2006) contended that learning how to make informed decisions lies at the heart of the social studies. Social studies simulations, then, should be about using social studies understandings to make decisions, and to learn through reflecting on how the simulation “talks back” in response to those decisions. To further address this question, I draw on Gresalfi and colleagues’ (2009) discussion of *consequential engagement*. Gresalfi et al. outline three levels of engagement: procedural, conceptual, and consequential. Drawing on Pickering’s (1995) notion disciplinary agency, procedural engagement “involves using procedures accurately… but not necessarily with a deeper understanding of why one is performing such procedures” (Gresalfi et al., 2009, p. 22). In social studies, procedural engagement might look like accurately constructing a supply-and-demand curve in economics or identifying the source of a primary source document in history. Conceptual engagement moves beyond such procedural steps to additionally involve why a procedure works, or understanding the value a procedure brings to a larger process. For example: Understanding the underlying relationship between supply and demand, or understanding how sourcing a primary document helps identify perspective and potential bias. Consequential engagement “requires interrogating the usefulness and impact of the selection of particular [disciplinary] tools on outcomes” (Gresalfi et al., 2009, p. 22). As Gresalfi and colleagues explain:

> This final level of engagement includes a bi-directional interplay between intentionally choosing tools based on the situation being engaged, and reflecting on the consequence of that choice in terms of the impact on situations. For learners who are still beginning to understand how particular tools work and why, this interplay is crucial both in that it can push back on students’ understanding of the tool, and also illustrate that such conceptual tools can be consequential in the world (p. 22).

What might consequential engagement look like in social studies simulations? Consequential engagement includes a bi-directional interplay between (a) the choice of tools, and (b) reflecting on the effectiveness of those choices. Thus, for a social studies simulation to be consequentially engaging, it must offer participants tools from which to choose based on the situation at hand.

Before discussing the role of choice in consequentially engaging scenarios, I will clarify what I mean by the word "tools." By tools, I mean what Vygotsky (1978) meant in his use of the term: something that grants the learner the ability to act upon the world around them. In terms of the more familiar conception of tool as a physical object exterior to the user, this might mean sighting tubes used for geographic surveys, or geographic information systems. But tools can also be conceptual, such as marginal cost and marginal benefit in economics, or cause and effect in history.

Whether concrete or abstract, the tools offered to learners through social studies simulations should be disciplinary in nature in order to facilitate domain learning. In other words, social studies simulations should be designed around disciplinary knowledge, skills, and concepts as tools and using these tools to solve intrasimulation problems and challenges. Additionally, the task-participant structures of the simulation should invite and require the use of these tools in such a way that their use affords participant actions within the simulation, actions which approximate the ways of knowing, doing, and thinking in the domain within which the simulation is situated. A consequentially engaging economics simulation, therefore, would present learners with a task that can be attended to using the conceptual tools of economics; for example, choosing from among multiple, sufficiently unlike options by using marginal cost and marginal benefit to identify in simplest terms the tradeoffs (what is gained and what is lost with each choice) between options. Constructing such decision-making frameworks is the heart of economics as a discipline, and thus, such a simulation would invite and require tool use in such a way that participants engaged in an approximation of the professional practice of the economics domain.

Signs and sign systems are the complement of tools (Vygotsky, 1978). They are two sides of the same coin, so to speak. While tools afford the user the ability to act on the surrounding environment (Engels, 1940), signs and sign systems aid in organizing one's self, thoughts, and actions. When I speak about tools and tool use and their role in learning through experience, then, I note as well the role of signs and sign systems. In history, an example of a part of a sign system would be the concept of change and continuity over time, or how things change, stay the same, or both over the longue durée of history. As a norm in the history discipline, change and continuity over time helps organize one's thinking about the past.

Now I return to the issue of choice. Choices only hold meaning relative to available goal-mediated actions (see Gee, 2015; Glenberg, 1997; Seligman et al., 2016). Additionally, for a choice to be meaningful, different choices must be perceived to lead to substantively different outcomes. To offer learners multiple tools to choose from, a requisite of consequential engagement, each tool must possess substantively different affordances for goal-mediated action; that is, each tool must be better for some work, and less good for other work. What makes the choice of one tool over another at all meaningful, then, is that tool's affordances for learner action in the face of a problem.

Still, that one tool affords some actions in the face of a problem while another affords others remains insufficient. What is still needed is a goal against which tool choice and use can be measured. Without a goal in mind, any action will do; actions result in outcomes, but without a goal, how do learners attribute meaning to those outcomes? Goals give meaning to outcomes—and therefore actions, and therefore choices—by rendering some outcomes desirable and satisfactory and others less so.

But how do learners know which goals they should have? One way might be to simply design explicit goals into the simulation (e.g., using economics concepts, choose the path of action that results in the most equitable and sustainable distribution of commons resources). Another, more implicit way of designing goals into simulations is in providing avatars. Within the framework of their in-simulation avatars, learners develop and select their own goals, and they have a good idea from the start which tools might be appropriate for those goals, because the relevant tools are baked into their avatar's toolkit.

As I have alluded to throughout this section, choice and subsequent reflection relies on outcomes, or consequences (in the neutral sense of the word) to learners' actions. To have choice, then, we need goals and goal-relevant outcomes. Without outcomes or consequences, there is very little for learners to reflect upon when they have finished using the tools they have selected. Indeed, without clear outcomes, goals themselves become quite meaningless, as they can be neither achieved nor failed.

For a social studies simulation to be consequentially engaging, I suggest it must look something like the real world. This is not to say, however, that simulations must be tightly aligned with the "realness" of the world. In fact, I contend this could constitute a serious shortcoming. I contend that simulations whose content or substance are too tightly coupled with the real world as it is or as it was create equally tight constraints on students' thinking. For example: a sense of needing to do the simulation "right." I suggest such pressures undermine what I have argued ought to be the goal of social studies simulations: to develop fluency with disciplinary knowledge, skills, and concepts as tools for making sense of and acting in/on the world in an effort to (re)design it.

Rather, we should strive to design simulations that align tightly to the *deep structure* of real-world events, concepts, processes, and phenomena. By deep structure, I mean the core of the problem at hand (Willingham, 2009). For example, the core attributes of a supply-and-demand problem in economics remain the same whether it be in regards to shoes, skirts, or wartime steel production: supply is still calculated the same, as is demand, and they share the same relationship to each other.

The *shallow structure*, or surface structure, the essentially irrelevant topical details of a problem, however, can shift while preserving the underlying deep structure. For example, inflation and other factors associated with economic recession or collapse can be studied through multiple historical cases (e.g., Weimar Germany, Great Depression United States, 2008 Great Recession); their surface structures are topically different, but their deep structures are the same (this is not to say the contextual details are the same, nor are they irrelevant to other learning aims).

Again drawing on literature from games scholarship, I suggest *playable fictions* offers a useful conceptual lens. Playable fictions "are interactive stories in which one is positioned as a protagonist who makes game choices that have consequence in the fictional world" (Barab et al., 2011, p. 4). Playable fictions offer the ability to design simulations around the deep structure of consequentially engaging problems. They would also support designing for participant action and agency, while mitigating potential constraints on action and agency that may result from maintaining verisimilitude too tightly.

Towards a (Design) Theory of Social Studies Simulations for Learning to Know, Do, and Be in the World

In this penultimate section, I outline what I suggest are critical attributes (Parker, 1988) of what I will now call *disciplinarily integrated, consequentially engaging simulation games*, or *DICES*. I offer a new term, because after at least 60 years of scholarship in the area of social studies simulations, there has been little interest in defining simulations. It would appear, then, that the existing term, "simulation," adequately performs a task the field finds useful, and thus I do not seek to stake definitional ground there. I also do not adopt another related term, "simulation game," as I view this term as perfectly useful for the task to which it is often put: identifying and discussing videogames that approximate something in the real world but with little or not explicit intention to educate (games like *Civilization* or *Age of Empires II*) (e.g., McCall, 2011, 2012).

I also seek to clarify here that my use of the term "game" does not necessarily imply digital videogames. Why, then, use the term "game" at all? There has been a fair deal of discussion concerning the relationship between games and simulations, with some contending simulations are distinct from games (Young et al., 2012), others contending games are a subset of simulations (Tobias & Fletcher, 2012), and still others suggesting either argument unduly privileges form at the expense of function (Wright-Maley, 2015a). I am not interested in entering this debate. Rather, I am content to argue for a particular kind of simulation that, while approximating slices of the real world for the purpose of learning through experience, also capitalizes on that which makes good games good learning environments, many of which are outlined below. Hence, by using the term "game," I seek to foreground the alignment of DICES to the principles of good learning found in games.

+Experiences: Actions to Take, Caring, and Well-managed Attention

I have contended simulations should not be viewed so differently from other learning experiences such that we ignore general principles of learning design. Thus, I suggest simulations should, first and foremost, be designed as +experiences. By this I mean that learners must have actions to take within the simulation, learners must care about the outcomes of those actions, and some part of the simulation design should help manage learners' attention. In terms of having actions to take, simulations must present learners with goals; afford the taking up of roles, whether provided explicitly or afforded implicitly as part of the design; and situate learners with tools for planning and taking actions that approximate the doings of a discipline.

Learners should be able to act in and on the simulation world prior to formally learning the content and developing fluency with the disciplinary tools that will help plan and take well-informed goal-mediated action. In this way, the simulation game is neither curriculum nor assessment, nor is it a "hook" to motivate future learning. In this view, the simulation game is all of these recursively, by which I mean that participants develop relevant domain knowledge and understanding while engaging with the simulation game. As they engage with the simulation game, learners develop theories about the simulation world and test those theories through the actions they take. Learners in turn reflect on the simulated world's response, revising their theories as appropriate. Through iterative cycles of planning, taking, and reflecting on actions, learners calibrate their understanding of the disciplinary knowledge, skills, and concepts around which the simulation game is structured. These iterative cycles are facilitated by the kind of depth through looping curricular design suggested by Parker and colleagues (2011). Over time, I argue, this calibration of understanding represents deep learning of the disciplinary knowledge, skills, and concepts embedded within the simulation game. As such, I argue this developing understanding could be assessed through the simulation game, operationalized as outcomes that align to learners' planned and taken goal-mediated actions.

DICES give participants reasons to care about the outcomes of their actions by providing goal-relevant feedback from the simulation world. The simulation should respond to learners' actions in ways that provide consequential feedback (Gresalfi & Barnes, 2012) to learners regarding their use of disciplinary tools to plan and take goal-mediated action. While this is similar to Wright-Maley's (2015a) contention that social studies simulations must be designed to unfold dynamically in response to students as active agents, I emphasize here that DICES unfold in response to participants' better or worse use of disciplinary knowledge, skills, and concepts as tools for taking in-game actions. In other words, the better or worse participants use disciplinary knowledge, skills, and concepts to act in the simulation leads directly to better or worse outcomes relative to their goals.

Roles and goals in DICES help participants know what is important to pay attention to. There appears to be a direct relationship between the complexity of a simulation and its associated learning goals, and the time that should be allocated to it (Stover, 2007). This suggests that DICES, which I conceptualize as being intended to facilitate complex learning goals associated with learning to know, do, and be as certain kinds of people in the world, may take a significant amount of time to participate in compared to more traditional methods, even other simulations. Thus, it becomes important to consider another way in which participants' attention ought to be managed: through well-designed and well-sequenced "levels" (Gee, 2003). By this I mean that DICES start small, inviting and requiring learners to understand and master discrete concepts and tools as they engage with simple problems. Over time, the problems become more complex, using more relevant concepts. In this way, DICES are designed with depth through looping in mind (Parker et al., 2011).

Consequential Engagement through Deep-structure Verisimilitude

DICES must approximate the deep structure of real-world events, concepts, processes, and phenomena. This is in general agreement with Wright-Maley (2015a), though I build on this by considering verisimilitude at two levels: deep structure, and shallow structure. Take, as an example, a simulation of the Versailles Treaty. The shallow structure of the Versailles Treaty includes all the specific details of the historical event: it was held in France, Germany was held accountable for the outbreak of WWI by the Allied Powers and made to pay reparations, and so on. The deep structure does not include specific places or actors. Instead, the deep structure is focused on the "heart" of the event: the end of a global conflict, a nation who had perpetrated war crimes at the mercy of a centuries-old adversary, the backdrop of nationalism embodied through imperialism and colonization. I suggest deep-structure verisimilitude is non-negotiable, while shallow-structure verisimilitude may not be necessary depending on the learning aims at hand.

In my view, deep-structure verisimilitude does not necessarily preclude shallow-structure verisimilitude, as long as the deep structure of the real and simulated phenomenon are aligned. Nevertheless, I do suggest shallow-structure verisimilitude is more likely than deep-structure verisimilitude to place unwanted constraints on learners' experience if the goal of the simulation is, as I have suggested it should be, to enculturate learners into ways of knowing, doing, and being in the world, rather than toposition students to learn about an event, process, concept, or phenomenon. Stoddard and colleagues' (2019) study of *Purple State* provides an example of when simulations designed with shallow-structure verisimilitude still result in the kind of learning to become for which I have advocated here. Students participated in a series of activities designed to look very much like the real-world doings and doers that inspired the simulation: students are placed in the roles of interns at a strategic communications firm—a real position in the real world—and were asked to research and make recommendations on real contemporary issues.

Related, I also contend the kind of deep learning I suggest is possible through social studies simulations does not preclude "content." Indeed, the content of the domain around which a simulation is designed provides the disciplinary tools and sign systems that support disciplinary integration.

Disciplinary Integration

Finally, DICES are disciplinarily integrated. By this I mean that the simulation is explicitly designed around the ways of knowing, doing, and being of a discipline. Furthermore, participants are positioned with tools that afford takeable actions that approximate the doings of the domain relevant to the simulated experience and associated learning goals. I suggest this would look similar to the concept of disciplinarily and conceptually integrated game mechanics from the field of games scholarship (Clark et al., 2015; Sengupta et al., 2015; Sengupta & Clark, 2016). Game mechanics are, in short, how players take actions in games (Gee, 2015). In a game like *Super Mario World*, referenced earlier, jumping is a game mechanic. In *Civilization*, a popular commercial off-the-shelf videogame used widely in social studies education contexts (Squire, 2011), game mechanics include selecting government types, making alliances, and the like. For a game mechanic to be disciplinarily integrated, it would have to afford, and indeed require, player actions that approximated the doings of a discipline. Disciplinarily integrated mechanics in a social studies DICES game focused on history, then, would require that learners think and do in ways that approximate how historians think and do. Learners' planning and taking of actions, then, would require some level of textual analysis (e.g., sourcing, contextualizing, and corroborating; see (Wineburg, 1991a, 1991b), which I envision as taking place in much the same way good games invite textual and intertextual engagement (Gee, 2003). As a concrete example, learners might be presented with a choice, say, in how their nation state (avatar) weighs in on the rebuilding of global order following a world war. This approximation of the deep structure of the Versailles Treaty would invite historical analysis of the cause and effect of reparations following World War I. Using the same example, economics, geography, and civics would be easily integrated into the learning experience through such mechanics, as well.

Playable Fictions

The critical attributes I have outlined thus far constitute the requisite components of the kinds of simulations I suggest foster coming to know, do, and be as certain kinds of people in the world. Taken on their own, these generate a kind of simulation I suggest is better aligned to powerful and purposeful learning in social studies education. Nevertheless, what makes DICES a kind of game is that they are situated within playable fictions (Barab et al., 2019). That is, participants are positioned as protagonists within a narrative that mirrors the deep structure of the event or phenomenon under investigation. Within this narrative are embedded domain-relevant concepts and processes, and learners are positioned with the disciplinary tools and ways of knowing and thinking consequentially useful in taking goal-mediated actions. Players "enter" the playable fiction as avatars (Gee, 2015), and thus are positioned with tools and toolkits useful for planning and taking in-games actions.

Conclusion

Herein, I have offered the beginnings of a design theory of simulation games in social studies education. Along the way, I highlighted the need for such a theory, in particular the need for such a theory to be sufficiently grounded in learning theory. As such, I outlined salient perspectives on learning and learning design from two fields: learning sciences and games scholarship. Bringing it all together, I have suggested a theory for a particular kind of social studies simulation: disciplinarily integrated, consequentially engaging simulation games, or DICES. I now turn to what I see as the implications of this effort. First, though I have undertaken the preceding work in the context of social studies education, I envision this DICES framework is applicable not just to social studies but to other disciplines as well.

The framework I have proposed has several implications for studying social studies simulations. First, the kind of social studies simulations for which I have advocated here must be designed, tested, and researched. I suggest it is unlikely simulations that fulfill the critical attributes I outlined above exist "in the wild"—at least, not many of them. Thus, the naturalistic case study approach common to past and current research efforts may be insufficient on its own. Case study method (e.g., Yin, 2018) is useful for developing deep insight into phenomena within a limited scope. By definition, case study method requires placing boundaries around the phenomenon under investigation. Coupled with the haphazardly applied definition of simulations in social studies, the case study method therefore limits efforts to understand simulations to individual interventions—knowing deeply about one instantiation of a social studies simulation tells us little about simulations on the whole.

This is not to say that case study method is not a useful tool in the methodological toolbox. Girard (2019), for example, highlighted the potential limitations of simulations when the intellectual labor of students is unevenly distributed. Lo and Tierney (2017) suggested the engagement first principle (Parker et al., 2011) may be insufficient on its own for maintaining interest, and that additional scaffolds are warranted. Rather, I suggest additional methodological tools are warranted, in particular for the purpose of establishing clear links between DICES mechanics and the facilitation of processes that afford deep learning in social studies. For example, quantitative ethnography (Shaffer,

2017) and design-based research (Barab & Squire, 2004; Brown, 1992) may be particularly useful approaches.

Second, while I contend what I have offered thus far is in some ways more specific than what is represented in the extant literature, I also suggest it is not yet specific enough. Take, for example, my inclusion of roles in the framework. While learning theory tells us roles are omnipresent in experience, it tells us little about what those roles should look like in the context of social studies simulations. Should learners be positioned in roles of power and authority? While there may be affordances of roles at such scale—for example, seeing the “big picture” of the phenomena under study—they may also be reason to be concerned—for example, would it encourage development of machiavellian views of the relationship between the state and the people? Or should learners be positioned as the every(wo)man? In truth, I suspect there are affordances and constraints to each, and that each would result in different design confluences, which may alter what is learned and how well. As a concrete example: would high-level roles of power and authority be better or worse in terms of developing historical empathy? Understanding of supply and demand? We cannot know what those affordances and constraints of different scales of roles may be without testing them against each other. Roles is just one example; I suggest this is true of many design elements not sufficiently discussed here (e.g., scale of time and place, the length of a simulation, the presence and size of teams). To be clear, I do not mean randomized controlled trials. Rather, I mean to suggest we might design DICES and test different versions of them with real students in the messy contexts of real classrooms, and then compare findings across versions.

Pre-service teachers need some level of education on games and simulations in social studies. Not to provide such instruction is a disservice not just to pre-service teachers but also to every student who enters their classrooms. I have suggested that the framework I have offered, with its emphasis on disciplinarily integrated mechanics and consequential engagement with disciplinary tools and real-world phenomena, offers a way of thinking about simulations that may be useful. It is my hope that, by focusing on disciplinary integration, for example, the field can better prepare pre-service to, at best, make effective use of social studies simulations, and at the very least, effectively avoid leveraging social studies simulations in such a way as to perpetrate curriculum violence upon young people (Ighodaro & Wiggan, 2010).

Thinking of simulations the way we think about games, particularly as designed environments, means designing simulations will take longer. This is not necessarily a bad thing. I hope that simulations into which greater temporal, cognitive, and creative resources are invested will lead to better outcomes overall, and fewer horrendous ones. If we think of simulations as more than one-off "experiential activities" meant to "engage" students and facilitate understanding of one discrete piece of content in a particular way, and more as longer-term purposeful experiences that talk back to learners when they take actions, I hope there would not be much room for the kind of curriculum violence perpetrated on young people through poorly conceived simulations often portrayed in the news.

To conclude, I want to draw stark attention to a component that is not included in the DICES framework: simulating difficult histories. In short, I have come to the conclusion that simulations should not be used in the context of teaching and learning about difficult histories. The risks are too great, the payoff too meager and too unreliable. To borrow a concept from economics, the marginal benefit fails to outweigh the marginal cost; that is, the risk of things going wrong is very high, and the payoff if it goes well is not significantly better than those of alternative practices. Meanwhile, the consequences of it going poorly are severe: Historicized emotional trauma perpetrated upon young learners by their adult teachers; the trivialization of tragedy such that, at best, students fail to develop meaningful understandings of genocide and injustice, and at worst, the minimization of such evils to the extent that young people are not sufficiently horrified at the prospect that many of their fellow citizens relish a resurgence of, for example, Nazi ideology; and on the part of the teacher, the loss of employment. While it is easy (and correct) to be deeply concerned with the first two, I would like to assume most teachers falling into this third category are well-intentioned educators with their students' best interests and education at heart. American democracy needs such people employed as social studies teachers, and it is thus important to adequately prepare them to think about how to use simulations—and how not to use them.

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CHAPTER 5

CONCLUSION

In the preceding pages, I have forwarded the following primary argument: simulations are used widely in social studies education, even held up as best practice in social studies standards documents, yet the lack of conceptual clarity and sufficient grounding in learning theory is problematic. Across three stand-alone journal articles, I have (1) proposed *mechanics analysis*, a qualitative inquiry method for analyzing how a game's mechanics generate opportunities for players to practice using disciplinary knowledge, skills, and concepts (DKSCs) as tools for taking goal-mediated actions in the game world; (2) leveraged mechanics analysis to conduct an empirical study of three digital social studies-themed simulation games to identify opportunities to practice (OTPs) social studies DKSCs; and (3) proposed a theory of simulation games in social studies education closely aligned with sociocognitive views on teaching and learning. What follows is a discussion of limitations and implications, which I organize by chapter.

Chapter Two (Article 1): Limitations and Implications

I argued that a qualitative approach to analyzing opportunities to practice in social studies-themed videogames offers a compliment to existing approaches grounded in quantitative inquiry (e.g., Shute et al., 2016; Shute & Ventura, 2013). I argued that such quantitative approaches, while valuable, may obscure analysis of videogames, a fundamentally a qualitative experience, and what is learned from them. Nevertheless, as with all forms of qualitative research, reliability and validity remain concerns despite such a qualitative turn (Maxwell, 2013). Such concerns can be confronted through repeated application of the method; in other words, the more MA is used, the more the method may be honed. As with discourse analysis, validity and reliability of MA may increase with application, both in terms of number of applications, variety of phenomena to which the method is applied, and the number of researchers (Gee, 2018). Additionally, MA may be used alongside other methods to support triangulation (Maxwell, 2013).

The implications of MA are many. MA represents at least as much a way of thinking about videogames and similar experiences as it does a method of inquiry. I envision this way of thinking being useful for researchers, designers, and teachers and teacher educators alike. In the hands of researchers, MA represents a means of looking more holistically at learning through videogames as a process, rather than focusing entirely on learning as measured by pre-post tests. For designers, MA represents a way of thinking about the design of educational videogames that foregrounds learning to know, do, and be as certain kinds of people in the world, rather than as a means of content transmission (e.g., Barab et al., 2019; Gee, 2015a). I envision this being useful during three phases of game design and development: (1) As a front-end design tool, (2) as an ad hoc check on designed interactions, and (3) as a post hoc evaluative tool. For teachers, MA represents a way of thinking useful in the evaluation of games during the selection process, with an emphasis on meaningful learning beyond content acquisition. Teacher educators may find MA provides a useful framework for teaching pre-service teachers ways of thinking about selecting and using videogames for classroom use.

Chapter Three (Article 2): Limitations and Implications

In Chapter 3 I reported on an application of MA to three social studies-themed digital simulation games: *Offworld Trading Company*, *Frostpunk*, and *Surviving Mars*. Findings showed *Offworld Trading Company* generated many OTPs relevant to social studies DKSCs, including 80 and 83% of economics and geography DKSCs represented in Vignette 1. Overall, *Offworld Trading Company* includes many OTPs for economics and geography, but few for civics or history. *Frostpunk* offers a significant number of economics DKSCs, though these were largely abstract in nature; for example, considering tradeoffs between different options for in-game actions. *Frostpunk* was the strongest of the three games in terms of civics DKSCs; though, again, these were quite abstract. *Surviving Mars* offered the fewest OTPs.

Limitations of this study included that I was the sole researcher conducting the analysis, raising possible concerns regarding validity and reliability. Additionally, analysis of the *C3 Framework* for DKSCs may have been limited due to my positionality as a former social studies teacher and current social studies teacher educator and researcher, as opposed to membership in one of the professional discourses on which the *C3 Framework* draws.

Chapter Four (Article 3): Limitations and Implications

In Chapter 4, I proposed an initial theory of simulation games in social studies education. I grounded this theory in sociocognitive perspectives on learning. Limitations include my role as the sole researcher, as well the non-systematic nature of the literature review I conducted to develop the resulting theoretical framework.

Nevertheless, I envision the theory I have proposed as a starting point for what I view as sorely needed attention to learning theory in research and practice as it pertains to social studies simulations. My review of the literature identified a common lack of theoretical grounding. Without theoretical grounding, I contend the field of social studies simulation research will be left to wallow in what Aldrich (2009) called the Babel problem, in which researchers are left to talk past one another. In such a state, our claims to knowledge about simulations are and can or should do well are tenuous at best.

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