# Metagaming: Cognition in gaming environments and systems

by

Seth Jordan Lickteig

B.S., Kansas State University, 2007
M.S., Kansas State University, 2017

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Curriculum and Instruction
College of Education

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# Abstract

The primary purpose of this focus group study was to explore how learning occurs during iterative experiences within a singular games-based environment. Using constructivist learning theories as a foundation, this study sought to identify how those processes were used in games-based settings. This qualitative study included eight undergraduate participants primarily in education-based fields. Over the span of six weeks, participants learned the game of *Magic the Gathering*, its rules, mechanics, and systems. Research questions sought to identify what was learned, how it was learned, and why the learning was effective. Four total focus group interviews were conducted, which were recorded and subsequently transcribed. Initial coding, axial coding, and analytic memoing were employed during data analysis, resulting in a tiered approach that refined data into patterns and then further into potential themes. Additionally, participants kept an on-going reflective journal in which they recorded their experiences with the game outside of the focus group meetings.

Findings suggest participants engaged with the game system in a variety of ways, demonstrating high-level skill incorporation and practice. With repeated play, participants naturally began to inquire into the deeper workings of the game. This resulted in participant learning which included both mechanical and social forms of metagaming. Mechanical metagaming reflects the learning which occurs when engaging directly with the game systems, mechanics, and processes. Players analyze and synthesize complex systems in making determinations that inform future gameplay. Social metagaming signifies the understanding of peers during gaming environments. When playing against familiar opponents, participants made evaluations dependent on the personality and strategies of that particular opponent. Participant learning took place via an inquiry-based approach which allowed individuals to approach the

game from their own perspectives and for personalized purposes. Learning was effective because it took place in a social environment, was reinforced by emotional responses to gameplay, and was highly personalized for each participant.

Implications from this study suggest a games-based approach to learning can be organized and structured to provide students with the opportunity to form a deep understanding of higher skills through direct engagement with a game. The study theorizes the use of a games-based inquiry approach to classroom pedagogy, where a game serves as the primary object of study. Instead of games serving as a single use form of additional media for disciplinary content delivery, students explore the game itself in repeated playthroughs. This arrangement allows for direct skill practice in 21st century skills which quickly becoming the norm in school curriculums. Games-based inquiry encourages student engagement, collaboration with peers, critical thinking, problem-solving, and a deep understanding of increasingly complex systems. Ultimately, a games-based inquiry approach hypothetically could employ game design as a creative, generative classroom experience.

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# Chapter 1 - Introduction and Purpose of Study

A group of friends gather around a table which has been setup in a basement. The six friends come prepared with snacks, drinks, and bags of dice. On the table sets a series of miniature figurines, some depicting fearsome beasts, others beautiful characters frozen in heroic pose. On one end of the table sits a screen, painted with images of dragons doing battle with humans. On the other side of the screen, obscured from the players view, a variety of data tables, rules explanations, and hand drawn notes fill every inch of the screen, as if wallpaper. The player sitting behind the screen weaves a narrative tale in which the others, her players, interact in the world which she dreamed. Together, the players attempt to solve the complex situations in front of them through the lens of their character. Puzzles, traps, exploration, combat with enemies all determined through random dice rolls and a defined set of rules. Moral dilemmas spark conversation amongst players. Which villager should be rescued? What should we do with the bad guy? Like their characters, the players learn how to play the game while also learning about the game and their peers.

In another setting, strangers engage in an on-going discussion on an internet message board about which virtual item has more value. Each post is filled with mathematical formulas, suggesting correlation between different items, statistics, and character specialization. Next to the usernames of posters is list of hours logged in the game, numbering hundreds and sometimes thousands of hours. At the end of the lengthy post a list of citations, similar to those found at the end of an academic paper, provide links to evidence and thanks to previous thinkers for building upon the pool of knowledge. Subsequent posts are filled with questions about methodology and criticisms. How did you gather the data on damage output? Did it vary between high and low armor targets? Did creature level impact or skew the output? The thread listed above the

mathematical analysis is from a new player, seeking advice on how to improve after their initial playthrough. The virtual game has produced a virtual community, which often creates lasting relationships between gamers and the games they play.

The manner in which humans interact socially has been radically altered with the invention of the internet and the onset of the digital era. The types of learning necessary to succeed in modern jobs and thinking no longer reflect the industrial model employed by schools. Desks neatly lined up in rows and a system of competition between students are no longer espoused by employers. Instead they demand a workforce which is capable of collaboration with coworkers from varied backgrounds and, often, nations. The romanticized notion of standardized tests echo of a bygone era. Evaluating the ability of students to memorize facts are no longer necessary in a world where global knowledge is readily available.

Modern demands of student learning place increasing focus on the development of cognitive skills, such as critical thinking, logical processing, and program evaluation. Unfortunately, many current curriculums are rooted in traditional methods including teacher-centered lesson delivery, textbook-centric topics, and high-stakes testing. Even modern teaching strategies fail to engage students in robust, interdisciplinary thought, focusing instead on the development of a singular cognitive thought-process at a time. Given the wide range of potential skills these programs attempt to address, it becomes necessary for students to practice these skills within a closed, defined system. Incorporating games into the curriculum provides both closed and open systems which allow students to develop cognitive skills through engaged practice. Additionally, study in to games-based learning presents opportunities for addressing many interesting research issues in games and learning, including opponent modeling, incomplete and

imperfect information, utility of computation, change of representation, strategic analysis, learning from experience, and discovery learning (Pell, 1992).

Experienced teachers have undoubtedly been exposed to inquiry-based teaching models through professional development and methods courses. Each content discipline proposes its own, unique system for modeling to students the daily endeavors of disciplinary professionals. In the realm of social studies, historical thinking and document analysis allow students to be a historian. In science, experiments allow learners to recreate the inspirational moments of chemists, biologists, and physicists. More recently, educators have been introduced to games-based learning, a pedagogical perspective which promotes the incorporation of gaming principles in the classroom. Though sharing similar constructionist views on learning, application of inquiry and games-based learning has not been widely promoted or discussed. This study seeks to explore the intersection of learning occur via inquiry in games-based environment and generally accepted constructivist learning theories.

## Rationale

Recent work in classroom pedagogy has incorporated various systems of games into curriculum. Research on games-based learning curriculum has shown increased student engagement (Hsieh, Lin, & Hou, 2015), improved test scores (Hofferth & Moon, 2012; Mahimker, 2014), and improvement in both critical thinking and problem-solving skills (Dormann, Caquard, Woods, & Biddle, 2006; van der Maas, H. L. J & Nyamsuren, 2017). Recent shifts from content-based, high-stake testing curriculum objectives to skill-based practice standards have enabled strategies such as gamification to be more widely accepted in place of teacher-centered, traditional methods. Additionally, students and teachers are more familiar with games, engaging with them on a personal level outside of the classroom.

Unfortunately, most educators possess a basic level of comfort with games-based learning. Research into teacher perceptions of the use of games-based learning in their classroom has shown four factors limiting its adoption: effective implementation, technology challenges, established limits of the current educational system, and lack of resources (Watson & Yang, 2016). Currently, games are employed to deliver only a single part of the content, often used one time before moving on to other topics. The primary use of games usually occurs only to review previous content or as an incentive reward for students who finish other learning tasks.

Application of games-based learning has proven to be difficult for classroom teachers to implement because of how radically different it is in pedagogical framework. Negative perceptions of games permeate education. They are viewed primarily as entertainment or for play, lacking in content delivery potential, and as a gimmick to garner false motivation from students. Other concerns center on feasibility issues. Among these are a shortage of resources in schools, including time, money, and technology. Though a growing percentage of adults are gamers themselves outside of the classroom (Entertainment Software Association, 2015), there exists an unfamiliarity with teaching methods incorporating games-based learning.

Teachers are possibly missing an opportunity to assist students in deeper thought processing by developing an understanding not just of the theme of the game (the content), but of the entire system used. With the emergence of gaming in school, there is value in understanding how students engage in metacognition as they try to process the systems associated and generated within games. By providing the students the prospect of extended work within the system of the game, students come to view the game from both an inside and outside perspective. They identify the bounds of the system developed by the game, experiment with stretching rules and conceptions of game play, and incorporate data collection and analysis into future play.

Additionally, students who practice these skills of metacognition are able to apply them in broader views of other systems. Thus, games provide a system for which students can work collaboratively towards a creative end, whether it is identifying an unknown solution or creation of game improvements and extensions

Interacting with games in this manner requires higher order thinking skills, the development of problem-solving, and logical reasoning. These skills are in demand for modern-day occupations; as automation replaces factory line workers, employers now actively seek a work force of thinkers, not cogs to replace parts along the assembly line. Additionally, these skills are beneficial for students to be successful in higher education and as adults (Bellanca & Brandt, 2010). Critical thinking, collaboration, creativity, and communication skills have been established as 21 Century Skills, and in some states, have replaced or enhanced traditional content standards as school curriculum (Partnership for 21st Century Learning, 2007).

There currently exists a gap in research in regard to the deeper use of games-based learning curriculum in the K-12 classroom. While a plethora of research has focused on the learning possibilities of using games-based curriculum, few if any have delved into the complex cognitive processes used in metagaming. Shifting the research target from content enhancement to the development of metacognitive skills will provide insight into how games can be more fully utilized in classrooms targeting those in-demand 21st Century Skills. In this manner, players learn *of* the game, not simply about the content or context presented through a game. Games themselves function as complex systems, composed of a series of mathematical functions, logarithms, and principles (Goodman, 2011). As players experience a game, they inquire into these systems, discovering information which improves their success rates and understanding of the game. Depending on the style type of game, this learning can be described as strategy.

Inquiry into game systems is often referred to as metagaming by those in the gaming community. Boluk and LeMieux (2017) define metagaming as a "signifier for everything occurring before, after, between, and during games as well as everything located in, on, and beyond games, the metagame anchors the game in time and space" (p. 11). When players engage in metagaming, they seek to master the game systems through a fundamental understanding of how they function. Players accomplish this through delving deeper into the mechanics, mathematical structures, and other aspects generated by the game. Various types of inquiry occur during the course of metagaming (Lickteig, S. J., 2019). On an individual level, players internalize, hypothesize, and deduce on a mechanical level. Games allow the individual to engage in these types of experiences in engaging manners, where the individual free of punishment. Additionally, individuals are encouraged to experiment, to engage in trial and error without fear of failure. If done as a group, metagaming occurs naturally in a social setting, in which players discuss, brainstorm, and collaborate on improving individual results. Within the historical context of games-based learning scholarly work, social metagaming has rarely, if ever, been utilized as the primary inquiry. Considering the foundational tenants of games-based learning, constructionism, and metagaming, it is believed that engaging in a gaming environment on a group level would prove beneficial for all members involved.

## Research Purpose

The purpose of this study is to explore personal learning in iterative games-based settings of a singular game. The study is composed of eight undergraduate students majoring in secondary education at a midwestern university. It conceptualizes the phenomenon of metagaming as it occurs both individually and socially. It seeks to identify, describe, and align

behaviors and cognitive processes humans use when encountering complex systems such as games.

**Research Questions**

1. What knowledge and skills are learned through multiple playthroughs of a singular game?
2. How do participants effectively construct knowledge through iterative experiences with a singular game?
3. What potential pedagogical and curricular implications do iterative games-based learning experiences pose?

**Operational Definitions**

1. *game* - A close-system experience in which participants attempt to reach a goal within the bounds of the established system. The definition of game has been greatly expanded to include the process of play and subsequent categorization of various types of games including video, physical, and mental games (Rowe, 1992).

2. *cognition* - The term cognition evolved during the course of the 20th century. This shift has created a duality of the term; cognition can function as both a process and a product. During the course of this research, students will engage in the process with the goal of developing the product. The process of cognition includes "a variety of functions such as perception, attention, memory coding, retention, and recall, decision-making, reasoning, problem-solving, imaging, planning and executing actions" (Brandimonte, Bruno, & Collina, 2006, p. 3).

3. *meta* - From the Greek prefix meaning "with", "after", "between" or "beyond". Incorporated with nouns, extends the scope or viewpoint of the original term to include a more

complete, outside understanding. The term has grown in popularity during the onset of the internet age and is used in those settings to shorthand the term metagame (see below). Additionally, in online gaming culture there exists a portion of the community who believes the phrase meta is an acronym (META) standing for Most Effective Tactic Available.

4. *metacognition* - Generally defined as the recognition of the individual upon their own thinking processes. Consideration is needed for both metacognitive knowledge and metacognitive regulation (Teaching Excellence in Adult Learning, 2011). Elements of metacognition include three variables: person, task, and strategy variables (Flavell, John H., 1979). Person variables include the awareness of personal learning preferences, including individual strengths and weaknesses. Task variables provide the ability to determine the nature of a task and how to approach a solution. Strategy variables provide the tools needed for solving previously mentioned tasks through flexible and creative techniques.

5. *metagaming* - As a relatively new term, metagaming is the process of using both internal and external knowledge of the game system to the benefit of the player. After engaging in the system, patterns are noted, and new strategies are employed. When considering the results of others, the player begins to engage in metagaming. The process involves much more than simply reflecting on the process of play: "[a]ttitude, affinity, experience, achievement, status, community, opponent, strategy, series, spectatorship, statistics, economics, politics, practice: the metagame explodes the logic of the game ... What the metagame identifies is not the history of the *game*, but the histories of *play*" (Boluk & LeMieux, 2016, p. 320-21).

## Theoretical Frameworks

The researcher personally adheres to an interpretivist epistemological perspective, rooted in a critical realist ontology. From this philosophical foundation, the study employs

constructivism as its primary theoretical framework. Constructivism posits the individual learner builds understanding through both knowledge acquisition and experiential learning. To learn the socially constructed ideas, the individual experiences and generates unique personal meaning of the topic (Crotty, 1998). This philosophy lies between the objective and subjective philosophies, implying an ongoing development of understanding the world around us. The emphasis on the relationship between the learner and the experience is a fundamental aspect of games-based learning. As the individual engages within a predesigned system, they experience interaction and construct meaning and understanding.

Further, this study explores the learning in games-based settings via eight different constructivist learning theories. These include cognitive constructivist theories of Bloom's Taxonomic Model (1956), Bruner's Discovery Learning (1961), and Perry's Theory of Intellectual and Ethical Development (1999). Social constructivist learning theories are also investigated, including Vygotsky's Zone of Proximal Development (1934), Bandura's Social Learning Theory (1977), and Lave's Situated Learning Theory (1991). Lastly, metacognitive theories considered including Flavell's Metacognitive Theory (1976) and Kolb's Experiential Learning Theory (2009). By identifying and aligning data from this study with previously accepted learning theory, the hope is to explore how these theories overlap with the learning experiences of the participants in games-based settings. Further details on each of these learning theories can be found in Chapter 2.

Games-based learning engages learners in two primary forms, individually through cognitive development and socially through gameplay. The role of the classroom environment has been often included in progressive, constructivist work. Dewey (1897) believed learning depended on both psychological and sociological contexts. Socially, with roots in the child

developmentalist movement of the late 19th century, stress was placed on the engagement and social interaction of children. The two sides were "organically related" and learning was most successful when the two were equally satisfied. Games-based learning utilizes both the psychological and social; the former through game theory, the latter through the ecology of play.

**Game Theory**

Additionally, this study employs game theory as a framework for understanding how individuals approach gameplay. Game theory with emphasis on educational pedagogy has collectively become known as games-based learning (GBL). Game theory has roots in a constructivist epistemology that requires players to directly engage with the game system. Game theory historically developed as part of applied mathematics, though it has been adapted for use in the social sciences as a way of modeling the complex interactions a society undertakes (Michener, 1983). Developed originally during World War II, game theory was used by the military to engage cadets in combat simulations and scenarios. John von Neumann and Oskar Morgenstern's book *Theory of Games and Economic Behavior* (1944) introduced the conceptualization of game theory. This was followed by *Games and Decisions* (Luce & Raiffa, 1957) which introduced game theory in the realm of social sciences. The move away from mathematics and into the social sciences provided "provocative insights, showing that concepts of rationality are far more problematic and contradictory than had been supposed, and such game as the zero-sum game and the prisoner's dilemma came to be seen as archetypes for recurring social interactional problems" (Heckathorn, 1986, p. 206). Whereas mathematical game theory worked to identify a type of min-max thinking in an attempt to win, game theory in the social sciences provided systems which were more complicated. Opportunities for concessions were

possible, even encouraged. The systems generally much more complex because of extended participation and the involvement of human emotion and social interactions.

In 2000, American economist Herbert Gintis provided a modern summary of the basic ideas of game theory (see Gintis, 2000, p. xxiii-xxiv). First, games theory is a means of solving complex problems, with emphasis placed on both critical reasoning and creative problem-solving. Secondly, it is a tool used universally in behavioral sciences. Though traditionally found in economics and biology, game theory has expanded recently to the fields of anthropology, political science, sociology, and psychology. Thirdly, game theory is a tool which allows individuals to investigate the world. Experiential learning theories, inquiry-based instruction, and other similar progressive pedagogical approaches extol the use of logical experimentation. Fourth, game theory is a study on human collaboration and cooperative social interaction. Engaging in systemic thinking with peers enables opportunities for feedback and growth. Finally, game theory provides context for the development of human behavior. It exposes the process in which human behavior is formed, from the beginning stages through experimentation and subsequent consensus.

**The Ecology of Play**

The ecology of play provides a theoretical framework for ideas based in ludic pedagogy and theories of play. Sicart (2014) surmised that to play is to be human, and as such, needed to be described as an ecological framework. Play is not a simple act; establishing an accurate definition requires one to understand the multiple moving parts which occur during play. It is an experience; one in which an individual engages in a system (open or closed), with others, and within an environment. The ecology begins with the individual, who establishes personal (psychological) reasons for the purpose of play. Play can be carnivalesque, appropriative,

disruptive, and autotelic. The framework also considers the philosophy of playfulness; consider an individual taking on a playful attitude outside of play.

After purpose has been established, the individual determines the system for which play will take place. Systems include the setting for play, tools used by players (sometimes referred to as toys), and the structure of play. Structure determines the boundaries for play; and thus, generally establishes the rules and goals for participants. The system may be open, meaning loose enforcement of rules and outside interaction is encouraged, or closed, in which a series of rules exists, and structure provided. Games often incorporate closed systems of play, with clearly defined rules, game environments, and goals.

Using game theory and the ecology of play, data can be gathered on the rather complex processes of cognition. This study aims to bridge understanding of metacognition and metagaming, arguing metagaming is the process of developing metacognitive skills while engaged in games-based learning. Through game theory, cognitive processes such as reasoning, problem-solving, and critical thinking are employed. Further, students involved in games-based learning experience learning through play; collaboration, creativity, and systems analysis. Blending the two concepts, as Dewey remarked, provides the setting for positive educative growth.

**Methodology**

Determining a connection between metacognition and metagaming requires research into the cognitive processes used by individual when interacting in game-based learning. This study seeks to identify those cognitive processes though phenomenological inquiry. This pragmatic approach is specifically focused to assist classroom teachers with future implementation of games-based learning curriculum. The qualitative research method follows the prescribed steps

proposed by Anselm L. Strauss (1987) when attempting to reach conclusions about the phenomenon in study. First, an overall description of each participant is generated, demonstrating the relationships between participant and games-based learning. This includes establishing background information and baseline qualities of participants, including their familiarity with the game studied, historical background playing games, and preferred learning style. Next, participants engaged with the singular game system repeatedly over the course of six weeks. Qualitative data was generated through focus group interviews, participant journaling, and gameplay data sheets. The third and final step of Strauss' qualitative methodology is the generation of conclusions linking the individual cases to each other. These general conclusions will inform the researcher of both the personal and social cognitive processes used during metagaming.

This study utilized focus group methodology to explore the complexities of learning in games-based environments. Johnson and Christensen (2014) define focus groups as “a type of group interview in which a moderator leads a discussion with a small group of individuals to examine, in detail, how the group members think and feel about a topic” (p. 234). Focus group methodology emphasizes generative group interaction which allows the researcher to observe how participants form opinion and process information (Kleiber, 2004). In this manner, participants engage in social constructivist discussions, forming their own conclusions after listening to others and reflecting on their own personal experiences (Liamputtong, 2011). Study into games-based learning consists of a variety of different subject matter and skill employment. By their very nature, games are complex forms of media. Focus group methodology enables data generation which reflects these complexities. Stewart and Shamdasani (2015) conclude, “[t]he ebb and flow of focus group research across and within various disciplinary fields – and the

attendant intellectual elements of thesis, antithesis, and synthesis – make focus groups an interesting and dynamic arena that continues to merit consideration and use" (p. 13).

Data collection used during research include focus group interviews, participant journaling, and gameplay session logs. Focus group interviews occurred on four different occasions throughout the study. These interviews allowed the researcher to ask pointed questions at learning processes utilized by participants. More importantly, the causal friendly nature of the focus group interviews allowed participants to talk and discuss with one another about their learning. This yielded deeper conversation and evidence of learning beyond the scripted questions of the researcher. During focus group interviews, the researcher took on the role of active observer of participants, recording notes during focus group meetings. As participant observer, the researcher was able to elaborate and probe participants as a peripheral member of the study (Bhattacharya, 2017). Participants were responsible for recording personal thoughts and reflections through participant journaling. This form of data collection provided supplementary data on personal and social cognitive growth directly voiced from the participants. The final form of data collection includes gameplay data collection via Google Forms. Participants recorded the results of games played outside of the focus group meetings, including win-loss, deck played, opponent's deck, and additional postgame reflections. This form of data provided participants with an immediate response process to communicate their thoughts and feelings directly after a game ended.

Focus group interviews were first transcribed and analyzed via coding to identify emerging themes and processes individuals describe while participating in games-based learning. This provides the participant the opportunity to describe both the concrete experience and the personal reflection of the experience, often times providing emotional thoughts not shared during

an interview (Charmaz, 2006, p. 36). Coding included three distinct steps: initial coding, analytic memoing , and axial coding (Saldaña, 2016). Initial coding was done during the transcription process and primarily focused on descriptive and narrative codes aligned with research questions. During transcription and initial coding, the researcher employed analytic memoing during transcribing to describe the tone and attitudes of participants during focus group meetings. This provided the opportunity for the researcher to interpret and conceptualize data while identifying potential emerging themes (Given, 2008). Next, axial coding was employed during a second read through of the transcripts, allowing the researcher to identify specific data aligned with larger themes. Additionally, field notes and analytic memos provided a holistic perspective of focus group meetings and an created an additional level of researcher reflexivity (Bhattacharya, 2017, p. 141). After the three primary methods of data collections were analyzed, the results were triangulated to establish consistency and legitimacy of emerging themes. Triangulation of analyzed data also generates trustworthiness in interpretations and conclusions made by the researcher. The additional alignment of data and results through triangulation "provides stronger substantiation of constructs and hypotheses" (Eisenhardt, 1989).

**Game Selection: *Magic the Gathering***

Game selection is a vital component of research regarding games-based approaches to learning. Gaming has exploded in popularity in recent years. Access to new platforms of technology, expansion and better access to the internet, and greater accessibility to the games themselves have made it easier than ever to play. Consequently, there also exists an ever-increasing number and type of games. Students at various levels of schooling engage in a plethora of game types, platforms, and systems outside of schools regularly. Prior to this study and as part of my doctoral coursework, I considered a variety of games for potential use in a

prolonged focus group study. After engaging in a series of interviews, I concluded the use of a *serious game* with a complex series of game mechanics would potentially yield the best data for an iterative study of games-based learning with undergraduate students. *Serious games* are those which are designed for commercial entertainment purposes and not primarily for education (Ritterfeld, Cody, & Vorderer, 2009). Sicart (2008) defines game mechanics as "methods invoked by agents for interacting with the game world" (p. 1). Game mechanics are the systems employed by the game that players interact with. They are typically composed of mathematical algorithms, randomness, and game sequencing. In this manner, the game selected for study was similar to those played by participants recreationally.

Ultimately, I decided to use *Magic the Gathering* as the game for study. Originally released in 1993, *Magic the Gathering* by *Wizards of the Coast* is considered the first commercially successful trading card game. Players construct decks using cards which can be obtained in packs. A robust variety of strategies exist in *Magic* because of the assortment of mechanics and sheer number of cards produced. Recent studies into using Artificial Intelligence to computationally solve the game have been unsuccessful (Churchill, Biderman, & Herrick, 2019). The authors conclude, "This construction establishes that *Magic: The Gathering* is the most computationally complex real-world game known in the literature" (p. 7). In typical games, players attempt to kill their opponent by getting their life total to zero. Using a resource produced by land cards called *mana*, the players cast spells and creatures to develop their gameboard and attack their opponent. In addition to the paper settings, *Magic* released a digital client called *Magic the Gathering Arena* in 2018. The digital product mirrors the paper game but allows players to engage in play in online settings against anonymous opponents. Both paper and digital forms of *Magic* were employed during this study.

## Limits and Possibilities of the Study

This study is one of the first specifically focused on the development of metacognition through the use of games-based learning. As such, it should be viewed strictly as an exploratory study; one concerned primarily with the identification and description of how learning occurs in gaming environments. Additionally, it should be noted this study employed a small sample size via focus group research. While an attempt is made to connect metagaming to other research in the area of metacognition, this should be viewed primarily as a preliminary analysis. Further, delineation is necessary to describe the relationship of meta-thinking (both cognition and gaming) and those higher-order thinking skills projected by 21st Century Skills standards.

Additionally, this study focuses on classroom pedagogy but does so from the perspective of the student. Considerations from the teaching perspective, those shared by the researcher in this instance, only reflect a singular view on games-based learning in the classroom. The background of the researcher serving in the capacity of the teacher throughout the research reflects a positive position on the use of games in learning. Additionally, the researcher has extensive knowledge and experience in games-based learning curriculum a typical classroom teacher would not find available. Further research is needed from a pedagogical stance to better explore and describe the possibilities of metagaming on classroom teaching. Consequently, an understanding of current teacher perspective on games-based learning needs to be determined in planning future professional development opportunities and teacher-education course work.

## Researcher Background and Positionality

My background in gaming goes back to my childhood, where games played a major part of my social and leisure space. I was part of athletic teams from an early age. Team-based sports provided the foundation for my competitive and collaborative drive. My family had video game

console which evolved as new systems were released. My brothers and I found solace in gaming environments; they were an opportunity to engage in competition and collaboration when the weather was bad. We played everything: platformers, simulations, sport games, adventures. Games provided the structure to experiment, be creative, and have fun. They were books brought to life. We created our own games, a mix of imagination, math, and dice. We devised entire sports leagues with fully maned rosters. We war-gammed territory in the yard and neighborhood. Games gave us purpose to our activities; they drove us. *Magic the Gathering* was one of the many games we explored. After taking a break from the game during college, friends and I rediscovered our interest in the game and have been actively playing for eight years.

Unfortunately, public school typically did not align with the experiences we were having at home. I believe I had good teachers growing up. My mother was a special education teacher at the elementary level and made sure that we did our part in the classroom. I was a student at a unique time in public schooling: the waning moments of the child development models of the 1980s to just before No Child Left Behind standardization. I had some teachers who engaged in project-based learning, where others recited from a textbook. My math courses especially were designed to provide maximum rote practice. Homework each night, assigned evens of forty possible questions. The answer was all that mattered, not the process. It was not satisfying to me as a student because I did not see the application or point. I was learning to fulfill a requirement to move on. Outside of school, games continued to offer me the avenue to be creative and inquire deeply. They engaged me in ways school never could. I wrote and brainstormed game ideas during class. Friends and I created a card league during high school with standing, rankings, and statistical performance. We asked ourselves, why couldn't school be like this?

After my undergraduate experience, I worked as an 8th grade social studies teacher at a school on a military post in the Midwest. During my tenure, we focused on satisfying the reading and math requirements as dictated by No Child Left Behind legislation. In social studies, specific content pieces were identified for students to essentially memorize by the end of their 8th grade year. Most of these were sheer rote facts, a laundry list of who, what, when, and where questions. There was very little time for depth or exploration of topics. Instead, we were encouraged to move from subject to subject quickly to cover the exhaustive list. A student asked, "Why? If I need to know, I'd just look it up on my phone." This thought permeated through my graduate coursework. How can we make it more meaningful for students? Why was this learning important? Important to who? As the No Child Left Behind era ended and the potential for games-based learning curriculums resurfaced.

As a researcher, I acknowledge that I have hypothesized a theoretical pedagogical framework related to games-based learning prior to the completion of the study. Specifically, I believe a games-based learning taxonomic structure through an inquiry-based model offers potential for exceptional learning. Personal experience and self-reflection have led to the generation of a three-step implementation process with games-based learning. The first level is the simple exposure of the game to students, typically as an extension on content knowledge in the form of academic review or reward. The second stage, metagaming, is described during this process of this study. Hallmarks of this stage include the iterative use and focus on the systems generated by the game. Finally, the concluding step in the process, the creative generation by students of extensions and modifications to the game. I believe the primary barrier to acceptance of games-based approaches in classrooms is the false perception that what it teaches has no

value. This study seeks to identify the complex, higher-order skills employed during inquiry into games which would support their inclusion in K-12 classrooms.

**Chapter Summary**

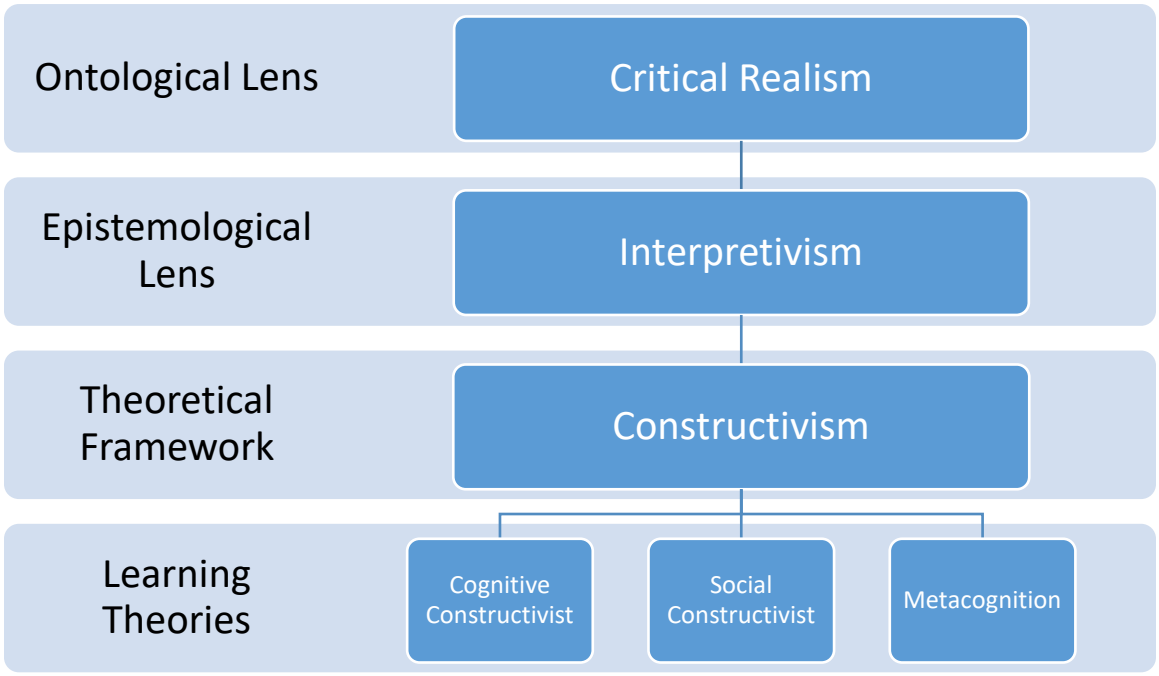
This chapter has introduced the reader to the structure and purpose of the study on cognitive development through use games-based learning. Rationale included the changing philosophical purpose of education within a modern society, including access and employment of 21st Century skills. The researcher utilizes a constructivist epistemology, focusing on the dual lens of individual cognitive development and social learning typically found in public schools. Two theoretical frameworks are employed to address the two lenses: constructivist game theory for individual cognitive development and social constructivism to interpret the interactions of the individual and peers. Focus group methodology is employed for the study consisting of data gathered via focus group interviews, participant journals, and gameplay data collection. Data was then analyzed via procedural coding consisting of initial coding, axial coding, and researcher analytic memoing. From this data, patterns were identified, and emerging themes formed. Finally, limitations of the study were explored, and researcher subjectivities were discussed.

# Chapter 2 - Literature Review

This chapter provides a review of literature which forms the foundation of understanding for the study. Qualitative studies require subjective interpretations of the researcher during the course of data collection, analysis, and interpretation. Included are the ontological, epistemological, and theoretical philosophies which form the foundational understandings of the researcher (see Figure 2.1). Specifically, this study explores the development of cognitive processes though games-based environments. Understanding cognition is complex, especially in a learning environment which the individual interacts with both their environment and peers. Games-based learning employs metacognitive skills requiring both individual and social aspects in the conceptualization and formation of personal learning. These skills are vital for student success in a modern world, where abilities such as data analysis, critical thinking, creative problem-solving, and social skills are in demand.

**Figure 2.1**

*Philosophical Foundations, Theoretical Frameworks, and Educational Learning Theories Employed by this Study*




This chapter is divided into three main sections. The first establishes the ontological, epistemological, and theoretical foundations informing the study. I have included direct associations between the philosophical underpinnings and engagement with games-based environments. The second section focuses on learning theories and frameworks often incorporated in games-based learning pedagogical strategies. It is through these learning theories that potential classroom implementation is established, with an emphasis on the use of metacognitive strategies and 21st Century Skills. Lastly, a review of appropriate theories related to the utilization of play and games in curriculum, both of which form the foundation of games-based learning pedagogy is included. A historical and current review of games-based learning is included. Concepts of games-based inquiry and metagaming are also introduced and discussed.

## Ontological, Epistemological, and Theoretical Foundations

Ontological, epistemological, and theoretical foundations for this study are rooted primarily in traditional constructivist thought. Constructivist approaches to learning primarily focus on student-centered activities with which individuals build their knowledge through experience. Each opportunity for learning builds on subsequent understanding. Therefore, knowledge is not compartmentalized into small blocks of factual rote information, but instead the intricately woven combination of experience and processes. Knowledge acquisition is a personal experience and thus involvement of the learner is vital for its success. Student personal interests, immediate relevance of the curriculum, and the exploration of big ideas motivate individuals to seek knowledge and put into practice holistic skills (Brooks & Brooks, 1999). Through realization of these philosophies, educators are encouraged to take a pragmatic approach towards learning.

Previous research employed in games-based learning have typically employed a similar approach. Games-based learning provides learners with direct experience by which they construct knowledge through interacting within the confines of the game environment and systems. Additionally, games often take place in social settings, either pitting players against each other in competitive formats or requiring individuals to cooperate or collaborate to achieve success. The study of individual and social learning is complex, often demanding the use of multiple perspectives in interpretation and analysis. In addition to discussing cognitive aspects of learning, a brief consideration is given to exploring the emotional facet of education. Games, like other forms of media, engage the participant in the affective domain, eliciting emotional response to gameplay, story narrative, and social interactions.

## Ontological Foundation: Critical Realism

The ontological foundation informing the researcher is best described as critical realist. In this section I will summarize the ontological and epistemological philosophical implications on the researcher, emphasizing the metatheoretical concept of critical realism. Critical realism questions the relationship between ontology and epistemology, and as such both have been included in this section. The educational lens of this study directly leans on the relationship between reality and knowledge as described by critical realism. Additionally, associations between critical realism and the games-based inquiry and metagaming models utilized in this study are included.

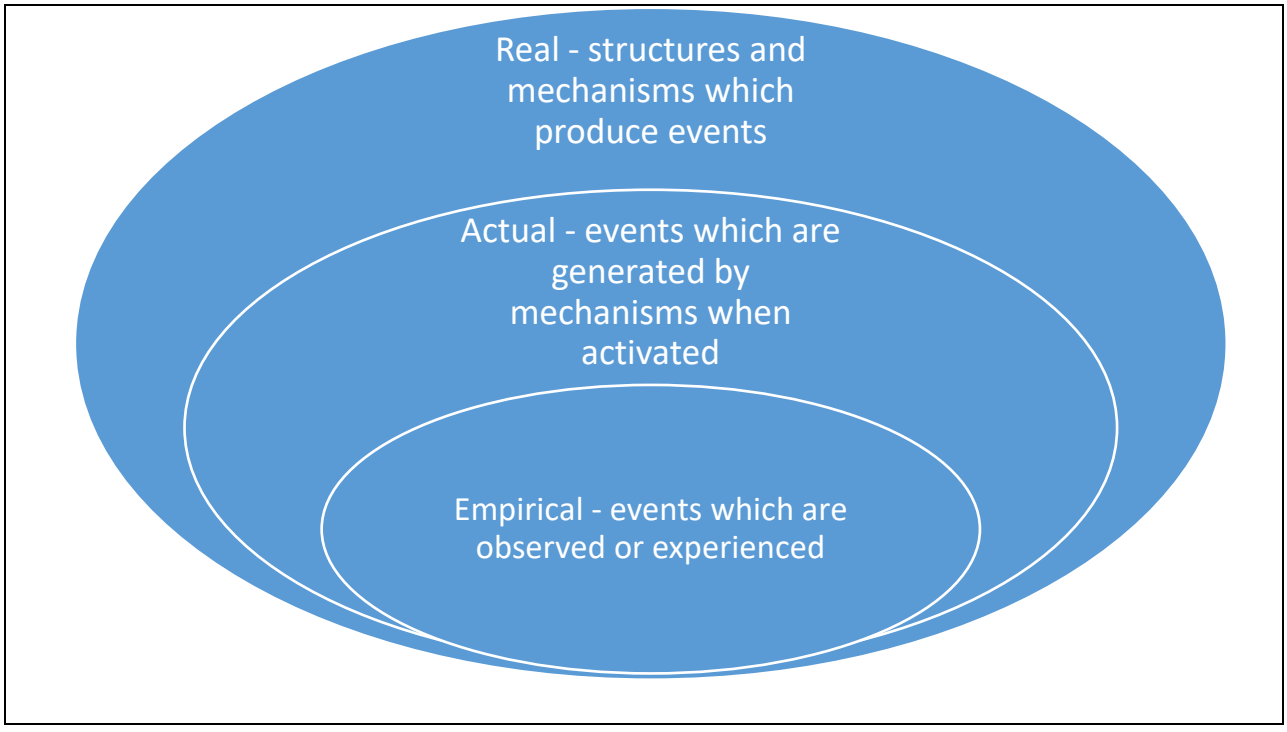
Critical realism was the result of philosophical attempts to move beyond post-positivist thought which dominated social sciences in the 1970s. Originally conceived by former economist turned philosopher Roy Bhaskar, critical realism attempts to blend the scientific structures and processes commonly associated with positivism with the interpretive methods of postmodernism primarily concerned with interpretation and hermeneutics (Archer et al., 2016). Critical realism espouses the existence of a single reality with multiple forms of interpretations. Reality is composed of four modes: material, artefactual, ideal, and social realities (Fleetwood, 2014). The role of knowledge in critical realism is the discovery of casual mechanisms with the acknowledgement that knowledge is subject to change and reinterpretation. Critical realism is the elision of Bhaskar's two conceptions, transcendental realism and critical naturalism (Corson, 1991).

Bhaskar's first conception was transcendental realism (1975) which was originated in the realm of science. This philosophy posits scientific study is the vehicle which informs human understanding of complex, ever-changing structures within the natural world. Knowledge is

transitive and fallible, changing over time as new scientific information become available. In this regard, reality is explicit, not presupposed as empirical realists suggest. Bhaskar instead suggests that reality is composed of three domains: the real, the actual, and the empirical (see Figure 2.2). The real is comprised of the objects, structures, and casual powers, both known and unknown, situated in the real world. The actual are the events which occur whether humans experience them or not. Lastly, the empirical are those events directly experienced by people. This approach to understanding reality differs from a traditional realist view which holds that reality is singular, which allows for the understanding of casual relationships. Critical realists instead accept the reality of mechanisms which cause events even if they do not fully understand them.

**Figure 2.2**

*Stratified Reality Viewed from the Lens of Critical Realism*




*Note*. A stratified reality as espoused by critical realists, which recognizes the causal relationship of events which may or may not be predictable. Causality is directly connected to the context of the event, whether observed or unobserved. Reproduced from (Raduescu & Vessey, 2009).

Additionally, Bhaskar expands that reality is stratified and emergent. Relationships between objects in the domains results in causation, transformation, and even the emergence of new structures and objects. In this regard, reality the interaction of different objects is necessary and the relationship between them may not be immediately discernable. Transcendental realists do not subscribe to the traditional scientific principle that causality is determined by the regular events but instead that mechanisms of objects which potentially initiate events. The primary emphasis of transcendental realist philosophy is therefore on generative understandings of reality, that is, the mechanisms and interactions which compose events.

Later, Bhaskar extended the philosophy directly to social sciences under the label critical naturalism (1979). Bhaskar posits that the same philosophical lens which was applied to the understanding of the physical world can also be employed in explaining human interaction and systems. Similar to transcendental realism, critical naturalism seeks to explain the mechanisms underlying social events. Clearly human worlds are more complex and require a deeper knowledge of human behavior than those scientifically explained from the natural world. Particularly, critical naturalism accentuates the relationship between human structure and individual agency. Human agency is made possible through the realization of these social structures, which are in turn influenced and modified by human agency. These structures are analogous to those found in games-based environments, where the player interacts with the system in similar means.

**Epistemological Foundation: Interpretivism**

Bhaskar also challenged the epistemic fallacy, the traditional view that ontology begets understanding, that is, that epistemology, theoretical framework, philosophical perceptions, and research methodologies are all derived from one's ontological foundation. It is impossible to

compare the two, ontology addresses the concept of reality whereas epistemology focuses on knowledge. Thus, it is impossible to consider ontological statements derived from epistemological questions because the two are "operating on different dimensions – one transitive and changing [epistemology]; the other intransitive and relatively enduring [ontology]" (Varaki & Earl, 2005, p. 1). Critical realism is therefore a metatheory because it directly influences what other philosophical foundations an individual identifies with (Fleetwood, 2014). Although understanding and science are ever changing and fallible, critical realists maintain an underlying goal of improvement and betterment.

From an epistemological perspective, critical realists align with interpretivist thought. An interpretivist perspective of knowledge suggests that it is predisposed by historical, social, and cultural influences. Thus, knowledge by its very nature is defined by its contextual and conceptual associations (Archer et al., 2016). Interpretivists espouse the role of personal views, prior life experiences, and cultural backgrounds in assessing individual knowledge. When viewed from a learning perspective, knowledge is constructed through engagement with new experiences. Prior knowledge informs the learner, who apply earlier understanding to new contexts, often through experimentation or trial and error. Interpretivists emphasize the importance of social learning because it is through a social lens that individuals understand their environment (Bhattacharya, 2017), and more importantly, the differences between groups of people. It is through these experiences that individuals interpret their reality. This perception of knowledge aligns directly with a constructivist philosophy of learning and a phenomenological approach to research design.

## Ontological and Epistemological Foundations in Gaming Environments

The complex relationship between objects and structures is similar to those artificially created in gaming environments. As players engage in a game setting or system, they too discover and interpret this form of reality. The rules of the game reality may be completely different than those experience in real world settings. Within game environments, the three realities Bhaskar described are directly experienced and discovered by the player. During early playthroughs, the player experiences the system organically, without inquiring into the algorithms and mathematical properties which the game functions on. These are the mechanisms which create gameplay events. Though they are unaware of these systems, that does not mean they do not exist. When experienced for the first time, player interaction with the environment has a more profound emotional affect, that is, gameplay is more memorable because the player is unaware why or how it occurs.

Epistemologically, individual understanding of game environments and systems are directly influenced through their personal interpretation of events experienced during gameplay. With multiple playthroughs, the player develops and changes their strategy as information becomes available. In the first playthrough, the primary goal of the player is survival. Usually this is achieved through a direct focus on a single strategy. In subsequent playthroughs the player discovers and experiments with new strategies, ones which they had previously been completely unaware of. The initial strategy which they had highly valued may be interpreted completely differently as knowledge of the game environment and system occurs. Player success is also informed by prior knowledge of games of similar styles or genres. Success in first-person shooter (FPS) games for example is a strong indicator of subsequent success in new FPS games.

Additionally, playing with others can profoundly impact the route and manner which individuals approach game systems. If a player observes another achieve success with a different strategy, they will incorporate that strategy into their own, often evaluating their approach to the other. Access to watching other players play games has greatly improved with the expansion of the internet and streaming platforms such as Twitch and YouTube. Multiplayer games exist solely in a social setting which provides grounds for the development of a metagame. As player knowledge of game systems increases, a process of minimum or maximizing occurs. This development requires great knowledge of the game, often driven by data analytics, in determining the most efficient strategy for success for that specific social-competitive environment. As groups of players change their strategy, the metagame shifts in response, sometimes drastically changing the method players approach the game.

Critical realism suggests that science should be viewed as an ongoing process, improved with subsequent observations, data, and tool development. In a similar process, as players engage in multiple iterations of a gaming environment or system, their knowledge and strategy also evolve through scientific experimentation. The player identifies objects, structures, and powers which cause and influence events in game. This suggests an inquiry-based relation between the player and game, one which can be purposefully utilized in learning environments. Inquiry-based knowledge aligns and conforms with constructivist theoretical and learning frameworks.

**Theoretical Framework: Constructivism**

Utilized and espoused by a variety of education philosophers, a constructivist approach to education has become synonymous with providing students the opportunity to experience content though engagement with their environment (Perkins, 1999). Constructivist thought runs counter to traditional, behaviorist philosophies on learning. Emphasis is placed on cognitive

development and deep understanding instead of implicit behaviors or skills (Fosnot & Perry, 1996).The process of learning is very much a personal experience, how the individual interacts with the environment around them varies from person to person. Similarly, players who engage in gaming environments, experience and interpret the setting differently. Constructivists hold that learning is both an individual and social process, resulting in the development of cognitive and social constructivist philosophies. Through constructivist lens, knowledge is the personal conceptualization of experience.

Constructivism derives its philosophical roots in the work of progressive educational theorists of the early 20th century. Functional psychologists challenged behaviorist thought, suggesting that consciousness was more than biological constraints as suggested in Darwinian thought. Instead, functionalists like Edward Thorndike emphasized the importance of individual experience in the development of the mind. Functionalists viewed cognition not as an innate ability to be fulfilled, but rather a process which could be practiced. Later, John Dewey expanded on this perspective and its role in educational settings. Dewey (1897) suggested that education is gained through two processes, psychological and sociological, which occur while an individual experiences learning. Previous philosophers viewed the two as separate, whereas Dewey believed:

> I believe that the psychological and social sides are organically related and that education cannot be regarded as a compromise between the two, or a superimposition of one upon the other. We are told that the psychological definition of education is barren and formal - that it gives us only the idea of a development of all the mental powers without giving us any idea of the use to which these powers are put. On the other hand, it is urged that the social definition of education, as getting adjusted to civilization, makes of it a forced and

external process, and results in subordinating the freedom of the individual to a preconceived social and political status. (p. 1)

Dewey believed that real answer lies between the two dialectic positions. The only way to contextualize knowledge was through understanding an individual was from both inter and intra perceptions. From these, cognitive and social constructivism is found.

**Cognitive Constructivism**

The concept of genetic epistemology attempts to explain the origins, or genesis, of knowledge. Psychologist Jean Paiget (1936) posited cognitive development occurs primarily through biological development and experience with environment. Early experiences of the child are primarily sensor-motor, the individual determines they simply exists amongst other elements. Later, as the child distinguishes the permanent state of other objects, they are forced to recognize external objects including the existence of peers. This process is achieved through reciprocal assimilation (Sugarman, 1987, p. 393). The child responds to stimulants found within their environment, receive feedback from others, usually a mother or father. The child assimilates the action, generating some form of causality between action and environment. This exposure to others requires the individual to develop conceptual thought, such as "mass, weight, and movement and logical and mathematical relations" (Piaget, 1972, p. 2). The formation of conceptual thought permits the child to satisfy conflicting knowledge through socialization, that is, the collaborative interpretation of others influences an individual's personal understanding. Subsequently, conceptual thought provides schema for interacting with new situations based on similar experiences.

Radical constructivists argue the subjective personal nature of experience prevents influence from social contexts. Philosopher Ernst von Glasersfeld posited truth, or the idea of an

objective truth, cannot exist independently of the individual (Cardellini, 2006). Though the experience may be shared by many, interpretation and understanding are achieved on an individual level. “But all kinds of experience are essentially subjective, and though I may find reasons to believe that my experience may not be unlike yours, I have no way of knowing that it is the same” (Glasersfeld, E., 2013, p. 1). If a positivist truth does not exist, the purpose of educations is to provide active experiences for students to construct personal knowledge. This approach discounts the value of social interpretation and construction of social meaning of experience.

**Social Constructivism**

Alternatively, social constructivists hold that conceptual knowledge is constructed through interaction. Meaning is found through social construction, not biologically or individual retrospection. “Men together produce a human environment, with the totality of its sociocultural and psychological formations” (Berger & Luckmann, 1966, p. 69). Experiences with others provides the framework for personal knowledge to be challenged, refined, and possibly evolve. Shifting away from the development of an individual, social constructivists emphasize language and interchange with peers (Jaworski, 1998). This perspective demonstrates a fundamental attempt to move beyond psychology and towards a more sociological domain, replacing the ideology of the individual for those of the community (Gergen, 1995, p. 24).

A final clarification regarding the differences between cognitive constructivism and social constructivism. Guterman (2013) summarizes that although both , “… endorse a subjectivist view of knowledge, the former [cognitive constructivism] emphasizes individuals’ biological and cognitive processes, whereas the latter [social constructivism] places knowledge in the domain of social interchange” (p. 13). Both prescribe to the idea that knowledge and

understanding is developed through experience. This provides major implications for educational curriculum, namely the need for student-centered, student-led, active learning environments which provide learners the opportunity to experience content and skills.

By their nature, games provide the player a constructivist experience through personal engagement with a system devised on incremental difficulty progression. The game begins with basic commands, narrative, and expectations before increasing complexity as the player improves. Games-based environments provide the opportunity for experiential learning, providing access to an almost endless range of content, skills, and settings. Additionally, games-based environments engage the learner in both individual and social cognitive situations. When players engage in either single and multiplayer modes, knowledge and conceptualization of the game system are developed, improved, and reinforced through both cognitive and social constructivist domains.

**Constructivist Learning Theories**

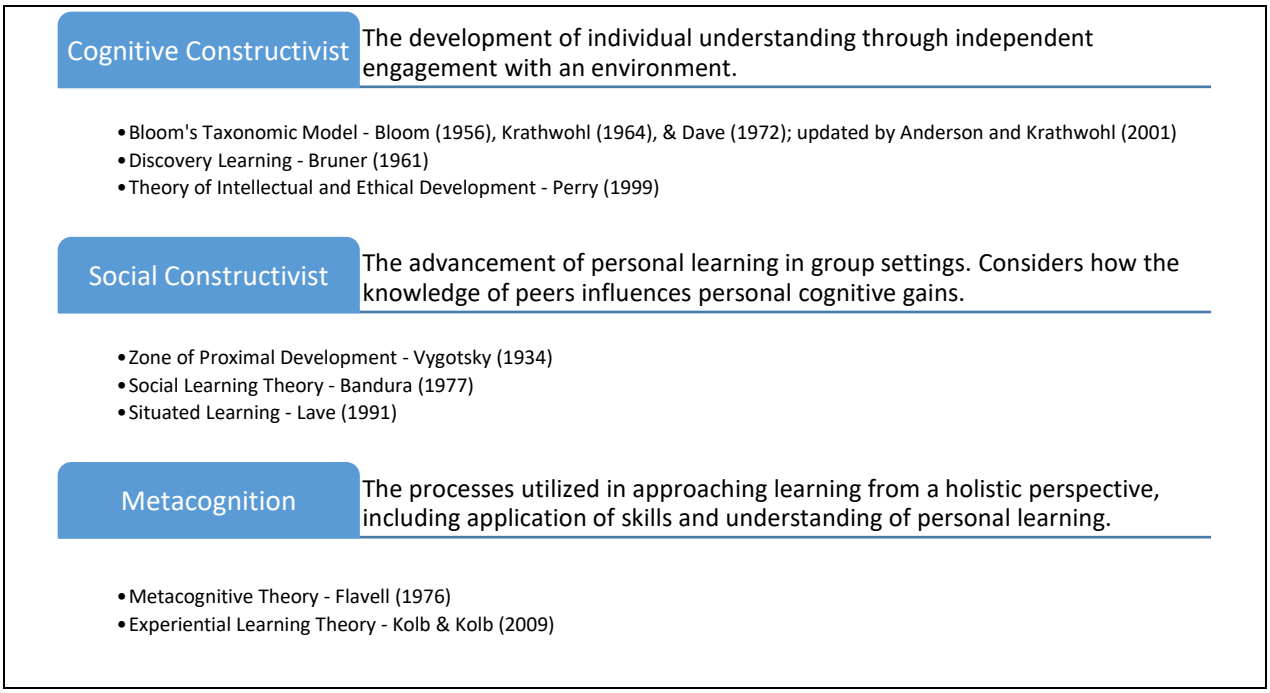
In this section I will elaborate upon theories of learning which align with constructivist cognitive philosophies outlined previously. Constructivists hold that knowledge is constructed through individual experience within the context of an environment. Emphasis should be noted on both experience and environment in this brief definition. Personal interactions allow for personal definition of objects, others, and situations through interpretations of surroundings. Cognitive constructivist learning theories address how the individual constructs this knowledge and how learning directly connected to the holistic experience. When surroundings include a social domain, the individual comes to understand their environment through a collaborative process with others, whether peer or teacher, refining and blending their personal understanding with that of others. Social constructivist learning theories emphasize how the learning is situated

to the student and the influence others have in the cognitive development of the self. Lastly, metacognitive learning theories consider the importance of having a personal understanding of how an individual learns. Metacognitive theories address the processes of learning and how the individual uses their knowledge in approaching new tasks.

The flexibility of games provides the framework for varied instructional approaches for learning. Games-based learning environments and strategies engage the learner in all three constructivist learning domains: cognitive, social, and metacognition. In practice, game-based learning engages each domain in a fluid process, activating each personal (cognitive), social, and metacognitive learning simultaneously as the learner engages with the environment through various forms of experience. Figure 2.3 lists specific theories explored for each domain in subsequent sections.

**Figure 2.3**

*Constructivist Domains Utilized in Games-based Learning Environments*




*Note*. Domains are connected through games-based environments, pedagogical approaches, and natural cognitive development.

## Cognitive Constructivist Learning Theories

Constructivists hold that learning is more than simple factual retention. Individual learning is constructed through experience between an individual and their environment. Cognitive constructivist learning theories specifically consider what development occurs within the individual in learning environments. These models stress the importance of learning processes and instruction in skills. To be successful, the learner must be engaged with their environment. Personal connection to the subject matter motivates the learner to inquire deeper and internalize complex relations between concepts. These philosophical underpinnings align naturally with games-based approaches to learning, suggesting they may be successful with modern students and 21st century curriculums.

### *Bloom's Taxonomic Model*

Bloom and colleagues (1956) identified three domains related personal learning: cognitive, psycho-motor, and affective. The cognitive domain is composed primarily of knowledge, the psycho-motor by skills, and the affective by attitudes or feelings. By addressing the three domains, students develop holistic understanding of content and improve learning outcomes. This was primarily achieved through enhanced educational objectives which addressed both lower and higher order thinking skills. Teachers were encouraged to go deeper in their instruction, to encourage students to understand the how and why of content knowledge. Additionally, Bloom's model encouraged educators to incorporate interdisciplinary practices into their instruction, suggesting that learning extends beyond textbooks and perceived content boundaries.

Bloom et al. first addressed the cognitive domain in *Bloom's Taxonomy of the Cognitive Domain* (1956). The taxonomy was designed as a type of hierarchy for organizing cognitive

objectives for students. The original taxonomy consisted of six different levels, ranging from foundational factual mastery to more complex processes. Bloom's taxonomy was updated for the 21st century by Anderson and Krathwohl (2001) to address criticisms of the original. The new taxonomy utilizes an outcome-based approach to education and reflects scholarship from the fields of cognitive psychology, educational testing, and curriculum and instruction. Instead of labeling the levels by nouns, the 2001 version of the taxonomy incorporated verbs to accentuate the role of student participation and action in their learning. The six original levels, their updated names and descriptions are (note the change of position between Synthesis and Evaluation in the newer version):

1. Knowledge → Remember. The student is able to recall information or idea using their memory. This level constitutes traditional curriculum demands, generally assessed via standardized testing to evaluate student mastery of rote learning.
2. Comprehension → Understand. The student can translate or interpret information to construct understanding of new material.
3. Application→ Apply. The learner is able to incorporate ideas or procedures into situations which require a similar problem or task.
4. Analysis→ Analyze. The breaking down of complex material into parts while also determining how the parts are connected to each other. Students are able to show analysis through the use of graphical representation and models. This level is the first of the so-called higher-order thinking processes.
5. Synthesis→ Evaluate. The student assesses or critiques the work of others using a set of predetermined criteria or standards. This position was swapped because to effectively create a new product, students need an example to model their work

from. This also allows for learners to determine what is necessary to create a new product.

6. Evaluation→ Create. The creation of a new product is the final position of the taxonomy. This complex process requires the individual to form a cohesive product by harnessing basic elements into a complete manifestation.

Levels of knowledge were included and expanded upon in the revised edition (Wilson, 2016). Knowledge levels work on a different matrix from the cognitive processes of the taxonomy. That is, the knowledge being taught can be done so in varying levels. The lowest level is factual knowledge, or the basic elements necessary to understand more complex processes. Factual knowledge is generally specific to a discipline or content area. Conceptual knowledge is the understanding of how facts interact within more complex processes. Next, procedural knowledge requires processes or methods. The updated taxonomy also included metacognitive knowledge, which is the awareness of self-learning. Metacognition requires personal problem-solving skills and deep self-reflection.

Games-based learning pedagogy should consider Bloom's taxonomic approach to the construction of knowledge in individuals when designing instruction. The revised Bloom's taxonomy demonstrates the cognitive processes engaged by players in games-based environments. As players play through a game, they form a foundation of factual knowledge about how the game system and environment functions. This foundational knowledge satisfies the remember and understanding levels of the taxonomy, and often includes the rulesets used in the game and the realization of what conditions are necessary for success. With repeated play, the player develops and forms strategy which they apply and analyze to fit new situations imposed by the game in later stages, which are typically more difficult than early ones. This

applied knowledge requires the player to understand both concepts and procedures utilized by the game systems. To implement the final stages of the taxonomy in a games-based setting would require extension beyond the game environment and are typically not found in games-based learning pedagogy. Potentially these levels of the taxonomy could be achieved by having learners compare games of similar genres or create new types of gameplay within existing systems. Further discussion on the cognitive potential of games-based pedagogy can be found in Chapter 5.

The psychomotor domain addresses the physical skills developed by an individual during learning. Psychomotor considerations regarding games-based environments include ability for the player to engage with the game, known as gameplay. Typically, player-game interconnectivity is comprised of game mechanisms, responses, and adaptations. Expanding upon the previous work of Bloom, Dave (1967) developed a psychomotor taxonomy consisting of the following levels:

1. Imitation: the ability to repeat an act demonstrated by a more experienced player. The new learner demonstrates a willingness to learn a new skill and often engages in trial and error until successful. Individuals at this stage struggle with understanding basic commands in games-based environments.
2. Manipulation: the continued practice of a skill or sequence. The individual is successful at reproducing the action with coaching. A budding confidence in the skill is exhibited. Players engaged in a games-based environment are able to master basic movements and controller inputs to interact with the system.
3. Precision: basic skill mastery is obtained. The individual accomplishes physical actions accurately without the guidance of others. Skills become seen a habitual

response. Gamers at the precision level are able to respond to stimulus without assistance or hesitation.

4. Articulation: consistently is able to perform actions at a high level. The individual is able to modify actions in response to changing situations, including shifting movement patterns and devising problem-specific solutions. Participants in gaming environments are able to incorporate situation-specific movements and actions, supplementing base physical response.
5. Naturalization: the response is automatic, accomplished in a seemingly natural manner. Achievement is at a mastery level, allowing the individual to experiment with new strategies. Gamers who engage in speed-running games, whose end goal is to successfully complete games quickly, demonstrate the ability to devise new strategies to master old content, sometimes abusing game engine or mechanics.

Psycho-motor characteristics are a fundamental aspect of games-based environments. These constitute the physical actions of the player in interacting with other players and/or the game system. The ability to throw and catch are necessary parts of playing games like football and baseball. Possessing mechanical skills are one of the precursors to being able to engage in video game environments, and often, a requirement for success. These skills allow the player to engage with game mechanics and occasionally can determine the limits of potential ability a player has.

The affective domain includes individual feelings, attitudes, and emotions. Krathwohl et al. (1964) further posited an affective taxonomy, describing the process of a person's affect on an object from awareness to personal internalization. The five stages include:

1. Receiving: the individual develops an awareness towards ideas and phenomena. Movement from stage zero to the receiving level shows a willingness by the individual to tolerate unsupported notions. Examples include to differentiate, to accept, to listen for, to respond to.
2. Responding: shows a small commitment to the phenomena by actively responding to them. Examples include to comply with, to follow, to commend, to volunteer, to acclaim.
3. Valuing: willing to be perceived by others as holding value in the idea, material, or phenomena. Examples include to increase proficiency with, to relinquish, to subsidize, to support, to debate.
4. Organization: the resolution and merging of the newly received value with previously held beliefs. Examples include to discuss, do theorize, to formulate, to balance, to examine.
5. Characterization: to act accordingly and consistently with the phenomena, demonstrating internalization of the object. Examples include to revise, to require, to avoid, to resist, to manage, to resolve.

Games specifically have a powerful potential in developing the affective domain in learners (Gilleade, Dix, & Allanson, 2005). The use of narrative is used widely in games, creating worlds where the player lives and interacts. Many of these environments are influenced by real world historical and cultural events. The player fulfills a role in this world, acting out personal consciousness or experimenting with role playing other perspectives. Some games require ethical choice in decision making moments in the game world. Political situations can be simulated, historical events replicated, and ethical dilemmas posed. The connection to the game

world can be so intense that players generate personal stories (fan fiction, cosplay) or expand on existing worlds and systems (modding). Entire groups exist solely in game settings, complete with social hierarchy, expectations, and demands. It is important to note the safety of experiencing emotion and attitudes in a game setting. Games allow the individual to experience and challenge philosophical, moral, and ethical quandaries in a safe environment. Often alternative choices impact subsequent plot or gameplay, allowing the player to experience the game in vastly different ways.

### *Discovery Learning*

The emphasis of experience by cognitive constructivists is highlighted in the theoretical approaches of discovery learning. The term discovery learning was conceptualized by Jerome Bruner in *The Act of Discovery* (1961). Bruner explained that discovery is "in its essence a matter of rearranging or transforming evidence in such a way that one is enabled to go beyond the evidence so reassembled to additional new insights" (Bruner, 1961, p. 22). The process of discovery occurs naturally in humans and thus can be utilized for educational purpose. Incorporation of discovery learning enables the student to become a self-motivated independent thinker, personally determining which route to take their scholarship based on their unique interests. Additionally, discovery learning provides direct practice in finding personal solutions, creating a bridge to future problem-solving situations. Discovery learning concepts are utilized in games as players inquire into the environment and systems. By design, games create motivation for the player to continue play through individual (e.g., set a new high score, improve your time, beat the higher difficulty) and social avenues (e.g., beat your friend, partner with others to compete against the AI or others, developing metagame structures). Games-based environments

encourage the player to discover and test new strategies, often these strategies translate to other games or situations.

Bruner (1971) later refined the concept of discovery learning by extending his perspective to its role in general education. Instead of serving only to satisfy momentary mastery of material, discovery learning instead should assist the learner in practicing inquiry-based approaches to problem-solving. This approach is similar to metacognitive learning theory and aligns directly with games-based learning. Bruner's model of discovery learning is composed of six sub-problems to address for successful problem-solving (Weibell, 2011):

- Attitude: are learners motivated to engage in discovery learning?
- Compatibility: can students incorporate new material with their current level of understanding?
- Activation: is the experience personally recognized by the learner?
- Practice: does the learner have the opportunity to use information and problem-solving skills?
- Self-loop problem: can the student articulate or recognize the learning which occurs during discovery?
- Information capacity flow: can the learner handle the amount of information being processed during inquiry?

Game designers address these sub-problems during the design process and are often the flaws of so-called edutainment games, that is, games specifically designed for educational settings. Triple Failure to address these concerns stifle the players ability to engage with the game, likely resulting in players quitting and the likelihood the game will not become a commercial success (see Serious Games, p. 112).

Bruner is also responsible for the notion of spiral learning, another cognitive constructivist learning model applicable to games-based learning. Bruner (1960) surmised the act of learning was composed of three process. First, the acquisition of new information or the refinement of previous knowledge. Secondly, information undergoes transformation, allowing the individual to apply it to new situations. Lastly, evaluation occurs when the individual determines whether the acquisition and transformation of information was successful. The stage of evaluation aligns similarly with Dewey's (1910) emphasis on reflection during learning experiences. The process then begins again, as the learner inquires for new information to supplement and refine previous understanding. When individuals engage with games, a similar process occurs. During the first playthrough, the player acquires a basic understanding of the game environments and systems. This knowledge is transformed as the game progresses and the player engages in multiple playthroughs. The player evaluates play in an ongoing process. This is often supplemented by the game which provides feedback through methods such as scoring systems, completion time, and completion percentage.

Bruner therefore suggests procedural learning spirals upward, improving as additional information is acquired, transformed, and confirmed. He suggests school curriculums should "revisit these basic ideas repeatedly, building upon them until the student has grasped the full formal apparatus that goes with them" (Bruner, 1960, p. 13). Spiral learning underscores the need for skill instruction regardless of grade level. Often school curriculums are bound by grade-specific content expectations which limit the range of information available for students to inquire into. Games-based learning approaches are skill-centered, primarily focused on problem-solving, critical thinking, collaboration, and creativity. When utilized in recurring frequency, games-based learning environments also form an upward spiral of learning. Players inquire into

game systems and environments, then apply their learning in future games-based learning settings. Thus, players who play similar genres or sequels of games are likely to be more successful than first time players.

### *Theory of Intellectual and Ethical Development*

Participants in this study are students presently enrolled in college course work, that is, from an educational perspective the participants are adult learners. Therefore, a brief discussion of cognitive development in older students is warranted. By this level, learners have experienced extensive practice in cognitive development in school settings, mastering both content and skills. Psychologist William Perry (1970) studied the intellectual development of undergraduate students, noting that students of this age continue to develop cognitively. Notably, college aged students begin to question morality and the epistemological foundations their previous knowledge is built upon. Perry proposed a model of four sequenced steps which these learners progress. In the first stage, dualism, the learner acknowledges all problems are solvable and that answers are either right or wrong. The second stage, multiplicity, the learner recognizes multiple sometimes conflicting solutions may exist and that their personal input matters. At the third stage, relativism, students recognize the contextual elements surrounding problems. During the final stage, commitment, the individual integrates knowledge learned from others with personal experience and values. Learners who reach the final stage find joy in exploring new information, the processes of finding resources, evaluating the quality of those sources of information, and ultimately engaging in intellectual interaction with others regarding their learning (Barker, 2016). Educators who are aware of Perry's stages can assist students who struggle with understanding big picture concepts by recognizing where they are developmentally.

Perry's model is potentially transferable to K-12 students. Some modern high school curriculums require students to address dualistic perspectives. Many of these graduates arrive at college already at the stage of multiplicity (Hall, 2013). From a games-based perspective, Perry's model suggests a similar approach to intellectual understanding of game environments and systems. Novice players adhere to the dualist stage, recognizing only a single strategy is successful. When confronted with difficulty, these players often seek assistance from others and implement it directly. As players experience more games-based situations, they begin to experiment what is viewed as the traditional method of approaching gameplay. They attempt different approaches to see which is most efficient. At later stages, players attempt to break game environments and systems through rule bending, environment hacking, and game manipulation. These very processes constitute a domain of metagaming by viewing the game itself as a game to be inquired and mastered.

### Social Constructivist Learning Theories

Previous constructivist learning theories highlighted the role of individual cognitive development in the construction of knowledge. However, many learning environments, especially those found in school settings, are also composed of a social domain. Social constructivist philosophy considers the role of others in the development of self and how social interactions shape individual understanding. Games-based learning pedagogy incorporates and encourages social settings in learning environments. Games are often played in competitive, cooperative, and collaborative settings with other players. This section describes the theoretical social processes which influence independent learning and connections with games-based learning environments.

### *Social Development Theory and the Zone of Proximal Development*

The traditional method for assessing development in children is through a battery of standardized tests which indicate personal intelligence. This method does not account for complex processes which transpire when engaged learning occurs, that is, the association, contextualization, and application of knowledge. Instead of comparing what learners can do on their own, psychologist Lev S. Vygotsky suggests "what children can do with the assistance of others might be in some sense even more indicative of their mental development" (Vygotsky, 1978, p. 85). Social development theory posits that learning first takes place in a social setting and is later internalized. In the social setting, the learner achieves things beyond their personal reach. With practice and experience, the individual repeats these processes, and on-going orientation occurs developmentally. "Their transfer inward is linked with changes in the laws governing their activity; they are incorporated into a new system with its own laws" (Vygotsky, 1978, p. 57).

The distance between what an individual can achieve alone and with the assistance of others Vygotsky labeled the zone of proximal development (Vygotsky, 1978). Whereas traditional tools assessed learning retrospectively, the zone of proximal development described the prospective level of cognitive development. This approach to learning allows educators to consider not just what the student has completed, but to also determine current processes being formed. In this manner, "what a child can do with assistance today she will be able to do by herself tomorrow" (Vygotsky, 1978, p. 87). Vygotsky stressed the participation of the learner, saying that learning processes within the zone of proximal development only function when the child engages with both their environment and in cooperation with peers. The role of the teacher therefore is not to be the traditional bearer of information reciting knowledge to students, but to

create learning environments which promote individual developmentally challenging processes in social settings. Vygotsky surmises good learning is not mastery of past content, but the ongoing advancement of personal development.

Games played in social settings demonstrate Vygotsky's social development theory. The individual personally improves by playing with and watching others. Cooperative game systems allow players to play together, regardless of previous experience or skill level. Whereas Player 1 and 2 may be unable to defeat the final boss of a level individually, with the support of the other, together they are able to succeed. Knowledge and skill gained in the social settings are later employed in solo playthroughs, improving success rates. Of note, in the zone of proximal development the skill level of the players should be of similar stages. Otherwise one player will carry the other without providing them the opportunity to personally improve. For these reasons, many game-based social settings are composed of similarly skilled players. Moreover, the potential for engaging players within zones of proximal development in games is striking. Advances in artificial intelligence have created computer-controlled cooperative teammates of similar skill level to the player. The scaling of player algorithms and game formulas levels the playing field for participants. Additionally, many game systems are now equipped with sliders to adjust difficulty levels for players, providing both customizability and flexibility for players of ranging skill levels.

### *Social Learning Theory*

Seeking to bridge the theoretical differences between behaviorists and social cognitive learning models, psychologist Albert Bandura observed the behavior children exhibited upon bobo dolls after watching adults engage with the doll in aggressive manners. He noted the response children had reflected whether the adult was rewarded, punished, or no action was

taken. From these results, Bandura (1971) posited social learning theory in which the individual learns from observation, imitation, and modeling of others' behavior, attitudes, and the outcomes of behavior. These processes are more complex, however, than behaviorists like Skinner define them. Bandura espouses the role of mediational processes during learning, that is, the cognitive associations which connect environmental influences to imitated outcomes. Specifically, four mediational processes occur: attention, retention, reproduction, and motivation. Attention addresses the extent to which individuals notice the behavior. We must be aware of the behavior before we can attempt to imitate it. Retention gauges how much of the behavior is memorized. Reproduction describes the ability of the individual to perform the behavior on their own. Though we may wish to reproduce the behavior, individuals may be unable physically or mentally to do so. Finally, motivation outlines the personal will to perform the behavior. Motivation is directly related to observed positive and negative reinforcements and outcomes. Games-based systems for learning are specifically designed to address these four mediational processes during gameplay. Otherwise the player would lack the setup, practice, or motivation to advance in the game. Consider a tutorial in a videogame, which teaches the player how to interact with the game environment. The player must be made aware of the skill, allowed opportunity to memorize it before reproducing it through a series of button commands, and finally rewarded for mastering the skill by in-game reinforcements, such as improved scores or character death.

Additionally, social learning theory emphasizes complex cognitive activities which occur during learning: vicarious, symbolic, and self-regulatory processes (Bandura, 1971). Vicarious processes occur during direct observation of others' behavior and its outcomes. Bandura notes "[f]earful and defensive behavior can be extinguished vicariously by observing others engage in

the feared activities without any adverse consequences" (p. 2). Games allow the individual to observe and learn vicariously through other players. Social settings such as a couch or online streaming services such as Twitch, allow the learner to improve personally through watching others in a perceived safe, welcoming environment. Symbolic representation allows humans to quantify, memorize, and utilize extensive amounts of information. These higher order processes allow individuals to hypothesize future action and potential consequences of personal actions. Games-based learning incorporates these principles by requiring the player to processes large amounts of information in actively changing environments. Engaging with game systems in this manner provide the player with insight into potential challenges later encountered in the game. Self-regulative processes require the individual to fully consider the potential consequences of their action, which may modify whether the behavior is reproduced. In games, the player develops and recognizes casual sequences which lead to success or failure. Incentives utilized by the game promote the player to correct incorrect behaviors at the cost of lost time, score, or outright failure to win the game.

Bandura updated social learning theory by expanding and elaborating on how individuals develop thoughts and feelings. The subsequent social cognitive theory (Bandura, 1986) postulates learning transpires through triadic reciprocal causation. Cognitive development occurs through the interactions of personal, behavioral, and the environmental factors. The personal determinate is composed of the self-efficacy level of the individual towards the behavior. Does the individual believe in their ability to reproduce the behavior? The behavioral level factor encompasses the outcomes the individual receives after completing the behavior, Lastly, the environmental influences address how the setting influenced the individual's ability to complete the behavior. Was the environment conducive for the behavior? Though the three factors are

independent of each other, their ongoing interactions lead to the cognitive development of an individual. In game settings, player development theoretically follows a similar triadic reciprocal course. The player's confidence and personal goals encourage play or will to improve. The game system naturally rewards successful behavior and punishes failure. Lastly, as gameplay progresses, the environment which the player finds themselves in also increases in difficulty, requiring the player to improve to succeed. Should the player struggle with any determinant gameplay halts or comes to an end. Personal motivation, game reward, and ongoing challenge stimulate the player to continue to improve.

### *Situated Learning*

The role of active participation in learning is an established essential of social constructivist learning theories. Through participation, individuals develop understanding through direct experience with subject or skill matter. Lave and Wenger (1991) theorized learning was more complex than simply receiving factual information and observing skills in practice. In looking at apprenticeship programs, the researchers noted how individuals were able to learn without direct instruction, primarily through direct contact with experts in daily practice. Novices and experts worked, communicated, and practiced their trade in a social setting, allowing the learners to unintentionally learn while doing. Therefore, learning is situated within the activity, context, and culture of the activity. Instead of focusing on individual cognitive processes, Lave and Wegner emphasize how the social environment and activity best provides context for learning to occur. Authentic learning environments provide the learner the opportunity to engage with learning within natural context. Therefore, situated learning requires learners to experience the learning in settings and applications which call for it.

The primary characteristic of situated learning is legitimate peripheral participation by the learner. “Legitimate peripheral participation provides a way to speak about the relations between newcomers and old-timers, and about activities, identifies, artifacts, and communities of knowledge and practice” (Lave & Wenger, 1991, p. 29). In this manner, learners seek to become experts through social interaction and authentic learning experiences. When groups of learners are involved in a shared activity, communities of practice form which embodies certain beliefs, language, and behaviors belonging to the group. Novices begin on the outside of the group with the goal of moving towards the center of the group. Lave and Wenger define this movement as centripetal participation. The drive to become a member of the group creates motivation which is amplified the longer the learner is engaged with the situated activity, context, or culture. That is, the longer learners are engaged with like-minded peers on an endeavor, the more motivated they are to succeed and deepen individual involvement.

Games-based learning structures provide a unique opportunity for educators to employ and utilize situated learning in classroom settings. Limited resources may not permit educators to fully offer the opportunity for students to engage in situated learning experiences. Instead of utilizing traditional teaching curriculums, teachers are encouraged to create learning curriculums which consist of potential opportunities for students to experience situated practice. Lave and Wegner (1991) conclude:

> The learning curriculum in didactic situations, then, evolves out of participation in a specific community of practice engendered by pedagogical relations and by a prescriptive view of the target practice as a subject matter, as well as out of the many and various relations that tie participants to their own and to other institutions. (p. 97)

Games-based learning provides the structure for the development of communities of practice. The social nature of games promotes group play, often resulting in the development of play groups which establish reoccurring game sessions for ongoing play. Additionally, games allow the individual to experience environments, contexts, and content typically found outside of the school setting. A game emulates authentic environments for the player to engage with. They player becomes a scientist, architect, archaeologist, historical figure, doctor, historian, soldier, or athlete. Learners problem-solve similar challenges faced by adults, within settings and environments which mirror the real world.

Consider a group of children playing basketball at recess. The same group meets day after day to play with each other, creating the opportunity for each to improve and practice with the group. They share language, knowledge, and skills with each other. The longer they are members of the group, the deeper they take their understanding of the game. A newcomer is drawn to joining the game or the social group. They undergo centripetal participation, starting on the periphery of the group (taking only a few shots, avoiding making mistakes) and increasingly become more active and involved within the group (becoming team captain, recruiting new members). New players best learn by playing the game, taking part in the authentic experience allows them to problem-solve and practice in purposeful settings. These skills mirror ones used by adults in professional settings, providing relevance to learners and the potential opportunity to use their learning in later situations.

### Metacognition and 21st Century Skills

Learning theories associated with games-based learning extend beyond cognitive and social constructivist philosophies. This section considers learning theories related to metacognition and current skill-based curriculums. Metacognitive theories are concerned with

how human cognition is composed of interconnected knowledge, skills, and experience. These principles are later applied when examining learning of game environments and systems. The final learning theory addresses the development and utilization of 21st Century Skills in games-based learning environments. These primarily include concepts of creativity, critical thinking, and collaboration which have not yet been fully discussed. As with prior sections, included with each is a brief discussion on the application of the theory within the context of games-based learning.

### *Metacognitive Theory*

Cognitive processing is composed of complex interactions between different types of learning. It is a holistic experience, one which engages the entire brain and varying types of information. Metacognitive theory posits an individual is able to think about their thinking, that is, to consider their personal abilities and preferences for learning prior to actually engaging in a learning situation. By thinking about how they will approach the learning, individuals are able to improve their retention and understanding of information, especially of complex processes such as problem-solving. Metacognitive processes allow the individual to orient themselves to the object of cognitive study. Although a student may not have the foundational skills to understand a text, by engaging in the metacognitive strategy, they are able to improve the chances of lasting learning. Metacognitive strategies can occur before, during, and after the cognition learning experience (Akturk & Sahin, 2011). For example, by pre-reading the material they utilize a metacognitive strategy which allows them to plan method to improve understanding. During the learning experience, individuals monitor their understanding, improving their understanding through question generation and clarification. After the experience is complete, the learner

evaluates and reflects on their learning processes – not the content itself. Engaging in metacognitive strategies improve and refine an individual's personal learning processes.

The development and conceptualization of metacognition knowledge was developed by psychologist John H. Flavell (1979). Flavell's initial research inquired into whether children were aware of their personal abilities in governing memory and cognitive processes. Researchers noted children in the study were able to reflect on their thought processes, suggesting they were aware of personal learning. Utilizing the results from the study, Flavell developed an initial definition of metacognition:

> In any kind of cognitive transaction with the human or non-human environment, a variety of information processing activities may go on. Metacognition refers, among other things, to the active monitoring and consequent regulation and orchestration of these processes in relation to the cognitive objects or data on which they bear, usually in service of some concrete goal or objective. (p. 232)

Additionally, Flavell noted three different *metas* the children expressed awareness of in genitive processing (Gobbo, 2018). First, the child recognizes the occurrences when intentional cognitive memory may be beneficial in future settings. Second, they are aware of ongoing information and are able to retain it for further utilization in problem-solving processing. Lastly, the child's awareness of potential problems enables them to deliberately search for information which may aide in solutions to unforeseen questions.

Flavell expanded upon his earlier metacognitive research by proposing a formal model of metacognitive monitoring (1979). The model is composed of four different classes of phenomena: metacognitive knowledge, metacognitive experiences, goals or tasks, and actions or strategies. Metacognitive knowledge consists of the personal beliefs an individual has on the

factors which impact learning experiences. Further, these beliefs can be characterized in three different categories. Person factors include the knowledge of self and others as learners. This includes knowledge and understanding of the task at hand, your personal preferences, and the strategy utilized to approach the object of learning. For example, learning modalities are common in educational pedagogical coursework. Your personal preference, acknowledgement that others may have other partiality, and the acceptance of instruction of varied modalities to improve general learning would exemplify an individual's metacognitive knowledge perspective. Metacognitive experiences are the emotions and feelings which come while engaging in learning. "You believe/feel that you have almost memorized those instructions, are not adequately communicating how you feel to your friend, are suddenly stymied in your attempt to understand something you are reading, have just begun to solve what you sense will be an easy problem" (p. 908). Goals or tasks are the objectives of the learning experience. Actions or strategies are the behaviors employed to achieve the goals or tasks.

Subsequent research and writing by Flavell furthered his definition and scope of metacognitive theory. In *Cognitive Development* (1985), Flavell recognizes two elements of metacognition which emerge, knowledge and regulation. Expanding on their earlier, Flavell identifies three types of metacognitive knowledge:

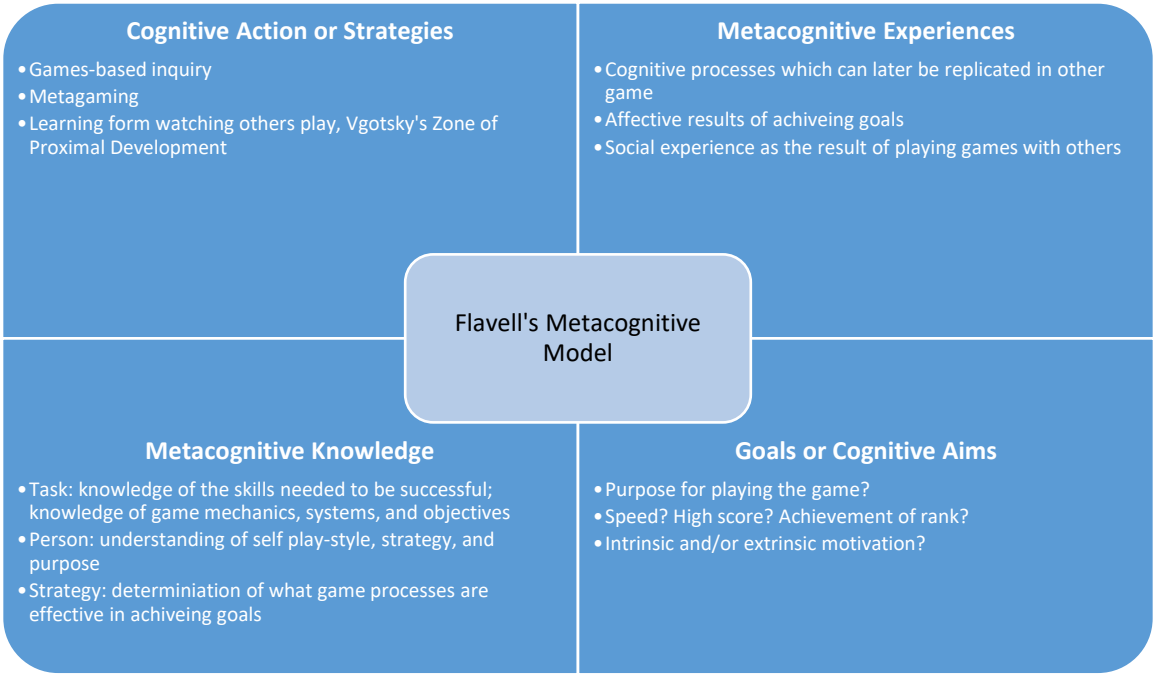
- Declarative: the knowledge of an individual's personal capabilities.
- Procedural: knowledge of a task, including the content and how personally difficult it is.
- Strategy: how an individual is able to incorporate processes to learn new information and adapt them given the context of a situation.

Metacognitive regulation are the processes by which an individual plan, monitor, and assess their learning. From knowledge and regulation, an individual forms a metamemory which describes the knowledge of how memory works and its use in future learning experiences. For instance, if a learner uses an acronym to memorize the sequence of a topic successfully, they are likely to use it in later similar context situations. Lastly, Flavell stresses the importance of practice and motivation in developing metacognitive processes. Many metacognitive processes can be explicitly taught and practiced in classroom settings (see Hacker, Dunlosky, & Graesser, 1998), which in turn encourages individuals to be aware of personal metacognition in future learning situations. Games-based learning environments offer the potential opportunity and motivation to achieve these ends.

Games-based learning can be situated within Flavell's Metacognitive Theory (see Figure 2.4), demonstrating the complex learning settings generated in games-based environments. Games themselves are composed of numerous working systems and mechanics, woven with interactions between the game and player. As players interact with the game, they discover these systems and inquire into their functions.

**Figure 2.4**

*Flavell's Metacognitive Model*




*Note*. Included are associations between Flavell's Metacognitive Model and Games-based Learning pedagogical approaches.

Games-based learning, in itself, is a practice of metacognition. The player is required to consider their personal approach to the game and how it influences their outcomes. Metamemory is engaged when players participate in games of similar genres and styles. Skills and knowledge are transferable between these games, allowing individuals to specialize in genres of games. For example, players of first-person shooter (FPS) games develop the psychomotor skills of reaction and hand-eye coordination which transfer to other FPS games. Motivation requirements are naturally satisfied by the individual choice of which game to play and the processes game developers use in commercially successful games.

### *Experiential Learning Theory*

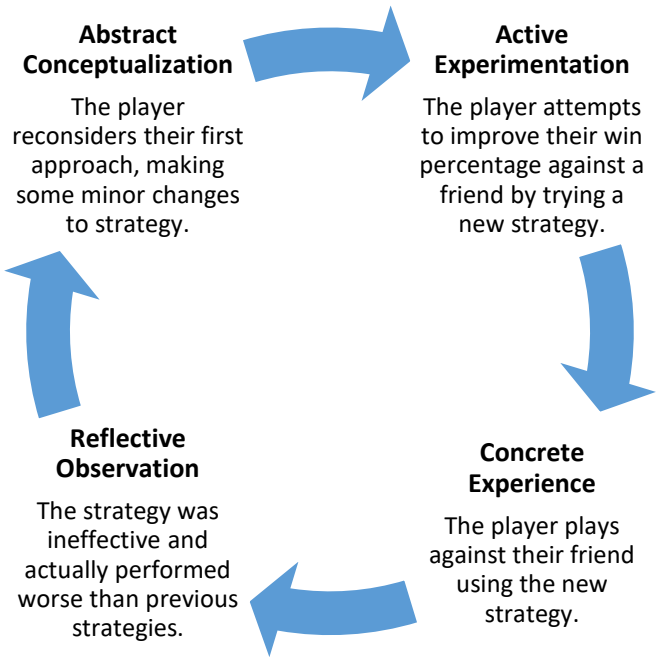
Closely connected with the concept of metacognition is the theory that experience matters in learning contexts. Experiential learning theory posits learning is successful when the learner is able to directly engage holistically with ongoing processes. That is, learning is composed of personal experience, perception, cognition, and behavior. Kolb (1984) begins by considering three constructivist models of learning which utilize experience in cognitive development: the Lewinian action research or lab method, Dewey's model, and Piaget's model of accommodation and assimilation of learning. Kolb identifies commonalities between the models, concluding the tenants of experiential learning are wide ranging and indicative of metacognitive activities. First, learning conceived on processes not merely the outcomes of the experience. Individuals utilize and master these processes to inform future learning endeavors. Second, learning is rooted in continuous practice grounded in experience. Though observation can be a powerful pedagogical tool, it is through the experience that learning is prescribed into metamemory. Third, learning is a holistic process of adaptation to the world around the individual. This tenant echoes metacognitive theory in the development of an integrated intelligence. Fourth, learning occurs when the learner interacts with their environment. The environment impacts the learning which occurs, impacting the experience of the individual both affective and emotionally. Finally, learning is the process of creating knowledge. Learning is not the transmission of knowledge, but the generation of it within the context of an individual's understanding. Kolb concludes by defining learning as "the process whereby knowledge is created through the transformation of experience" (p. 38). This learning occurs in a cycle similar to the previously discussed concept of spiral learning by Bruner composed of dueling dialectics: action/reflection and experience/abstraction (Kolb, A. Y. & Kolb, 2009a).

Further, through cyclical iteration of action/reflection and experience/abstraction, individuals can learn how they learn. Nelson (1996) proposed as individuals monitor their daily learning, they additionally inform their understandings on a larger, metacognitive level. Kolb and Kolb (2009b) incorporated this concept with the experiential learning cycle, proposing a modified model which posits the experiential learning cycle occurs on two levels: the concrete object and abstract metacognitive level. Learning which occurs at the object level is utilized in metacognitive processing and understanding. As the individual completes the cycle at the metacognitive level, they integrate personal understanding in controlling future object level learning experiences.

There is a potential connection between games-based learning and experiential learning as described by Kolb and Kolb. Figure 2.5 provides an example of how the experiential learning cycle is used in games-based learning.

**Figure 2.5**

*Kolb's Experiential Learning Cycle with Examples from Games-based Learning*



The player engages with the game on an object-level interaction which impacts the way they approach games in the future. Players first inquire into potential strategies which may improve gameplay results. Next, they test the strategy in a concrete setting environment. This allows them to engage learning processes through the experience holistically, improving understanding of both the game system and situation. Through reflection, the player evaluates and potentially refines the active strategy using the new information gained from the experience. With the experience finished, the player can conceptualize the game at a higher level, understanding its functions on a meta level of the game. Ongoing cyclical meta level analysis in games-based learning therefore informs future play methods, provides personal insight into play preference, and generates understanding of peer play styles during social play.

## Play and Games

This section addresses the foundational perspectives of play, games, and logic reasoning employed during games. By discussing the broad, philosophical elements of games, I posit games-based learning is justified and should be encouraged in learning settings. I will first consider ludic pedagogy, that is, the theoretical underpinning of play and learning. Next, I define the term game, including discussion on what constitutes a game system and the rules employed during gameplay. A subsequent brief discussion is included on the mathematical development and philosophical conception of game theory as described by Nigel Howard. These essentials form the foundation of the subsequent section which addresses games-based learning pedagogy.

### Theories of Play

There has been much research in the areas of play in recent years. Studies range from early literacy development (Schmitt, Hurwitz, Duel, & Nichols Linebarger, 2008) to pedagogical methodology (Baker et al., 2016), all finding conclusive results of the benefits of play in the

classroom and the individual. Though easily defined and acknowledged by children, scholars and academics have struggled with fully explaining the concept of play. “Play is one of those elusive phenomena that can never be contained within a systematic scholarly treatise,” (Spariosu, 1989, p. ix). Play is unique and complicated, extending beyond the simple act of a group or the imagination of the individual. What one person defines as play may be seen by others as work or punishment. It encompasses both the physical and emotional; the real and imaginary. Eberle (2014) noted understanding play requires acknowledgement of its inherent complexities, individuals viewpoint and purpose, the environment which it takes place, and with whom it involves. “Thus play unfolds as a series of fortunate events driven by emotional experiences” (Eberle, 2014, p. 231). Play occurs as a natural human activity, often in response to environmental conditions and setting. Humans utilize play activities to provide understanding and make sense of how the world around us works.

Some scholars have labeled the 21st century as the “ludic century”. Eric Zimmerman, a professor at NYU Game Center announced this proudly with his *Manifesto for a Ludic Century* in 2013, saying there exists in a modern world the need to be playful:

> It is not enough to merely be a systems-literate person; to understand systems in an analytic sense. We also must learn to be playful in them. A playful system is a human system, a social system rife with contradictions and with possibility. Being playful is the engine of innovation and creativity: as we play, we think about thinking and we learn to act in new ways. As a cultural form, games have a particularly direct connection with play. (p. 21)

With such interest in the use of play in classrooms and schools, it becomes necessary to accurately define the varying characteristics of play. In *Play Matters*, author Miguel Sicart

defines what he views as the “ecology of play”. Instead of suggesting a definition of play which derives itself from an object or activity, Sicart instead focuses on what it means to play. This view is primarily philosophical, an attempt to contextualize the relationships and interactions between individuals, complex systems, and their surroundings. He concludes that to play is to be human; “[t]o play is to be in the world. Playing is a form of understanding what surrounds us and who we are, and a way of engaging with others. Play is a mode of being human” (Sicart, 2014, p. 1). Through this more complex analysis of play, Sicart describes play as carnivalesque, composed of a diametric relationship of order and chaos in games. While it is important to provide structure and a sense of reality during play, there also exists an urge to experience the destruction and exploitation of boundaries.

**Defining Game**

Play takes on characteristics of a game when it is structured and begins to take on an element of purpose. The purpose of games is often for pleasure, learning, or competition between individuals or teams. Considering the philosophical foundations of earlier writers, philosopher M. W. Rowe (1992) surmised:

> “Thus, at bottom, there are two sorts of game: those that are constituted by sequences and those that are constituted by goals. Both kinds of game are abstract objects and they both have a common value: they guarantee purposelessness however seriously or relentlessly the activity they create is pursued, and this ensures that it is the activity itself, rather than any product of the activity, which has value. I should therefore define a game as 'An abstract object (either a sequence or a goal) which is designed to have no instrumental value; the realization or pursuit of which is intended to be of absorbing interest to participants or spectators” (Rowe, 1992, p. 478)(Rowe, 1992, p. 478)(Rowe, 1992, p.

478)(Rowe, 1992, p. 478)(Rowe, 1992, p. 478)(Rowe, 1992, p. 478)(Rowe, 1992, p. 478)(Rowe, 1992, p. 478)(Rowe, 1992, p. 478)(Rowe, 1992, p. 478)(Rowe, 1992, p. 478)(Rowe, 1992, p. 478)(Rowe, 1992, p. 478)(Rowe, 1992, p. 478).

More recently, Salen and Zimmerman (2004) define game as "a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome" (p. 93). It is from this definition I will approach games-based learning and this study. The inclusion of the phrase system is important because it denotes a series of processes exist in games which a player can recognize, inquire into, and master. Though it takes place in an artificial setting, games engage individuals physically, cognitively, and emotionally, creating a situated experience during gameplay. Rules provide the framework for the game to occur, establishing boundaries which reward players for understanding or pushes them to break. Lastly, there is an outcome which provides a reason and motivation for continued play.

The nature of games forms varying game types and purpose for play, including participant composition, and purpose. Game designer Raph Koster (as cited in Mitra, 2010, p. 39) describes games as either being symmetric or asymmetric. Symmetric games which the player's opposition is prompted with the same choices as the player, providing an equal input to all players. Alternatively, asymmetric games favor a side, usually a computer-based opponent in a single player setting. The development of computer-based artificial intelligence has increased the availability of asymmetric games, providing an environment for a player to engage in gaming in a non-social setting.

In *Man, Play and Games*, author Roger Caillois (2001) attempts to classify games through a matrix composed of two elements: type of game and level of rule enforcement. Game

types include *agon* (competition), *alea* (chance), *mimesis* (simulation), and *ilinx* (vertigo). Examples of *agon* games include sports which are common in professional settings in the United States. The primary goal of these types of games is to defeat the opposition, whether in an individual or team format. *Alea* type games are ones derived on randomness or where individual skill and experience does not directly play a key role in success. Casino type games like Roulette, Blackjack, and Craps all utilize a device (wheel, playing cards, dice) to randomize the result of a play session. Make-believe games children engage in are common forms of *mimesis* games. Adults play *mimesis* games such as tabletop roleplaying games, where the player takes on a created persona and acts out how the character engages with the world and others. *Ilinx* type games put the player directly against their physical environment, often achieved through spinning or change in speed. Feelings such as vertigo, dizziness, and disorienting change create a feeling of uncertainty in the player resulting in a moment of shock or surprise.

The second element composing Caillois' spectrum of games is the degree of rules implementation and enforcement. On one end of the array exists *paidia* focused on improvisation, freeform, and joy. On the opposite end of the spectrum is *ludus*, which Caillois describes as having purpose or a "civilizing quality". *Ludus* rulesets are structured and "reflect the moral and intellectual values of culture, as well as contribute to their refinement and development"(Caillois, 2001, p. 27). Generally, *paidia* games allow the player to engage with the gaming environment in an open world, free-form approach. *Ludus* rulesets are often goal-oriented and driven directly by a narrative, requiring the players to follow a predesigned path to completion (Broer, 2017). Games exist in varying positions on the diametric rule enforcement scale. For example, an *agon* (competition) type of game can occur using both *paidia* (a

spontaneous contest to see who can win a race to a goal) and *ludus* rules (an umpired game of baseball).

The inclusion of rules provides structure necessary to transform play into a game. Philosopher John Searle (1969) posited two distinct forms of rules exist, *regulative* and *constitutive*. Regulative rules provide order to existing independent behaviors. That is, these behaviors exist outside of the rule. Constitutive rules form their basis of the behavior; the behavior could not be regulated without the establishment of these constitutive rules. These rules define what the behavior is, logically deduced to the form "X counts as Y in C", where C is the setting or environment. In later writing, Searle (2018) elaborates on the "remarkable properties" of constitutive rules, noting:

- Constitutive rules have a creative aspect. They generate new institutional facts, and thus, form a new reality derived from these rules. These new realities are ontological subjective in nature.
- From these new realities, constitutive rules generate and require a system of power. Searle labels these powers as *deontic*, in that they "give us *desire-independent reasons* for acting" (p. 53). These powers provide motivation and a sense of duty to obey the constitutive rules.
- Language is necessary in the formation and understanding of constitutive rules. As such, they are transmittable to and understood by others.
- Human civilization is constructed on constitutive rules.

Rules function as the intermediary between the aspects of play and the cognitive processing of game theory, resulting in governing the interactions of the abstract (play) with the concrete (mathematical game systems). Games themselves function on constitutive rules and require

players to comprehend these meanings. Though rules may be similar between games of the same genre, how they are implemented or regulated can be different. Through inquiry and repeated play, players are able to more fully grasp both constitutive and regulative rules, improving their gameplay execution and chances for success.

## Games-Based Learning

This section contextualizes previously described learning theories through learner experience of games-based environments. Games-based learning is the pedagogical and instructional approach for utilizing games in a learning setting. In a games-based learning environment, emphasis is placed on the role of the student during learning. The student is personally engaged in the subject matter, determining for themselves which possible routes to approach the problems presented by the game system. Positing from a constructivist foundation, John Dewey (1910) theorized the connection between prior experience and interest provide structure and support for new learning. Additionally, the activities the student engages in outside of the classroom build upon those taking place during instruction. Through the implementation of a curriculum centered on games-based learning, students are the active creators of knowledge, with specific focus on student engagement and participation. Through interaction within the system provided by the game and in collaboration with peers, students build skill and cognitive processes.

### Curriculum Positionality

Games-based learning challenges traditional concept of classic school curriculums and pedagogical delivery. Traditional approaches to education emphasize the role of the teacher and disciplinary subject matter in the curriculum. The Tyler Curriculum (2013), devised originally in the 1940s, influenced curriculums across the United States to take an industrial approach to

education. Using scientific design as its foundation, teachers and administrators first determined the school objectives. These objectives were aligned directly with disciplinary content, often from academic textbooks. Learning experiences were then planned around these objectives, though often the sheer volume of objectives required the teacher to defer to direct instruction or lecture pedagogical methods. The final step to the Tyler model was evaluation of learning, typically done through final, summative assessment. Questions assessed aligned with the previously identified objectives, often requiring students to engage in rote memorization of facts. Criticisms of traditional curriculums include a limited range of learning material, which are often determined by administrators or school boards. Additionally, access to information brought about by the development and expansion of the internet has rendered factual memorization moot in a 21st century world.

Developmentalist approaches to curriculum instead focus on the development of the child in natural settings (Lassonde, 2010). Subject matter is viewed as foreign to children because they cannot fully comprehend its complexities. Instead, the role of the teacher is to allow the child to develop through their own self-realization, to encourage and motivate the student to continue to pursue personal quests. Developmentalists believed personality and character were more vital to the holistic education of the individual than subject matter. Games-based learning incorporates many pedagogical approaches utilized in child-centered curriculums, including active participation and interest-based learning. Critics challenge the purpose of education in developmentalist settings, namely, the transition from personal growth to subject matter which defines and informs society.

In *The Child and the Curriculum* (1902), Dewey speculated dualistic curriculum views at the beginning of the 20th century were inherently flawed. Instead of fully aligning with

traditionalists or developmentalists, Dewey proposed that the best route for student learning achievement was somewhere between.

> Abandon the notion of subject-matter as something fixed and ready-made in itself, outside the child's experience; cease thinking of the child's experience as also something hard and fast; see it as something fluent, embryonic, vital; and we realize that the child and the curriculum are simply two limits which define a single process. Just as two points define a straight line, so the present standpoint of the child and the facts and truths of studies define instruction. It is continuous reconstruction, moving from the child's present experience out into that represented by the organized bodies of truth that we call studies. (p. 11)

Students need to be part of the curriculum, to personally experience the content matter to construct their understanding. However, when left to their own devices, students lacked focus on purpose of education, instead they pursue their passions without care to application in later life. It is from this perspective on education that Games-based learning is constructed. The teacher constructs the curriculum with disciplinary knowledge and skill practice, allowing the students to experience *purposeful* personal learning.

Instead of aligning with traditional models like Tyler's, games-based learning incorporates more closely the ideas of a post-modern curriculum, highlighting learner engagement, student-led pedagogical methods, and the development of higher order skills. Post-modern curriculums are focused on improved depth of understanding rather than the traditional emphasis of breadth of material covered. W.E. Doll's Four R's (1993) post-modern curriculum emphasizes: richness, recursion, relations, and rigor. Richness is created during the inquiry stages of metagaming; the process of trial and error, the conversations with peers in articulating

systemic thinking, and general engagement of games through play. The process of spiral learning (Bruner, 1960) implies the idea of recursive skills, many of which students utilize outside of the classroom. Games-based learning provides the structure for students to engage in interdisciplinary learning, increasing the depth of understanding of the learner (Ke, Shute, Clark, & Erlebacher, 2018). Games-based learning assists students in forming relations between subject matter in a social setting. The game is understood not by a defined textbook definition but by the generation of individual and group knowledge. Relationships between knowledge and skill are directly applied, leading to increased learning. Instead of presenting material as inconsequential individual pieces, the student is able to generate lasting understanding of concepts. A narrative relation is also formed, providing the students with a story behind and to the learning, supplementing long term retention. Finally, a curriculum focused on games-based learning establishes a type of new rigor, one not based on rote-memorization of simple facts one could easily find on the internet, but one which requires students to solve problems, make connections, and articulate reasoning. Rigor in games-based environments require the learner to purposefully seek alternatives to solutions to gameplay. Inquiry is encouraged and potentially required for success.

**Games-based Learning Pedagogy**

Many educators have turned to gaming as an approach to both engage learners and provide context for students practicing 21st century skills. Games-based learning (GBL) is a pedagogical structure which attempts to blend the use of games in an educational setting. There has been substantial research done on the academic results of the use of gaming in schools. Studies exploring GBL have found boosting student motivation (Law, 2015; Saxton, 2015), problem-solving (Spires, Rowe, Mott, & Lester, 2011), increased written and oral

communication skills (Bodnar & Clark, 2017), and improved literacy scores (Partington, 2010; Schmitt et al., 2008). Salen and Zimmerman (2004) found that gaming required learners to think strategically, collaborate with peers, and understand complex systems. The use of serious games was shown to produce positive effect on learning compared to other types of learning materials (Backlund & Hendrix, 2013).

Gee (2007) explored learning and literacy as it occurs in video games. He identified 36 total examples of how games align with evidence-based pedagogical methods and increased learner performance. Some applicable principles from Gee's list for this study include:

- #15 Probing Principle: Models the learning process as a cycle, requiring the learner to continually engage in the activity, reflect on performance, form a hypothesis which may improve results, and then retesting or reevaluating the hypothesis.
- #17 Situated Meaning Principle: Understanding of words, actions, objects, artifacts, symbols, texts, etc. are made through embodied experience. That is, the player generates understanding of the game through direct gameplay involvement.
- #19 Intertextual Principle: The learner recognizes genre relations between related texts, determining similarities which my transfer to similar texts. This potentially frames a transferability aspect which exists between games of similar genres.
- #24 Incremental Principle: Learning at the early stages is slow and basic, allowing the individual to preserve cognitive effort in exchange for additional focus and retention. Later, early understandings of the game

become contextualized into the greater system, allowing for deeper cognitive exploration on part of the player.

- #28 Discovery Principle: The learner experiments and discovers useful information.
- #35 Affinity Group Principle: Learners form an affinity group with peers around shared endeavors, goals, and practices.

Research done by Dai and Wind (2011) on the use of computer games by low SES students demonstrated the effectiveness of games in student engagement, memory, intrinsically motivation, and problem-solving. They posited supplementary educational benefits could be gained from the use of computer games with practiced teachers. The researchers suggest two dimensions exist in the use of computer games in learning settings: educational and entertainment value. By employing experienced educators, students are likely to move beyond being simply engaged by the media (or *playing* the game) to a level which serious learning can occur (learners *purposefully* play the game). Additionally, Dai and Wind note a level of difficulty is required to provide room for all students, regardless of prior knowledge, a sense of challenge to continue to stimulate cognitive development.

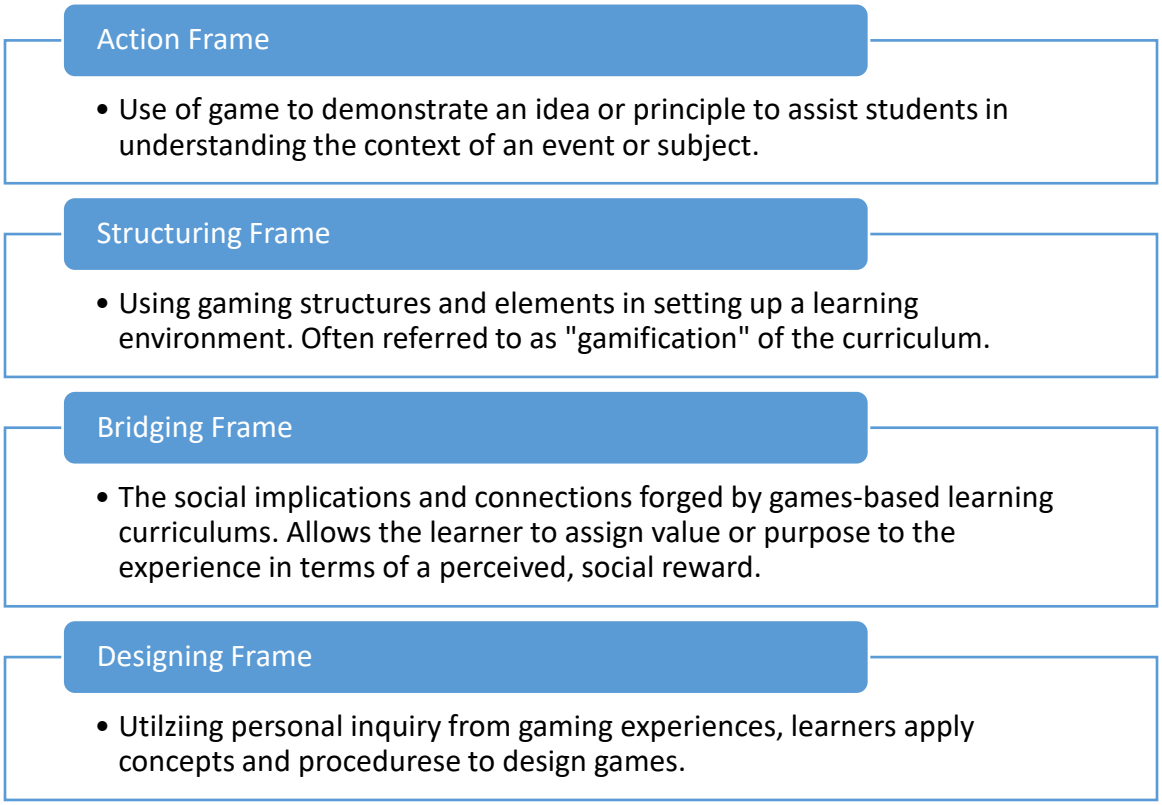
**Holmes-Gee Framework for Games-based Learning**

Holmes and Gee (2016) proposed a conceptualized framework for future academic research into the fields of game-based teaching and learning in higher education. Much of the previous research into games-based learning focused primarily on the use of games as actions, that is, the use of games as substitutes for tests or activities. The Holmes-Gee Framework expands on this basic level by proposing extension activities which further the effectiveness of games in higher education. In this way, the framework is similar to Bloom's Taxonomy

discussed previously. This framework informs the processes for which a framework of games-based inquiry can be situated.

**Figure 2.6**

*Holmes and Gee (2016) Framework for Games-based Learning in Higher Education*




The first frame is the *Action Frame*, which requires educators to view games not as replacement activities, but objects of study. Games from this perspective can be viewed as texts, which require students to understand them holistically. This perspective differs from the traditional use of games which incorporate repetition to drill information into student memory. The authors note games are designed, and therefore are similar to other forms of media like books, movies, and art. “They are “texts” that are not only infused with meanings intended by the designers but also invite interpretive “readings” … for example, feminist representations of

*Lara Croft*, or issues of race and violence in *Grand Theft Auto*" (Holmes & Gee, 2016, p. 7). Games provide the structure to allow students to learn more than rote memorization because they get to directly experience the content through game systems and environment. This leads to embodied and situated understanding of complex concepts. The second domain, the *Structuring Frame*, consists of using gaming elements, commonly referred to as *gamification*, to structure and organize a learning environment. Utilizing this perspective, teachers can motivate students by using leaderboards, badging, and achievement systems. The *Bridging Frame* makes up the third category and utilizes potential social connections formed through gaming. The authors note the power of games-based learning to help students and faculty connect beyond the classroom, college, and university. The final frame, the *Designing Frame*, shifts emphasis away from the player as a learner to that of designer. The expected shift is to move from playing to enjoy to understanding and designing similar systems and environments. Holmes and Gee note the underlying assumptions of constructivism, suggesting "that the process of knowledge construction is enhanced when learners are required to express their ideas in the form of tangible artifacts that are shared with other people" (p.12). The complexities of game design potentially expose learners to a variety of skills, including creativity, collaboration, computer programing, logical reasoning, critical thinking, and narrative development. Through inquiry, the learners ultimately become designers of their own games, providing situated and experiential learning experiences.

### Limitations and Implementation Difficulties of Games-based Learning

Though more teachers are incorporating gaming into the curriculum, many do it to simply motivate, reward, or provide a break for students. Traditional teaching methods and assessment demands have limited the extended use of games; the top two factors limiting the use of games in

classrooms according to surveyed teachers are "whether they track students' performance (43 percent) and whether they find evidence that the game is effective (37 percent)" (Korbey, 2014). From this perspective, games are simply an extension of content taught prior. Watson and Yang (2016) suggest district curriculums need to identify policies in regard to games-based learning, provide materials and training for teachers, encourage administrative support for teachers to experiment with these new strategies.

Further, Awwal, Scoular, and Griffin (June 2016) identify data design, game design, platform and delivery issues, and assessment design issues with further assessment in games-based learning classrooms. Data design refers to the sheer amount and type of data generated in games-based learning studies. As such, the tools used to gather this data are primarily viewed as being in their *infancy*, suggesting future technological improvements in educational game design will yield better assessment data from games. Platform and delivery issues correspond with the physical technological and database tools required to assess during games. Lastly, assessment design built around games-based learning are imperfect. Awwal, Scoular, and Griffin posit:

> The construction of games intended for assessment and learning purposes can be difficult. This is often because the goals of the games do not always align with the goals of assessment or learning, thus distracting individuals with in the game play process with dramatic game features. For games to be effective evaluation tools, they need to offer ample opportunities to participants to create, acquire, rehearse and apply skills and knowledge through active exploration within the collaborative virtual space. (p. 0909)

The authors suggest for games-based learning assessment to be improved, traditional perspectives of what assessment looks like will need to be *unlearned* and changed. By aligning

games-based curriculums with educational goals, assessment focus can be shifted away from objective knowledge and towards skill development and enrichment.

Unfortunately, teacher education programs have fallen behind the innovation curve in addressing the use of games in learning (Marklund & Taylor, 2016). Prospective educators experience a range of traditional methods but are not exposed to games-based learning as a pedagogical structure, even though research has shown games to have high potential for powerful learning. In *Serious Games in Education*, the authors note that "Game-based learning continues to be an exotic spice for many educators" (Egenfeldt-Nielsen, Meyer, & Sørensen, 2011, p. 8). Furthermore, they identify two major deficiencies in games-based research: the role of the teacher and the lack of *global* consensus of best practice. Much of the research on games-based instruction has been done outside the United States, namely Europe, Asia, and Australia-Oceania. Providing the structure and practice for perspective educators will improve the quality of games-based learning, allowing students the opportunity to do more than simply experience the game as a reward or content-reinforcement.

## Metagaming

Metagaming considers both the systems and culture of and surrounding games-based environments. On an individual level, players attempt to learn, classify, experiment, and master the game systems to improve success rate and enjoyability of the game. This basic definition contributes to the user-generated acronym of *meta*: most effective tactic available. As the game is experienced in a social setting, metagaming provides additional rules, expectations, and possibilities, all extending from the core mechanics and purpose of the game. In this way, technology has transformed games “into instruments, equipment, tools, and toys for playing, competing, spectating, cheating, trading, breaking, and making videogames” (Boluk & LeMieux,

2017). In practice, metagaming provides a higher perspective on the game itself, often posed in a consciously self-referential manner.

Huvila (2013) described metagaming as second-order conceptions of games and gaming, deriving primarily from two contexts: organizational decision-making and activities associated with games studies. The former, based primarily on Nigel Howard's game theory and meta-game analysis (1971), describes how the player develops and calibrates action within the system. Through repeated attempts and intellectual understanding of the system, the player analyzes the contextual situations and improves decision making. The latter describes the social contexts and perceptions created by groups of players who engage in games. The increased cultural exposure of gaming, especially through the internet and online gameplay, has produced an increased usage of the phrase *metagaming*. As the phrase grows in popularity, there exists a need for a more declarative definition of metagaming through social lens.

Of note, there does not currently exist a substantial collection of literature on the study of metagaming. The nature of the gaming community can be described as primarily being organized in online, digital settings. The targeted audience for such research is not primarily academic, and therefore, few scholarly peer-reviewed journal articles exist. I will begin by briefly addressing the concepts of game theory and the subsequent development of metagame analysis. Although understanding game design is important for further games-based learning pedagogical development, the exploratory nature of this study emphasizes the natural recognition of these ideas by players. The final section addresses the development of metagaming and its potential academic uses.

## Game Theory

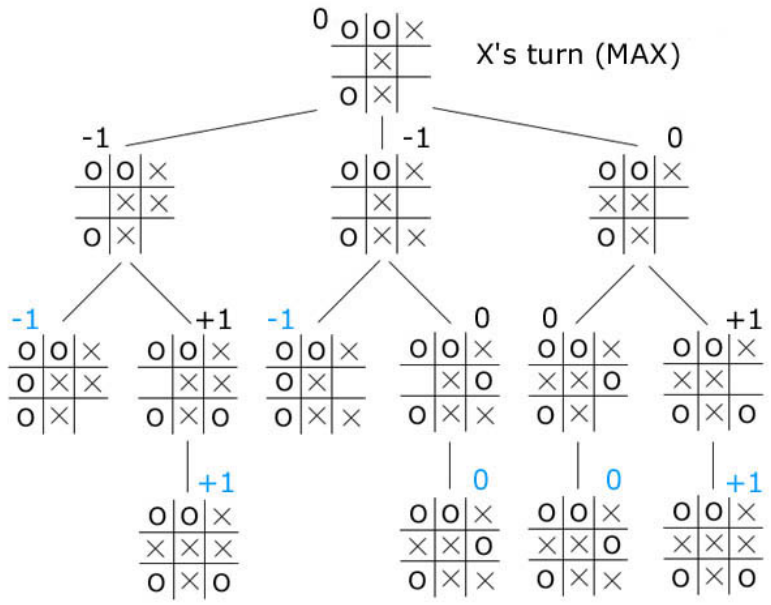
From a games-based learning perspective, game theory forms the intellectual foundation for inquiring into and of games. Academics have utilized the complex, generative properties of games in an effort to simulate human decision-making processes. Roger Myerson defines game theory as "the study of mathematical models of conflict and cooperation between intelligent rational decision-makers" (1991, p. 1). . By utilizing statistical analysis, mathematical models, and processes of reasoning, game theorists attempt to "solve" complex social questions. Additionally, game theory can be viewed as the utilization of economic theoretical decision making processes in determining how individuals approach choice, with respect to the preferences or utilities of those agents, even if outcomes are not previously known (Ross, 2019). Over the last hundred years, a variety of different game theories have been developed including symmetric/asymmetric, zero-sum/non-zero-sum, simultaneous/sequential, and metagames. These theories inform modern game design philosophies and therefore should be considered when approaching a games-based learning curriculum.

### Metagame Analysis

The existing structure of games provides the potential development of other, new games commonly called *metagames*. The term *metagaming* was originally developed in the field of economics and mathematics during the mid-20$^{th}$ century. Mathematician Nigel Howard (1971) posited individuals could consider the outcomes of a situation by framing it as a strategic game, improving their general decision making processes. By considering decision points which naturally occur during gameplay, individuals can develop a game tree, a graphical representation of each decision point. Figure 2.7 is an example of a basic game tree, demonstrating the decision points and subsequent results of each.

**Figure 2.7**

*Game Tree of Tic-Tac-Toe*




*Note*. A game tree displaying the potential plays for player X given a board state of 0. The positive and negative numbers display the game result, which currently adds up to zero. This indicates the game board state of 0 favors neither player. Reprinted from Alphabeta, by Yosen Lin. Retrieved August 8, 2019 from https://www.ocf.berkeley.edu/~yosenl/extras/alphabeta/alphabeta.jpg.

Computer science utilizes metagame analysis in generating meta learning processes and programming language. By using these algorithms, computers are able to learn through computing potential outcomes and then using the data to solve problems. Artificial intelligence programs such as Deep Blue in chess and AlphaGo in go have been successful in beating professional players.

> At every turn, Go has an enormous number of possible moves. Even with recent advances, computers don't have the power to run all those possibilities. So, instead, AlphaGo learns smart moves by observing millions of top human games and by playing against itself. Then, when choosing a move during a game, it only searches within a narrower pool of possibilities that seem reasonable. It plays out those possibilities "in its imagination," to see which is best, says David Silver, another member of the DeepMind team. (Diep, 2016)

Given a goal, in this case to maximize points and win the game, the machine learned through meta-analysis which play ultimately leads to the greatest chance for success. From a games-based learning perspective, humans also attempt to sort and make decisions based on meta-analysis of gameplay. This is often referred to as strategy in games and allows players to improve through repeated play and reflection. It is from this perspective that games-based inquiry is derived. Just as the artificial intelligence inquires into the game systems and results, so too do human players. Games-based inquiry seeks to employ these learning processes and activities into potential classroom learning situations.

**Defining Metagaming**

The definition of metagaming has undergone an evolution during the development, extension, and rise in popularity of games by the general public. The term incorporates the Greek prefix *meta* meaning "beyond; of a higher kind; an abstraction or self-referential" (Carter, Gibbs, & Harrop, 2012, p. 4) in application to games and gaming environments. Summarizing the term and how it relates to game designers, Salen and Zimmerman (2004) define metagaming as “the relationship between the game and outside elements, including everything from player attitudes and play styles to social reputations and social contexts in which the game is played” (p. 481).

They also note that it is everything which develops from the game itself, going beyond the *magic circle* which the game creates for player interaction. As with the study of other complex systems, meta-analysis is required to better understand the intricacies of human thought processes while engaging with games. Instead of considering the aspects of the game the player is currently involved with, metagaming instead requires a big picture type of thinking.

The economic and social successes of gaming have increased the impacts of metagaming into a new form of popular culture. Games have established communities, both online and real places for sharing and gathering of information, data, and stories. The successes of gaming culture rivals that of other forms of media and entertainment. Video games now generate more revenue than the movie and music industries, with continued growth expected through new innovations such as Altered Reality and Virtual Reality (Nath, 2016). Growth in competitive video games, called *esports*, has increased markedly and is expected to surpass a billion-dollar revenue in upcoming years (Perez, 2018). In these ways, games in general have become the most popular form of media in the 21st century.

Metagaming provides a creative structure for players to interpret the game system and narrative individually and socially. As players engage with others through games, personal stories become shared narratives, establishing familiar characters and story plot to players from around the world. Groups of players maintain websites dedicated to tracking the official canon, lore which was been officially accepted as part of the game universe. Other websites host fan-fiction, creative stories shared by players of their interpretations of the official lore. Research into this type of writing suggests the development of personal stories creates emotional investment and the possibility of challenging authorial authority (Barnes, 2015). Often games include design opportunities for players, allowing them to manipulate and create within the game

systems. Players create and share their own custom content, referred to as *modding*, adding new content to existing systems.

Additionally, metagaming involves an ongoing competitive-social aspect, in which groups of players experiment, share, and devise new strategies related to the game system. Often, players generate new ideas for strategy by asking experienced players or collaborating to create sources of game data for analysis (Oblinger, 2004). Players, especially those engaged in competitive settings, are exposed to a setting in which strategy is constantly changing. A strategy which is preferred for a tournament one week will often influence the subsequent competition. Players take advantage of data analytics and make consequent changes to their personal strategy, which results in a very different *meta* from the previous week. From this perspective, the player attempts to evaluate the entire community engaged competitively in the game, actively analyzing an entire population for trends and summaries. Included in this information is player strategy preference, knowledge of local competitors, and individual instincts (Karsten, 2007).From this information, the player is able to deduce which counter-strategy is likely to improve the player's overall chance to win.

**Ortho, Para, and Metagaming**

Given the scope of community engaging with the term, metagaming has taken on unique meanings in various contexts related to games studies. The work of Carter, Gibbs, and Harrop (2012) attempted to further normalize meaning of the term metagaming by considering the emic usage of the term. From their research into computer games and the gaming community at large, three distinct variations of metagaming were identified. The researchers maintained the use of prefixes derived from Greek in labeling the three: *ortho*, *meta,* and *para*. The first, *orthogame*, refers to the straight definition of the game. Although researchers found a variety of extension

applications to the game, they also found a desire by players to experience the original game system. As players progress through the game, they formulate understandings of mechanics employed by the game, which often build upon each other to more complex, advanced systems. Additionally, players are subjected to the narrative of the game. In this narrative, they come to understand the world developed by the game creators, developing a personal place in the context of the game world.

The peripheral extension of the game environment constitutes the *metagame* as defined by Carter et al (2012). The primary purpose of this extension of the game universe is the discussion and development of higher strategy by players. Using available data on opponents, the gaming environment, and current trends in play style, players could gain advantage. This planning occurred outside of the game itself and often times included a type of socialization with other players, sometimes competitors. Often players refer to this by the phrase *meta,* meaning an environment which is self-referential requiring abstract, high-level analysis of game system and interactions between players.

A second type of metagaming occurs in traditional tabletop role-playing games. In such games, players portray characters within a setting and plot devised by the game master, who enforces and adjudicates interactions made between the player and environment. The players are expected to behave and react in ways representative of the knowledge their characters would have. Borrowing a phrase from theater, the players have broken the so called "Fourth Wall" should they use information not available to their characters. Conceptually devised by Denis Diderot in the 18th century as a way of incorporating realism to classical theater, the fourth wall is the transparent boundary which separates the characters and plot from the audience (Stevenson, 1995). In this sense, players may have information available for use in strategy

which their characters do not have access to. From this lens, metagaming has a negative connotation; players are encouraged to forego this type of information and play according to the information available to their character.

The final type of metagaming noted by Carter et al., the *paragame,* involves extras included within the game environment. While not technically part of the game system, these supplemental structures create additional methods or purpose for play, without actually adding game content. Perhaps the most noticeable form of paragaming is the inclusion of achievement and badging systems. In games, badges provide recognition of achievement and mastery, starting simple and becoming progressively more difficult as the player's skill increases (see the Achievement Principle, Gee, 2007, p. 223). For example, an achievement in a game may require the player to master different characters, discover hidden items, or invest large amounts of time completing mini-game. Studies have shown these types of reward systems encourage the player to interact with the game in different ways, provides positive feedback for success, and boosts self-esteem and social status (Cruz, Hanus, & Fox, 2017). The online nature of modern, serious games provides the structure to share and compare individual achievements with friends, creating communities of similarly skilled players pushing one another to improve.

Studies have shown the inclusion of badging systems provide additional motivation for learners, especially in digital settings (Law, 2015; Saxton, 2015). Educators have utilized badging in learning to motivate students to continue working towards goals, acknowledging their successes, and providing them with recognition along the way. "A badge can become a gamification element allowing learners to compete with themselves or others, and to know how close they are to accomplishing a goal and acquiring its accompanying reputation" (Gibson, Ostashewski, Flintoff, Grant, & Knight, 2015). Through badging, students are recognized for

informal learning, specifically noting the developmental process of skills gained through individual achievement.

## Chapter 2 Summary

This section included a literature review of material relevant to this study. I began by addressing the ontological, epistemological, and theoretical frameworks which inform the researcher. These perspectives are generally progressive and pragmatic and aligns with the non-traditional nature of games-based learning pedagogy. I next addressed learning theories which are applicable in games-based learning curriculums. Cognitive constructivist theories center on the development of individual learning which occurs on an intrapersonal level. Given the holistic nature of games-based environments, these theories included cognitive, psychomotor, and affective domains. I would emphasize the potential of games-based learning to especially address morality and emotional learning objectives. Social constructivist theories incorporate how individuals learn in and from peers. The social element of games, whether cooperative, collaborative, or competitive, enhances learning and understanding of games because of the interactions with others. The final set of learning theories revolved around the concept of metacognition, or how learners use knowledge of their learning to enhance new learning. This approach aligns with how individuals approach games. By understanding their personal preferences and approaches.to games, they become aware of their personal strengths and weaknesses. This type of evaluation, analysis, and synthesis demonstrates an important skill for student growth. Next, I reviewed games-based learning pedagogical structures and the potential classroom benefits of these strategies. Lastly, I transitioned the concept of games-based pedagogy to the specifics of inquiry into games themselves. In this manner, games-based inquiry is proposed as a more in-depth approach to games-based learning. This inquiry includes a

concept of metagaming, or the creation of a new game from the game itself. This is typically socially constructed and allows individuals to improve success by understanding the game at the highest level.

# Chapter 3 - Methodology

This study explores learning within the context of reoccurring engagement with a games-based environment. The exploratory nature of the study conforms with a qualitative approach to inquiry, providing the researcher the opportunity to observe, question, and record learning from games. The research questions for this study are:

1. What knowledge and skills are learned through multiple playthroughs of a singular game?
2. How do participants effectively construct knowledge through iterative experiences with a singular game?
3. What potential pedagogical and curricular implications do iterative games-based learning experiences pose?

In this chapter I will discuss the research methodology utilized within this framework of this study. Some brief theoretical underpinnings are discussed, primarily focused on the connotations of focus group research design and how it pertains to the study. Additionally, detailed explanations of participation selection, game selection, data collection methods, data analysis processes, and trustworthiness are addressed.

## Qualitative Inquiry

This study utilizes qualitative inquiry to investigate the learning structures associated with games-based learning environments. Qualitative studies provide the framework for the researcher to engage in exploring complex processes in a scientific manner. Researchers using a qualitative approach view "human behavior as fluid, dynamic, and changing over time and place" (Johnson & Christensen, 2014, p. 35). Using a qualitative approach, investigators incorporate natural and holistic approaches to observe how an individual experiences a

phenomenon. With these observations, it is possible to attempt to describe reality and the natural occurring complexities of human interaction with environment and others. Qualitative inquiry does not typically attempt to generalize findings, instead recognizing the unique perspectives of participants in observable settings. In this regard, qualitative studies collect and interpret non-ordinal data composed primarily of text, images, or sounds (Guest, Namey, & Mitchell, 2013). Operating on the data gathered from study, a qualitative researcher identifies and generates themes related to the object of study. Results can therefore be considered to inform potential application in external settings while acknowledging the influence of individual, group, and environmental differences.

I am specifically interested in how an individual interprets games-based environments and constructs personal understanding through repeated playthroughs. Potential data which demonstrates this type of growth are composed primarily of feelings, emotion, and game results. Though game results can be numerically presented and ordinal in nature, a better understanding of performance is garnered through understanding the emotional and personal satisfaction of the individual after play. Personal data of this type can only be obtained through social interaction and conversation. Thus, the experience of the participant and their particular interpretation of the event are key determinants in data generation. Through this lens, questions pertaining to the how and why can be analyzed and better understood by the researcher. Qualitative studies include a variety of potential methodologies which can be utilized to glean deep understanding of individual experience. For the purposes of this inquiry, the researcher determined a phenomenological approach via focus group methodology would provide the greatest prospective for understanding the complex processes associated with individual cognitive growth in games-based learning environments.

## Focus Group Methodology

Focus groups are composed of a small number of participants who engage in group discussions of a shared phenomenon facilitated by the researcher. It is primarily defined by generative group interaction in which individuals make their opinions public and the processes they undergo in doing so (Kleiber, 2004). Historically, focus group methodology formed within behavioral sciences, including sociology and psychology. Focus groups have been utilized in research from a range of different fields, ranging from education to other forms of social science. Focus groups provide flexibility for the researcher to explore subject matter with participants in collaborative, non-intrusive manner. Additionally, the information gleaned from focus groups results in applicable results, ones with immediate, practical implications within the field of study. Focus groups commonly been utilized in the fields of marketing to generate feedback on products and services. These marketing focus groups are primarily interested in determining and evaluating the motivation of individuals.

Stewart and Shamdasani (2015) note four normative criteria which constitute focus group design theory. First, focus groups result in focused research of what Robert Merton describes as a "particular concrete situation". (Merton & Kendall, 1946). The participant is emboldened to participate because they have first-hand experience with the subject matter. As a methodology, focus groups allow researchers to utilize a pragmatic approach to study. Researchers are able to identify and explore a specific phenomenon without the additional costs of time or money. Second, the use of group interviews is fundamental to focus group design. The interactions and discussions of groups allow the individual to refine, synthesize, and construct understanding on the topic of study. Group settings provide a comfortable, safe environment for participants. The collaborative nature and tone of a facilitator is more approachable than traditional individual

interviews where the participant is subject to a battery of questions from the researcher. Third, focus groups produce in-depth data which go beyond surface level responses to delve deeper meaning of individual experience and understanding. Focus groups have been used with war veterans, abuse victims, and in social justice research because of their ability to elicit emotions, projections, and motivations. The shift towards marketing focus groups in the 1950s demonstrate two major factors which Stewart and Shamdasani (2015) suggest have weakened the overall effectiveness of focus group data: too many questions and the use of direct question and response. Effective focus groups provide the participants and researcher with an informal environment, allowing questioning to ebb and flow. Additionally, probing questions allow the researcher to probe deeper meaning from participant response. Lastly, focus groups embody the spirit of humanistic interview. For data collection, attention is placed on individual's lives and experiences. Focus groups attempt to garner meaning of the human experience.

In *Focus Group Methodology*, author Pranee Liamputtong (2011) describes the phases a researcher must consider prior to holding a focus group session. These practical stages include pre-discussion, introductory, questioning, ending, and post-session stages. Prior to the start of the group interview, Liamputtong suggests the researcher greet participants and provide beverages for the session. Doing so allows the researcher, moderator, and note-taker to "engage in 'small talk' to make the participants feel welcome and comfortable" (p. 72). After participants have arrived and become content with the social setting, the researcher begins introductions. It is important during this stage that the moderator shares the research topics to assist participants in understanding the purpose of the group interview. Additionally, the moderator should reassure participants of the value of individual views and the confidentiality of the study. Participants are asked to speak and direct comments to each other, not simply to respond to the moderator's

prompts. During the questions stage, the moderator should start by asking questions which build a "nonthreatening and nonevaluative environment" (Steward, Shamdasani, & Rook as cited in Liamputtong, 2011, p. 74). Questions should be generated prior to the group interview, but flexible enough to allow the moderator to probe for further understandings. Furthermore, Liamputtong suggests using stimulus materials and participatory activities to encourage participation from participants. After each question from the prepared interview guide has been asked, the moderator wraps up the group interview by debriefing with participants. Asking questions about the interview session itself can improve subsequent focus group sessions. The moderator is also encouraged to open the discussion to participants, in case they have personal observations or concerns which were not addressed during the interview. After the interview is over, focus group participants should be welcomed to stick around to eat and drink together, potentially allowing an opportunity to further clarify and refine discussion points.

### Considerations for Other Research Designs

Originally, I had considered the use of case study for the research design of this study. It was assumed that finding participants would be significantly easier if they all came from a similar setting, for my purpose, the same class at the local university. The class is designed specifically for education majors who are interested in how to incorporate games-based learning within their future classroom curriculums. After some review, I determined case study had the potential to negatively impact the trustworthiness of the results. Participants in the course likely have strong positive feelings and experiences with games, which would result in skewed results. The collaborative approach of focus group design provides an additional level of synthesis for the individual.

The exploratory aspect of the study also warranted the potential consideration of grounded theory research design. Although games-based learning is not a new pedagogical approach, there does not currently exist a large body of research specifically addressing the metacognitive processes developed through iteration within games-based environments. In other words, a lot of literature exists about learning *with* games in classrooms via games-based learning models, but little on learning *of* games. This study may potentially serve to generate and conceptualize a new type of curriculum, one in which students engage with games as the primary mode of study. Ultimately, I determined grounded theory may be too demanding for the purpose of a dissertation. Data and understanding developed from this exploratory study, which is focused exclusively on the learning aspects of games-based learning, may inform future studies resulting in pedagogical theory.

## Research Design

To study the development of knowledge through games-based learning, I utilized a single focus group composed of eight individuals. In this section, I will address how site, game, and participants were selected for this study. Site selection for this study was narrowed to a smaller, local university composed of a student population which mirrors that of the general population of the state. During coursework, I considered potential games to be used for study, ultimately determining *Magic the Gathering* would yield substantial, valid data regarding learning through iterative gameplay. Participants in each focus group were undergraduate college students majoring in varying fields related to education.

### Site Selection

Through this study, I sought to identify preservice teachers from local universities who had interest in games-based learning. A local university was identified primarily for prior

relationships the researcher had with administrators and students. Administrators at the university were excited to host the study. State University provided accommodations including the physical space for hosting the focus group interviews, access to the internet for online gameplay, and offered to assist students in borrowing PCs should their personal laptops not work. As a faculty member at the university, I was able to actively recruit participants with were familiar and comfortable working in the established settings.

### State University

State University (pseudonym) is a small Midwestern university in estimated population in 2017 of 24,724. The university was originally founded as a normal school with an emphasis on teacher education. The setting is best described as rural. Enrollment at the university was recorded at 5,877 on the date of record during the Fall 2019 semester. Overall, the university saw a 1.4% growth from the previous year. 69% of students identify as White, 8% Latinx, 4% African American, and 1% Asian. In 2019, 74% of students were residents of the state, 45% of the student population are enrolled in graduate level work. The college of Education within State University is the largest graduating body on campus, at both graduate and undergraduate levels, accounting for 33% of credentials awarded in 2019. The university notes the average student debt upon graduation for students is markedly lower than national and state levels. As a university, graduates have a 97% placement rate over a three-year period.

## Game Selection

When beginning a study into learning through repeated interaction with games, it's important to carefully select a game system for which data, observation, and depth can be obtained. An assortment of different games exist which require varying levels of understanding, engagement, and purpose. Prior to this study, I inquired directly into the game selection process

which would best yield results necessary for understanding cognition through games. Given the six-week time frame, I determined it important to find a game which a participant could engage with outside of the study via an online, digital setting and play with others during focus group sessions. Regarding the genre of game, I concluded a game which required physical action, the entry of keyboard commands or controller inputs, would potentially skew results because participant dexterity would potentially be a confounding variable. From a depth perspective, the game of study needed to be simple enough learn in a short time frame but complex enough to allow participants to explore new gameplay strategies and methods after learning basics. Typical games used in educational settings are shallow, providing learners a media for rote memorization practice.

### Serious Games

The study revolves around the use of *serious games*, defined as games built originally for entertainment value and utilized by educators for learning (Ritterfeld, Cody, & Vorderer, 2009). These games are not to be confused with the plethora of *educational games* developed in which the learning context and purpose takes precedence over pleasure from play. Games designed primarily for educational purposes have been found to be less engaging or attractive to students as commercial games (Kim, B., Park, & Baek, 2009). The use of commercial games also prevents the need for the costly development of games. The value of intrinsic motivation experienced through the ludic engagement cannot be understated: students engage with the game for the purpose of play, not primarily learning. Viewing the game as a toy emboldens the learner, encouraging both persistence and repetition (Oerter, 1999, as cited in Ritterfeld et al., 2009, p. 4). Additionally, the learner is provided an opportunity to experiment and create within an establish system of flexible rules, through the lens of various contexts (Sicart, 2014).

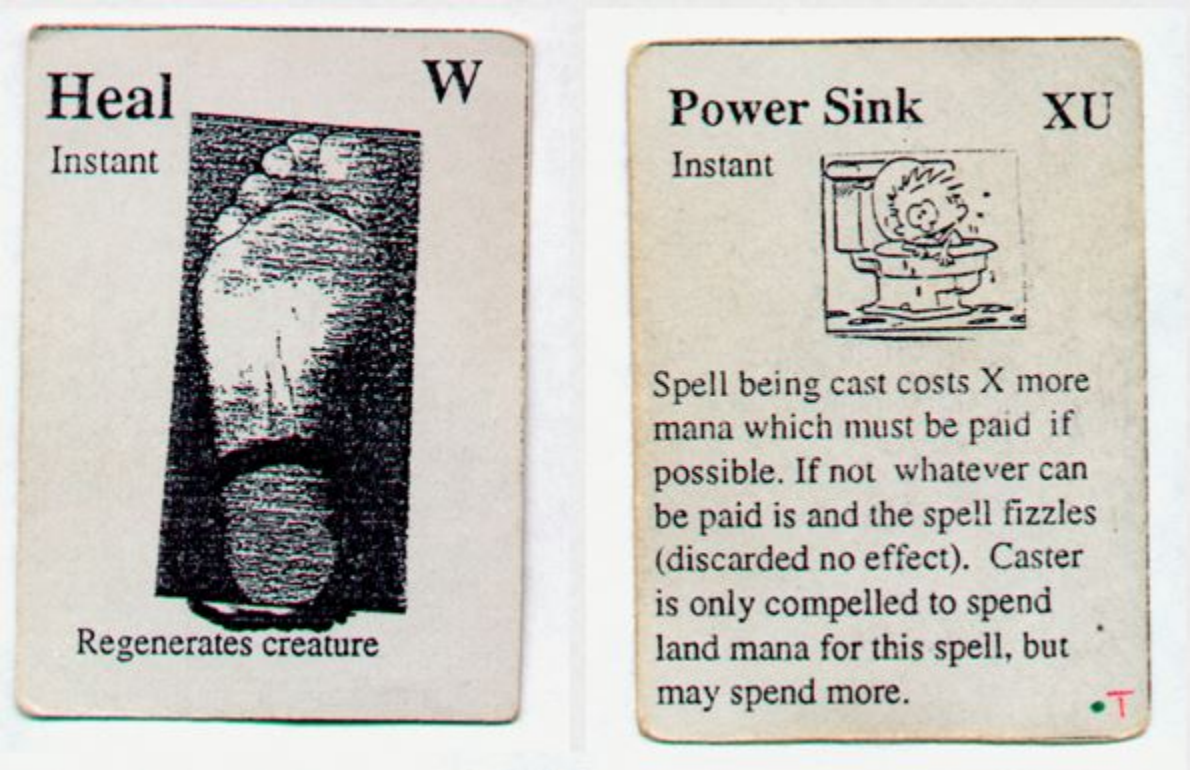
Modern games are no longer stand-alone products. Premium games are constructed by teams of hundreds of members with extensive budgets and resources. Major marketing campaigns are undertaken to build enthusiasm and increase sales. The game extends beyond the confines of the physical bounds of the game. Narrative driven campaigns connect the game world to literature, television, and movies. Competitive game scenes called eSports demonstrate a hierarchical system of showcasing the highest level of player skill and team collaboration within the game system. Commercial games are designed to illicit to deliver an emotional response to using the program. In this way, game developers create player bases which further the economic success of follow-up games, content, and expansions. In these ways, serious games offer an engagement potential which extends beyond the walls of a classroom and to the student's social and extracurricular activities.

**Magic the Gathering**

*Magic the Gathering* is a trading card game originally released in 1993 by Wizards of the Coast. It was designed by Richard Garfield, a mathematician who earned their PhD. In combinatorial mathematics before becoming a professor of mathematics. Garfield's interest in math translated to game design, where he developed a variety of different card games in the 1980s. *Magic the Gathering* was the result of the blending of earlier card game prototypes merged with roleplaying elements, similar to those found in *Dungeons and Dragons* (Garfield, 2013). Thematically, the player portrays a powerful wizard who builds their spellbook through a deck composed of cards. Cards are sold in prebuilt decks and smaller, randomly filled booster packs. Players can also trade for cards from other players; consequently, *Magic the Gathering* is considered to be the first collectible card game (CCG), spawning an entirely new genre (Boardgame Geek, n.d.).

**Figure 3.1**

*Playtest Prototype of Magic the Gathering Cards*




*Note*. Reprinted from Wizards of the Coast. Retrieved February 5, 2020 from https://media.magic.wizards.com/image_legacy_migration/images/magic/daily/arcana/4rgstutsz8_playtestcards1.png.

The game was immediately popular, selling the entire year's print run at the Origins Game Fair which it was introduced. A competitive scene for *Magic the Gathering* developed, supported by a tournament system called Duelists' Convocation International (DCI). Developed by Wizards of the Coast, this system was the first of its kind, allowing the game's producers to host tournaments, track and maintain player statistics, and implement a rewards players for participation and success (Wizards of the Coast, 2011).

From a game design perspective, *Magic the Gathering* has been at the forefront of the industry in mechanic and game development for over twenty-five years. Typically, four new

*Magic* sets are released each year, filled with both reprints and new cards. At the time of writing, there exists more than 20,000 unique *Magic* cards mechanically employing 25 evergreen keywords and 145 expansion keywords. Some mechanics are symmetrical in execution, whereas other produce random effects for each player. This produces a staggering amount of complexity when attempting to view or solve *Magic the Gathering* gameplay in its entirety. From a functional perspective, the game mechanics and interactions of *Magic* are so complex that they can process simple computations in game. Churchill, Biderman, and Herrick (2019) conclude *Magic the Gathering* is Turing Complete, meaning the card game itself can function as a programable system capable of systemically solving computational problems. For this reason, gameplay is governed and organized into formats, each independent from the others. Formats are typically organized and labeled by their respective card pools. Constructed formats allow players to use a larger pool of legal, available cards. Limited formats limit the size and availability of a player's card pool usually equal to a predetermined number of packs. Wizards of the Coast currently recognizes a total of eleven constructed formats, five limited formats, and four unique digital formats. For the purpose of this study, participants engaged in both constructed and limited gameplay settings and deckbuilding processes.

**Participant Selection**

The identification and selection of participants is considered the most critical aspect of focus group design because of the reliance on "group dynamics and synergistic relationships among participants to generate data" (O.Nyumba, Wilson, Derrick, Mukherjee, & Geneletti, 2018). I recruited participants who were enrolled in an instructional technology course, which is a required course in secondary education. As their instructor, potential participants were familiar with my personality and the subject of study, which I believe aided in the recruitment process.

Focus group methodology aims to create an environment which participants are comfortable, resulting in a more open, honest conversation regarding the subject. The presentation addressed games-based learning and therefore aligned with the subsequent study. Potential participants were asked to fill-out a diagnostic survey with background and contact information. It was necessary for participants to be enrolled in education coursework because one of the primary goals of the study is to explore potential curricular uses for games-based learning.

For the purposes of this study, participants are identified through a numerical pseudonym randomly assigned and labeled as Player X as a nod to the culture of games. The final demographic composition of the participant group mirrored that of State University. There were an equal number of male and female participants. All but one participant majored in the field of Secondary Education. A variety of subject areas were included, though a majority were in Physics and Sciences. As part of their participant application and the initial focus group meeting, participants were asked a variety of background questions which assisted in forming baselines for their familiarity with games. Additionally, participants took the Bartle Test, a test of gamer psychology which identifies player type of socializer, explorer, achiever, or killer (Bartle, 1996).

**Player 1**

The participant identified in this study as Player 1 is a female undergraduate student in Microbial and Cellular Biology. This player was recruited by Player 7 for the study and had no prior relationship with the researcher. They are roommates with Player 7, which allowed them a unique ability to play together outside of sessions. Being able to build decks and talk through the processes were beneficial to Player 1, who found the programmed tutorial clunky. Player 1 is primarily a cooperative player who finds enjoyment in games through interacting with peers. Additionally, Player 1 is the only participant who is not an education program at State

University. They are a relative newcomer to gaming and had no previous experience with *Magic the Gathering*. Player 1 was unable to attend the final focus group meeting but was present for the other three.

**Player 2**

The participant identified in this study as Player 2 is a female fifth-year undergraduate student who is dual-majoring in Music Education and History. Prior to the study, Player 2 did not have familiarity with the researcher. Other participants were directly recruited for the study through solicitation during class with the researcher. Player 2 was recruited by Player 7 because of their friendship and involvement playing games outside of this study, primarily *Dungeons and Dragons*. Unfortunately, Player 2 had to drop from the study after the second focus group session because of time commitments and restraints.

**Player 3**

The participant identified in this study as Player 3 is a male second-year undergraduate student in Secondary Education Physics and Earth Science. Player 3 identified as an Explorer on the Bartle Test, meaning they primarily enjoy exploring game mechanics and attempting to find creative solutions to in-game problems. They described themselves as being both a cooperative and competitive player, noting, "I can be both types of players. I work with others to beat other people." Player 3 has a strong background in the subject areas of history and technology. They describe their learning style as adaptive. Historically, they have been an active gamer for ten years, starting with Chess before transitioning to console video games. They are a relative newcomer to card games such as *Magic the Gathering*, only having limited play experience in paper settings with friends. They were familiar with Yu-Gi-Oh!, a Japanese Trading Card Game released after *Magic*. Player 3 attended each focus group interview.

### Player 4

The participant identified in this study as Player 4 is a male fifth-year undergraduate student majoring in Secondary Education Physics and Earth Science. Player 4 scored highly as an Achiever on the Bartle Test of Gamer Psychology, indicating they are primarily driven in game settings to gather points and levels. In school, they excelled in mathematics and science courses. They self-identify as being a visual learner who enjoys inquiry and discovery approaches, "I think my strengths are that I'm willing to be wrong so that I can figure out what is right." This participant identifies as being 100% cooperative, specifically noting collaboration with peers in competitive settings against AI-controlled opponents as their preferred game mode. Player 4 has a long history of gaming, starting with console video games when they were seven years old. They had no prior experience playing *Magic the Gathering*, though some experience playing other Trading Card Games. A unique remark shared by Player 4 in their background information was the awareness and utilization of data-driven decision making in gameplay, called the *meta*. This type of thinking aligns directly with this purpose of this study; Player 4 was aware of its existence more-so than other participants and utilized it in deckbuilding. Player 4 was unable to attend the final focus group session.

### Player 5

The participant identified in this study as Player 5 is a male second semester undergraduate in Secondary Education History. Player 5 is the junior member of the participants, whereas many of the other participants are towards the end of their undergraduate programs and beginning to transition to teacher practicum experiences. Player 5 is the participant with the most recent high school experience, being only a year removed from that setting. Using the Bartle Test, this participant was identified as a Socializer, a player who predominantly finds joy in

games through peer interaction. They had played *Magic the Gathering* on and off through high school, but they "mostly just play cards that are cool to me. Not much emphasis on true strategy." Player 5 labeled themselves a competitive player but not to the extreme, they're primary purpose for gameplay is fun. They have a history with playing games, going back to playing toy soldiers with their Grandpa. This participant views themselves as a "hare"-type of thinker, reacting to situations on instinct. Player 5 was able to attend all focus group sessions.

**Player 6**

The participant identified in this study as Player 6 is a male second-year undergraduate student majoring in Secondary Education Physics and Earth Science. They and Player 4 have some familiarity with one another because they share the same program, and therefore, have taken courses together in recent semesters. Unlike the other players who were either brand new or novices to *Magic the Gathering*, Player 6 had extensive experience playing paper and digital *Magic*. Their results from the Bartle Test was primarily Explorer, though their overall scores were balanced. They described themselves as mostly a competitive player with a history of playing a variety of games, including video, board, and card games. Player 6 personally describes their learning style as versatile, tactile, and hands-on. They were able to attend all focus group meetings.

**Player 7**

The participant identified in this study as Player 7 is a female third-year undergraduate student in Music Education. Player 7 is a competitive player who finds enjoyment in beating opponents in a variety of game settings. They were responsible for the recruitment of two additional participants, Players 1 and 2, with whom they had a prior outside relationship with. Unfortunately, Player 7 did not submit a participant journal for the study and therefore was not

included in that aspect of data collection. They were interested in joining the study because "Honestly, I am a nerd that loves all sorts of different things. So, when I heard about it, it piqued my interest." Player 7 had no previous experience playing *Magic*. They were able to attend all but the final focus group meeting.

**Player 8**

The participant identified in this study as Player 8 is a female student classified as a senior in the undergraduate program, dual majoring in Secondary Education Biology and English. Player 8 scored as equal parts Explorer and Socializer on the Bartle Test, which suggests they enjoy both interaction with the game system and with other players. Player 8 was interested in joining the study after spending some time mentoring a group of middle school students. They commented in their participant application:

> It is obvious that card games bring a sense of community to people who do not excel in sports and creativity necessarily. I worked with the kids at the middle school and many of them wanted to play Catan and Munchkins, but I was unable to be an effective player because they had to teach me to play. I want to be relevant.

Additionally, they noted in their participant journal a preference for kinesthetic and visual learning styles and a personal background of playing nostalgic video games with only a handful previous experience playing paper *Magic the Gathering*. Player 8 was able to attend all four focus group meetings.

## Data Collection Methods

A variety of collection methods were utilized for gathering of data during the study. Data generation was the result of both researcher and participant contribution. Focus group interviews included questioning and response from both participants and researcher. Furthermore,

participants were asked to personally create data for analysis through journaling and the recording of game sessions. Given the focus group methodology employed by the study, most of the data is qualitative in nature, including interview transcripts, participant observation, participant journals, and game reflections. Additionally, each participant was required to submit completed game results in the form of win-loss record, deck played, opponent deck, and format. The timeline and data collection for the study are identified in Table 3.1 below.

**Table 3.1**

*Study Outline Including Weekly Setting Description, Participant Tasks, and Data Collection Techniques*

| Week | Setting | Participant Task | Data Collection Utilized |
|---|---|---|---|
| 1 | Face-to-face | Introduction and setup of *Magic the Gathering: Arena*, personal journals, and gameplay datasheet. | Focus Group Interview #1<br>Participant Observation<br>Personal journal including answers to personality/background questions |
| 2 | Online | Complete the *Magic the Gathering: Arena* tutorial | Participant journal<br>Gameplay datasheet |
| 3 | Face-to-face | Using preconstructed decks, participants play games against each other. | Focus Group Interview #2<br>Participant Observation<br>Participant journal<br>Gameplay datasheet |

| Week | Setting | Participant Task | Data Collection Utilized |
|---|---|---|---|
| 4 | Online | Players modify and build their own deck using cards opened from packs. | Participant journal<br>Gameplay datasheet |
| 5 | Face-to-face | Players engage in a round-robin tournament with their personalized decks. | Focus Group Interview #3<br>Participant Observation<br>Participant journal<br>Gameplay datasheet |
| 6 | Face-to-face | Using paper *Magic* cards from a random pool, players build a deck and play one another in a traditional physical game of *Magic the Gathering*. | Focus Group Interview #4<br>Participant Observation |

**Focus Group Interview Format and Operation**

A total of four different focus-group interviews were held over the period of six weeks. The initial focus group interview was a preliminary meeting in which participants were introduced to the study, signed informed consent forms, downloaded the *Magic the Gathering Arena* client, presented to the data collection pieces participants were responsible for, and asked background questions to establish baseline descriptions of each participant. Subsequent focus group meetings included time for both group interview and gameplay experiences. Generally, participants were involved in playing games against one another for two-thirds of the total

meeting time of two hours. Group interviews were held both before and after gameplay, totaling between 25 and 70 minutes.

During meetings, the researcher provided food and drink for participants to assist in setting a casual tone for group interviews. As participants were more and more comfortable with their setting and peers, they openly communicated and shared specific details about their learning experiences while playing *Magic*. The atmosphere of later focus group meetings were similar to a gathering of friends preparing to play games together. Each meeting had a specific purpose and gameplay mode for players to explore in addition to the focus group interview.

The audio from each focus group meeting was recorded via microphone. Video was not recorded because the eight participants were difficult to capture with one camera. Instead, the researcher employed participant observation to be directly involved in the game sessions portions of the focus group meetings. Participant observation is used in research "requiring some extent of social participant to document or record the course of ongoing events" (Preissle & Grant, 2014, p. 163). This data collection method was a natural inclusion given the social setting of games of *Magic the Gathering*. This allowed the researcher to directly inquire into the interaction participants made during gameplay sessions, clarify questions or rule interpretations, and to take note of participant body language and setting.

**Focus Group Meeting 1**

After reaching out via email to finalize a participant pool, the researcher proposed a set day and time for the six-week study. The first session occurred in a face-to-face setting and primarily served a as a formal welcome to the study. Most participants had some level familiarity with the researcher from taking an undergraduate course the prior semester. During this initial interview, members were introduced to one another in an effort to build a social setting which

would be casual, familiar, and comfortable for participants. The researcher discussed the purpose of the study and confidentiality with participants before having them sign informed consent forms for official participation. Participants were then asked a series of background questions which they responded to in their newly created participant journals. These questions included:

- What type of gamer are you? [via the Bartle Test (Bartle, 1996)]
- What subjects were you "good" at? How would you describe your learning style?
- Are you a competitive or cooperative player?
- What is your history playing card games, board games, video games, etc.?
- Are you a tortoise or hare? This question explores the participants personal approach to decision making. Thinkers who are aligned as hares tend to respond and react quickly in learning environments, relying on their intuition. Tortoises prefer to make decisions and form conclusions after reviewing all possible information. *Magic the Gathering* is often played with a timer which may cause some players distress or form anxiety to respond.

After responding to the questions, the researcher shared the expectations for participants, primarily the requirement they keep a participant journal and log their games via the gameplay datasheet. The meeting finished with the download and install of *Magic the Gathering Arena*. Though the program is free to use, participants were required to create accounts. Participants were tasked with spending the following two weeks playing through the tutorial program on *Magic the Gathering Arena* and to prepare for games against each other during the second focus group meeting.

**Focus Group Meeting 2**

The second focus group meeting occurred two weeks after the preliminary gathering. Participants were tasked with finishing the tutorial program on *Magic the Gathering Arena* which introduces new players to game mechanics via a structured procedural process. Players were introduced to each of the five colors of *Magic* through introductory decks. These decks were primarily composed of simple cards with straight forward rules text. As players complete stages of the tutorial, they unlock additional cards for their decks which further the complexity of mechanics and rules the player interacts with. The game incentivizes players during the tutorial through an experience system that rewards players with unlockable cards and packs, collection of eight random cards from a *Magic* set. Additionally, a quest system incorporating in-game currency encourages players to log on each day and complete the task for gold reward which can be used to buy additional packs. These systems align directly with Gee's (2007) Achievement principle for effective learning.

The meeting started the focus group interview, where participants were asked questions related to their experience with the tutorial program and learning *Magic the Gathering*. Though the players are given prebuilt decks to use, the game allows some personal deck customization by the end of the tutorial program. Some players may have started with the same colored, prebuilt deck, but by the end of the tutorial may have wildly different cards. The interview lasted fifty minutes and was followed by gameplay for an hour. During this time, players used their favorite decks, derived from the prebuilt decks, in play against each other. The microphone was left live to capture the social commentary between players during this time. After the session, the game notes were reviewed by the researcher who identified and recorded potential quotations relevant to the emerging themes to supplement the interview transcript.

Prior to leaving, participants were given game codes which unlocked twenty card packs for their account. These card packs included eight random cards from a variety of *Magic* sets which players could then use to improve their existing deck or build brand new ones. As a group, they opened their packs and talked about how they interpreted the card's power and mechanics. This additional conversation was later transcribed and included in the game notes for data analysis. Additionally, players were introduced to the wildcard system employed by *Magic the Gathering Arena* which allows the construction of any card at the cost of a wildcard. In preparation for the third focus group meeting, participants were tasked with building decks from their new cards for a groupwide tournament.

**Focus Group Meeting 3**

The third focus group meeting occurred two weeks after the second, allowing participants ample time to review new cards and build their own, personalize decks. Players engaged in casual conversation prior to starting a round-robin, best-of-one competitive tournament. Each player competed in six total games over the course of an hour and a half. Win-loss results were recorded with a prize based on player finish. The microphone was live during gameplay, situated in the middle of the play area to record the conversations which occurred between players. During the transcription process, these dialogues were examined by the researcher for additional data relevant to emerging themes.

After finishing the tournament, a more formal focus group interview took place, concentrated on reflection of both the deckbuilding processes and gameplay session. This interview was the longest of the four, extending to a total length of slightly more than forty minutes. Each participant was asked to describe the deck they brought for play and how they approached deckbuilding. Additionally, players reflected on the games they played, especially

when opposing players mentioned an interaction which occurred during their matchup. Though the tournament was competitive, players were comfortable with the setting and each other to maintain a constructive atmosphere.

The focus group meeting finished with the rewarding of prizes for tournament finish. The researcher purchased a package of one thousand random, paper *Magic* cards ranging in sets from 1995 to 2019. The lot was randomly split into seven piles of roughly 140 cards and then placed inside a plastic bag for selection by participants. The winner of the tournament was allowed to pick first and then each subsequent finish picked until no piles remained. Players were assigned to build a sixty-card deck out of the sealed card pool they selected for play during the final group meeting. A few players looked through their cards on site, making preliminary comments and observation of the cards they received. The microphone was live during this phase of the group meeting and game notes were included by the researcher during the transcription process.

**Focus Group Meeting 4**

The fourth and final focus group meeting occurred one week after the third meeting. Unfortunately, this session lined up with midterms on campus, resulting in only four participants being able to attend: Players 3, 5, 6, and 8. Prior to the session, players constructed sixty-card decks from a pool of randomly seeded paper *Magic* cards. The *Magic the Gathering Arena* digital client calculated the number of lands needed for players, but during paper *Magic* deckbuilding, the players themselves were required to determine mathematically the portion of lands to add to their decks. The first portion of the focus group interview was help prior to the gameplay session and focused on having participants reflect on their deckbuilding processes for this week's decks. Players were encouraged to discuss how they started the process, how they

evaluated cards, what mechanics from new cards were potentially powerful, and a general summary of their strategy.

After reviewing decks, players engaged in a best-of-one round robin casual play with their paper decks. This environment was very similar to *kitchen-table Magic*, the typical setting where novice players learn while playing friends. Setup and gameplay did take longer because of the face-to-face element. Unlike in *Magic the Gathering Arena*, there was no automatic trigger stacking, rules interpretations, or automatic resolutions. This resulted in a much more social atmosphere because players were required to communicate to their opponent their gameplay mechanics and interactions. Players were able to play a total of two games in an hour with the second game being a matchup of winner-versus-winner, loser-versus-loser.

The focus group session concluded with the final focus group interview of the study. The researcher included some final questions for participants to reflect upon. These included a summation of their learning processes during the course of the six-week study, reflection on the difference between digital and face-to-face settings, prospective changes to their constructed decks, and the potential pedagogical or curricular implications of using a games-based approach in schools. Most participants had taken some methods or education courses prior to the study, giving them some foundation into pedagogical and curricular thought. It should be noted though, none had actual teaching experience, so this knowledge foundation was limited. Participants who were unable to attend had the final interview questions emailed to them with the expectation they would respond in their participant journals. I had originally planned to include a draft format at the end of the session, but we were unable to fit it in because of time restraints.

## Focus Group Data Collection Methods

During the course of this study, three different data collection methods were employed to generate qualitative data for analysis. The researcher was primarily responsible for the recording and transcription of focus group meetings. Additionally, during focus group meetings the researcher took on the role of participant observer. Participants were asked to contribute their own personal experiences via journaling and data recordation. Additionally, the researched posed supplemental questions for written response from participants when warranted by time constraints. Lastly, the participants were asked to log finished game playthroughs via Google Forms, resulting in additional reflective, qualitative data. Utilizing multiple forms of data collection assisted the researcher in triangulating data for the generation of patterns and themes during data analysis.

### Data Collection Method: Focus Group Interview

The primary source of data for this study was derived through focus group interviews between the participants and researcher. Participants met four times over the course of the six-week study to engage in gameplay and discuss the learning processes utilized during that timeframe. Effective focus groups require participants to be comfortable with the setting, peers, and researcher to fully explore their personal reflections on the subject matter (Stewart & Shamdasani, 2015). To this end, the participants were provided food and drink at the beginning of each session to ease the start of conversation and establish a casual environment. Additionally, the focus group meetings took place in the classroom at State University where most of the participants had class with the researcher. Prior to the group meeting, the researcher generated a list of potential questions to begin the discussion. As the study progressed, general discussion

shifted from how to play the game to more in-depth questions including strategy, skill practice, and potential pedagogical connections.

A microphone was setup in the middle of the group to record conversation and ran during the entire typical two-hour session. This allowed the researcher to capture commentary which occurred outside of the interview portion of the group meeting. After the initial meeting, each subsequent focus group meeting included periods of gameplay and interview. This provided an opportunity for both participants to respond formally to questions posed by the researcher and informally via spontaneous communication and interaction with peers during gameplay. The researcher then transcribed the formal group interviews using the program *oTranscribe*, noting time stamps and speaker. Additionally, the researcher utilized participant observation during gameplay sessions of focus groups. As participants engaged in games of *Magic the Gathering*, the researcher directly questioned and probed into participant thought processes. If questions about game rulings occurred or the participants had questions about an interaction, the researcher was able to respond. These interactions provided an informal commentary was included as additional game notes and used for supplemental data.

**Data Collection Method: Participant Journal**

Participants were asked to keep a detailed, ongoing personal journal during their course of the study in which they recorded their personal reflections to gameplay experiences. Meth (2003) advocates the use of dairies because it "provides the subjects of research substantial scope for reflection and self-determined knowledge presentation, it provides the researcher with extensive amounts of intensive material and it reinforces analyses of data gleaned from other methodological sources" (p. 203). The journal was suggested and encouraged by the researcher, though not required for participants. Throughout the study via email reminders of question

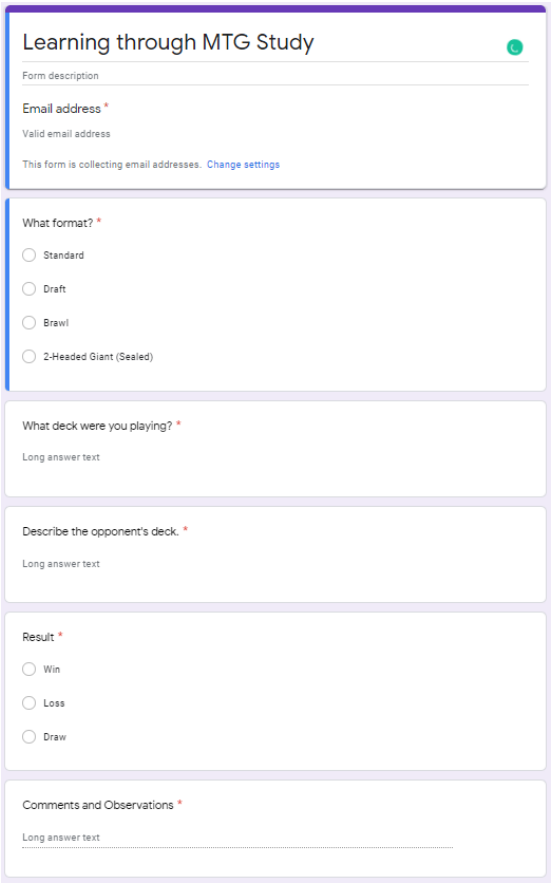
prompts which developed during focus group meetings. Initial applications for study participation included some basic background questions which were later elaborated upon in participant journals during the first focus group meeting. As participants engaged with *Magic the Gathering* outside of focus group meetings, they were encouraged to reflect on their gameplay through their journals. Final observations and comments were also recorded in these journals, specifically on the pedagogical and curricular implications of games-based methods in schools. A total of six participants, all but Players 2 and 7, submitted their participant journals at the end of the study for data analysis, resulting in a total of nineteen single-spaced pages of participant reflection and commentary.

**Data Collection Method: Gameplay Data Sheet**

The final form of data collected for this study involved supplemental reflective qualitative information generated from the log of completed gameplay sessions submitted by individual participants when playing outside of focus group meetings. The primary purpose of this data collection tool was to supplement qualitative data with direct evidence of improvement of gameplay during the course of the study. Participants were asked to only include results of games played against other players during gameplay outside of the focus group sessions. The AI-mode was not included because it was primarily utilized in game to be used as a tutorial. After finishing a game, players used a Google Form to submit responses to the prompts as seen in Figure 3.2 (below) which was then assembled into spreadsheet format for disaggregation.

**Figure 3.2**

*Gameplay Data Sheet Recording Device (via Google Forms)*




Players were asked to include emails for purposes of individualizing data results. During the second focus group meeting, players were introduced to popular terms which could be used to describe deck types. These included strategy (aggro, midrange, control, combo) and color-combination (blue-white, Azorius, etc.). These terms reflect environment-specific vocabulary unique to *Magic the Gathering* gameplay and design. The final field of the gameplay data sheet allowed participants to include direct observations from gameplay. These are the memorable moments from the game, that when the game is finished, stand out as major takeaways or

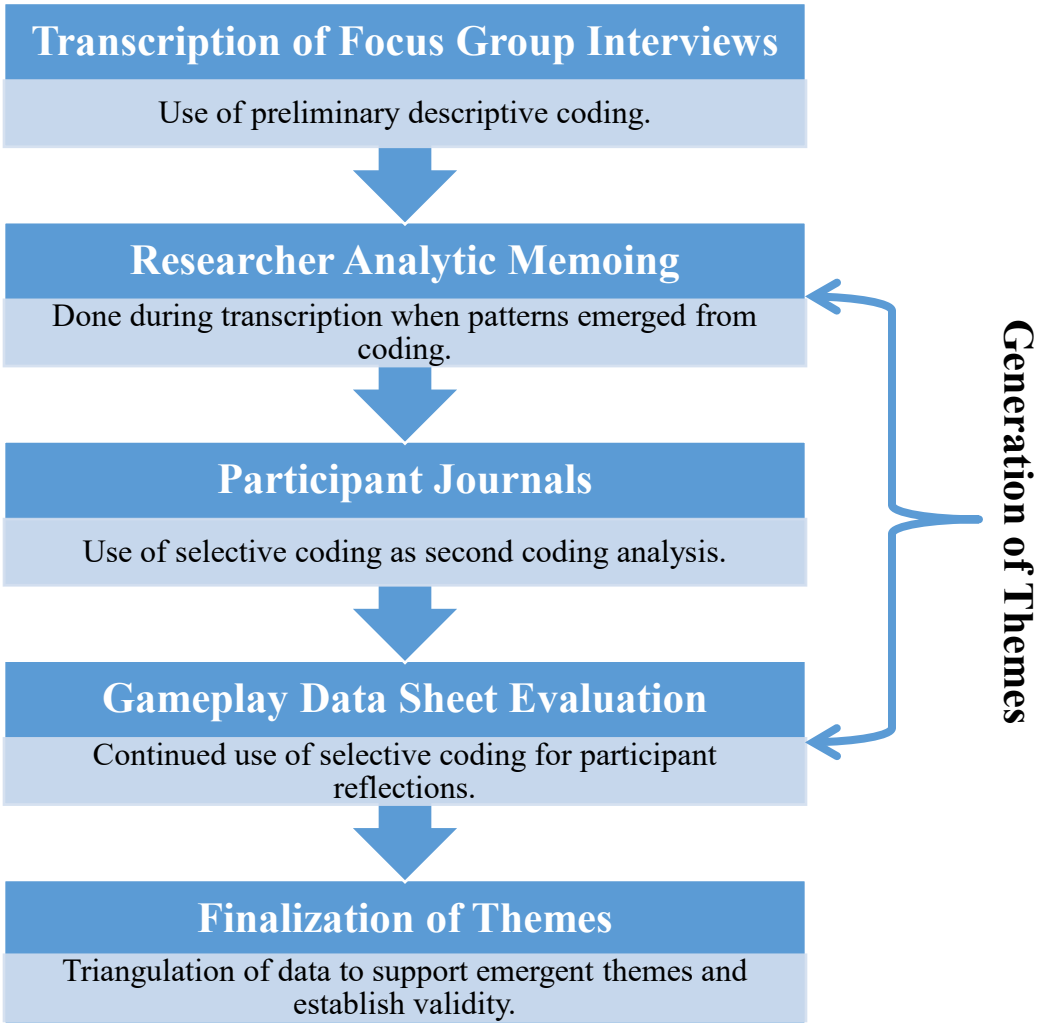
conclusions. Consequently, this section was vital in requiring players to reflect on their learning, as espoused in constructivist learning environments.

## Data Management and Analysis

In this section, I will discuss how data was managed and analyzed to identify elements of learning from gameplay. The total length of focus group meetings eclipsed seven total hours of recorded interviews, resulting in one-hundred twenty-five pages of qualitative textual data for analysis. Additionally, during transcription the researcher incorporated layered memoing between initial and axial coding. This process of initial and secondary coding involved "meticulous analytic attention by applying specific types of codes to data through a series of cumulative coding cycles that ultimately lead to the development of a theory" (Saldaña, 2016, p. 55).Submitted participant journals amounted to nineteen pages of single-spaced personal reflection and commentary on the study. One-hundred eighty-four total game submissions were submitted to the gameplay data sheet. All pieces of data were procedurally analyzed and interpreted, resulting in the generation of potential themes resonating to the research questions posed (see Figure 3.3). Additionally, triangulation of data was utilized to establish further validity and reliability in identified themes.

**Figure 3.3**

*Data Analysis Procedure and the Generation of Themes*




*Note.* Data analysis procedurally generated, confirmed, and reaffirmed emerging themes.

### Data Analysis: Focus Group Interview

Focus group interviews were recorded and subsequently transcribed to provide text-based data for analysis. With the data available in text form, the researcher employed coding to identify emerging themes derived from the initial guiding research question of this study:

- What knowledge and skills are learned through multiple playthroughs of a singular game?
- How do participants effectively construct knowledge through iterative experiences with a singular game?
- What potential pedagogical and curricular implications do iterative games-based learning experiences pose? This research question was specifically addressed during the final focus group interview.

Transcription was done using the web-based program *oTranscribe* (https://otranscribe.com/) which allowed the researcher to insert timestamps which could be reviewed afterwards. Speaker identification was done via short abbreviation, IN for interviewer or researcher, PX where X was the Player's randomly assigned identification.

The formal sections of the focus group meeting were completely transcribed. During moments of gameplay, the researcher as participant observer reviewed the recording and transcribed moments of conversation which related to initial coding. This approach was useful in trimming the total amount of transcription and aligns with what most qualitative researchers feel is best practice. Saldaña (2016) notes:

> Others [qualitative research methodologists], if not most, feel that only the most salient portions of the corpus related to the research questions merit examination, and that even up to one-half to two-thirds of the total record can be summarized or 'deleted', leaving the remainder for intensive data analysis. (p. 17)

The goal of coding was to conceptualize potential connections between games-based learning and constructivist learning theories. To this end, I employed a process of initial coding specifically considering constructivist learning theories while maintaining the potential for new

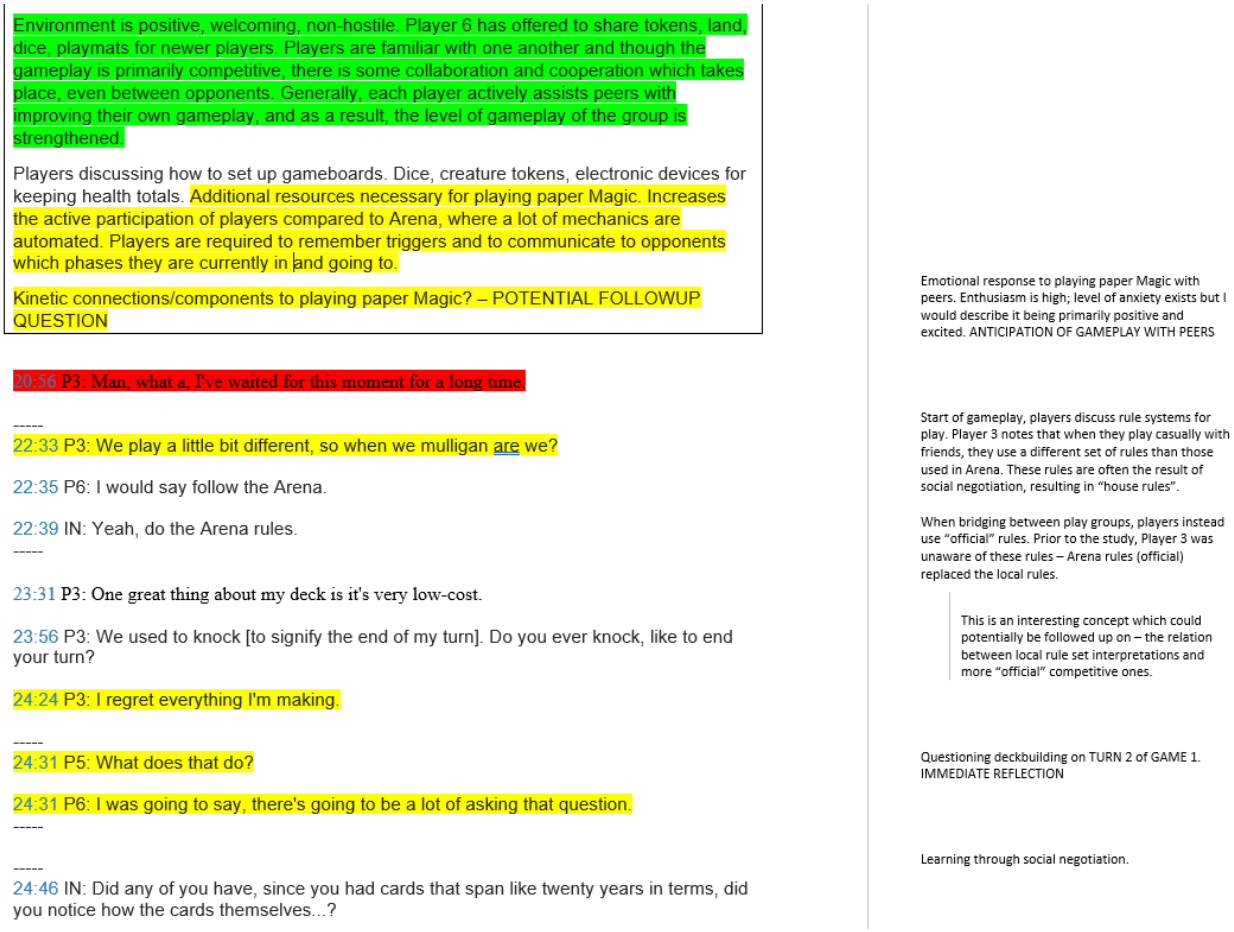
themes to emerge. Initial coding “breaks down qualitative data into discrete parts, closely examines them, and compares them for similarities and differences” (Strauss & Corbin, 1998 as cited in Saldaña, 2016, p. 115). The audio recordings including gameplay moments are maintained and stored should they be necessary for future reference and later deleted per the IRB agreement.

After transcribing the interview into a word processor, the researcher initially coded the text to identify data which suggested the learning. The researcher utilized the rough guidelines for coding provided by Bhattacharya (2017): "... by pulling out phrases, sentence, paragraphs that stand out to you. You then have the option of labeling what you have pulled out as your standout pieces" (p. 150). This process was done via the highlighter tool available on the word processor (see Figure 3.4). The researcher used four different colors as initial indicators of analysis which connected to constructivist learning theories:

- Red – Feelings and emotions. Metacognitive processes.
- Green – Setting and environment.
- Blue – Gameplay analysis. Cognitive constructivist learning theories.
- Pink – Socialization. Social constructivist learning theories.
- Yellow – Unorganized.

**Figure 3.4**

*Example of Initial Coding and Analytic Memoing During Transcription*




Next, the researcher employed the process of axial coding to further organize data into more distinct topics, allowing the researcher to generate subthemes through narrower and more refined lens. Axial coding "describes a category's properties and dimensions and explores how the categories and subcategories relate to each other" (Saldaña, 2016, p. 235). This secondary cycle coding was done during the transcription process via physical sticky notes (see Figure 3.5). Additionally, timestamps were included which highlighted participant commentary related to the code for potential reference and association during data analysis. At the end of each transcription, the researcher reflected on axial coding and reorganized the sticky notes to identify

emerging themes. This process resulted in a total of four different evolutions of sticky note placement, with patterns and themes becoming increasingly refined.

**Figure 3.5**

*Axial Coding Process Using Sticky Notes*


From these preliminary and secondary codes, patterns emerged in participant comments during both the interview and gameplay notes. Patterns are described by Saldaña (2016) as "somewhat stable indicators humans' ways of living and working to render the world" (p.6). These patterns can be derived from coding through the identification of similarities, differences, frequency, sequencing, correspondence, and causation. Patterns were roughly organized and sorted physically based on their association to the research questions. The result was the emergence of potential themes which were later reviewed and supplemented via other data collection methods.

### *Data Analysis: Analytic Memoing*

While creating the transcript of the interview, the researcher employed memoing to record the ongoing thought formulation on the topics (see Figure 3.4 above). Memos demonstrate additional considerations and elaborations by the researcher in response to participant comment. The researcher noted simple, brief comments about the transcript made while coding. This process allowed the researcher the opportunity to reflect directly on the recorded commentary and assisted in the development of potential themes from the qualitative data. The memos primarily included follow-up questions, clarification of participant remarks, and the generation of additional considerations for the study.

Furthermore, analytic memoing was utilized which focused specifically on synthesis and analysis of participant conversation. Analytic memoing is the process by which the researcher records ongoing interpretation of qualitative data, including the documentation of processes, inclusion of personal thoughts, hypotheses of prospective emerging themes, and reminders (Bhattacharya, 2017). This process demonstrates the reflexivity of the researcher, allowing comparisons to be made between personal beliefs, those of the participant, and the subsequent generation of new perspectives made after reflecting on the interview. By utilizing this analytic framework, the interactive processes connecting initial coding, axial coding, and analytic memoing, the researcher was able to identify potential emerging categories or themes.

### Data Analysis: Participant Journal

Six total participants, all except Players 2 and 7, submitted participant journals at the end of the study. Journals were analyzed via focused or selective coding after the process of focus group transcription and axial coding was completed. As a form of secondary coding, focused coding uses previously identified frequent codes from initial coding which "requires decisions

about which initial codes make the most analytic sense" (Charmaz, 2014 as cited in Saldaña, 2016, p. 240). This allowed the researcher to hone their lens during the coding of participant journals to the previously identified emergent themes. During selective coding it became clear the participants shared a meta-level piece in their personal reflections. This new theme was colored purple and labeled Metagaming during coding. Selective coding also provided the opportunity to find specific examples of participant commentary which aligned with identified themes. These passages were identified via sticky note and organized with their prospective themes.

Preliminary information on participant backgrounds was obtained via initial survey and questions posed during the first focus group meeting. All participants mentioned having some experience in gaming prior to the study, ranging from video games to board games. One player was a regular *Magic* player, three had previously played at least one game, and three were totally new to the game. Participants backgrounds were mixed and balanced:

- Equal representation in favored subject during school, including history, math, science. Additionally, English and technology were mentioned.
- Primarily self-associate as visual and tactile learners.
- Half identified as cooperative players; half as competitive.
- Virtually equal distribution of participants who label themselves as hare-learners compared to tortoise-learners.

During the time between the first and second focus group meeting, each participant was sent a reminder email including follow-up questions for their participant journals. Most of these questions asked participants to consider their learning of how the game of *Magic the Gathering* functions and plays. Analysis of this section revealed alignment with initial coding, primarily

commentary about gameplay mechanics and rules. It was during this phase of the study that players discovered their own personal playstyles within the game system. Some players were drawn to mechanics, others by aesthetics, and a few by external sources. Additionally, players reflected on the tutorial and bot-opponent program in *Arena*.

Subsequent entries in participant journals were sporadic. Four of the six participants who submitted participant journals continued reflecting on their gameplay experiences and processes, whereas two other participants stopped recording. Journal observations shifted from gameplay elements to more personal reflection on game sessions. A majority of participants mentioned feelings of rage or anger towards opponents during games. This theme had surfaced during interviews, but really stood out when presented in the participant's own words. Elements of metalevel processing continued to occur in player comments. Three participants naturally developed or described awareness related to strategies largely employed by the competitive player base. Two participants explicitly described their deckbuilding process which aligned with an inquiry-based approach in determining which cards and strategies would be effective in both the online and face-to-face setting. Each had a unique approach which is later discussed in Chapter 4.

A total of two participants recorded their responses to the final focus group interview questions related to the research question concerning potential curricular and pedagogical uses in classroom settings. Three other participants responded to the question prompt during the final group interview, and unfortunately, three participants did not record a response to the question at all. Participants each had their own interpretation of what types of learning processes they used during the study and how those could be subsequently incorporated into schools. Player 5 highlighted the creative nature of playing games like *Magic the Gathering* and how problems

generated by the game may need innovative, unconventional solutions. Critical thinking and problem-solving were identified by Player 6 as potential soft skills which were potentially transferable for students to real-world settings. Each noted the necessity of skill development in working with 21st century students.

### Data Analysis: Gameplay Data Sheet

The final form of data analysis used during this study was supplemental secondary coding of participant reflection submitted via complete Google Forms. Five participants took part in submitting their game outcomes, resulting in a total of 184 unique entries. Table 3.1 summarizes the results for the five players, including the format played, their win-loss record, and range of dates submitted.

**Table 3.2**

*Submitted Gameplay Data Summary*

| Player | Format | Win/Loss | Week(s) Submitted |
|---|---|---|---|
| 1 | Standard | 4 – 10 | 1 |
| 4 | Standard | 17 – 14 | 3 – 5 |
| 5 | Standard | 3 – 0 | 2 |
| 6 | Standard | 66 – 31 – 1 | 1 – 5 |
| | Draft | 9 – 1 | 3 – 4 |
| 7 | Standard | 18 -10 | 1 |
| | | 117 – 66 – 1 (64% Win Percentage) | |

174 of the submissions were games played in the Standard *Magic* format, 10 were draft games. Player 6 was able to complete two draft events, resulting in an exceptional record of nine wins, one loss. The group of participants went a combined 117-66-1, a total winning percentage

of 64%. This number was significantly higher than I expected of novice players and was primarily the results from the large number of submissions by Player 6, the most experienced player in the study. Player 6 submitted 108 unique entries or 58.6% of total entries. This player was more invested in the game of *Magic* prior to the study, and their additional participation suggests they plan to continue playing after the study. They were interested in recording the data for their own personal use, to reflect upon and make self-improvements to gameplay. I was generally disappointed in the number of submissions from other players; I had hoped to potentially have a sufficient number of games to make conclusions related to improvement over time during the study. Unfortunately, there just is not the data to support that.

Additionally, participants were asked to include brief comments and observations of the game in the final text field of the Google Form. This served as a third qualitative data source which could then be used for triangulation of data, improving validity of identified themes. Secondary coding was utilized to further align and identify emerging themes consistent with those which surfaced during focus group interviews and participant journals. Since these observations were recorded immediately after finishing the game, participants included more particulars and spontaneous commentary than during group interviews or participant journals. Reflections were typically short specific statements which summarized the generality of the game: “they were flooded”, “had bad draws”, “was a close battle”. Each player did adopt and employ vocabulary associated with the game of *Magic*, terms picked up during the interview process and used in-game were used in summarizing gameplay. Some entries demonstrated exceptionally deep understanding and reflection, ideas on deck modifications to solve a specific problem encountered in that specific game, and reflection on particular moments of the game where a different course of action may have resulted in victory. Post-game commentary was also

filled with emotional response to game play. These included feelings of anger towards opponent pace of play or deck construction, randomness of gameplay, mana screw or flood, and satisfaction of winning against the odds.

**Assurances of Confidentiality and Ethical Issues**

In alignment with focus group methodology, considerations were made regarding the confidentiality of participants and potential ethical issues which may arise during the course of the study. Effective focus groups rely on a certain comfort level between researcher and participants which encourages open discourse of interview questions (Liamputtong, 2011; Stewart & Shamdasani, 2015). Fortunately, the subject matter of this study, games-based learning via *Magic the Gathering*, held few potential repercussions. One potential effect which was specifically addressed by the researcher was the likely development of emotional response when engaging in competitive games-based settings. Participants were well aware of this potential risk because of their previous experience playing games. None felt it warranted additional precautions or safeguards. Prior to starting, the research design and plan was submitted through IRB at the local university for approval. No major concerns were identified.

Prior to the study, participants signed informed consent forms which addressed confidentiality and other potential concerns which may have surfaced during the six-week timeframe. Confidentiality and other ethical issues were discussed at length during the first focus group meeting, allowing participants an opportunity to ask questions for clarification and individual concerns. The researcher took steps to limit as many identifying markers to participant identification as possible, including the labeling of random pseudonym for names and the exclusion or anonymizing of personal information during the transcription process. It is likely that should participants read through this dissertation, as a group they may be able to deduce who

was which player, but any outside source would find it difficult to find enough information to surmise participant names. It was expected that participants would likely share their experience playing *Magic the Gathering* in an academic setting with peers. Participants were made aware of this potential disclosure but unanimously agreed it was not of major concern.

**Researcher Reflexivity, Subjectivities, and Trustworthiness**

During the course of the study, as a researcher I engaged in an on-going process of reflexivity, the critical self-reflection to identify potential dispositions and attitudes I may have towards the study. Johnson and Christensen (2014) note, "Researcher bias tends to result from selective observation and selective recording of information and also from allow one's personal view and perspectives to affect how data are interpreted and how the research is conducted." I recognize that I hold a general positive perspective of games-based learning and firmly believe the skills and process used in iterative gaming experiences hold potentially powerful learning possibilities. To address this potential subjectivity, I have included three different data collection methods which triangulated to support emerging themes. Data includes multiple layers of coding and analytic memoing which demonstrates researcher interpretation and understanding as it relates to the research questions posed. Furthermore, the primary purpose of this study was to explore the what is learned and how it is learned through gameplay. It does not necessarily measure the level of learning. Further studies will be necessary to determine the effectiveness of learning during iterative gameplay, especially comparted to traditional pedagogical methods.

Data triangulation was used to verify and improve the trustworthiness of analysis in this study. While qualitative studies do not attempt to glean absolute truths (Bhattacharya, 2017), they do invite multiple possibilities which are supported through data analysis of different collection methods. "The main purpose of using multi-methods in studies is the 'mutual

enhancement' that complements each method that is used. This is known as 'triangulation'" (Liamputtong, 2011, p. 93). In this manner, this study employed three different forms of data collection which were subsequently analyzed to determine similarities and differences between data sets. All three sources of data converged on similar themes, resulting in additional supporting evidence for their inclusion in final findings and results.

## Chapter Three Summary

In this chapter, methodology for the study was presented and discussed. Focus group methodology formed the foundation for qualitative research design. Site and participant selection were reviewed, including brief summaries of each participant's background in gaming and with playing *Magic the Gathering*. Next, I introduced three data collection methods utilized during the study: focus group interviews, participant journals, and data sheet collection. For each data collection method, I included summaries of how data analysis was employed, primarily through the use of initial and axial coding, analytic memoing, and triangulation of data results. Confidentiality and potential ethical issues for participants were included, highlighting the consent form participants were required to sign prior to participating. The chapter concludes by addressing potential researcher biases and data trustworthiness associate with the study.

# Chapter 4 - Findings and Discussion

During the course of data analysis, patterns emerged which suggested similar experiences and interpretations of learning for participants. These themes suggest a range of learning which occurs as players learn a new game, in this instance, *Magic the Gathering*. Firstly, players are required to learn about the game itself – the game objective, how it mechanically functions, what rules are employed, and how gameplay sequencing occurs. Secondly, if the game occurs in a social setting, players are required to understand what interactions can occur between players, what behaviors are acceptable during gameplay, how communication occurs between players, and ultimately, how does knowledge of your opponent improve your personal gameplay? These two aspects compose what I collectively will label as the *what is learned* during gameplay.

Additionally, this study sought to understand how individuals learn through playing a game over multiple playthroughs. This suggests skills and processes employed by players to make sense of the game mechanics, interactions, and settings. As players engage in the same gaming system multiple times, they begin to compartmentalize and interpret what the games presents, ultimately improving their individual performance because they better understand how the game works. These processes I label as the *how learning occurs* during gameplay. Finally, I have included a section labeled *why this learning is effective* which examines how games-based learning aligns with directly with constructivist learning models reviewed in Chapter 2.

## What is Learned During Iterative Gameplay?

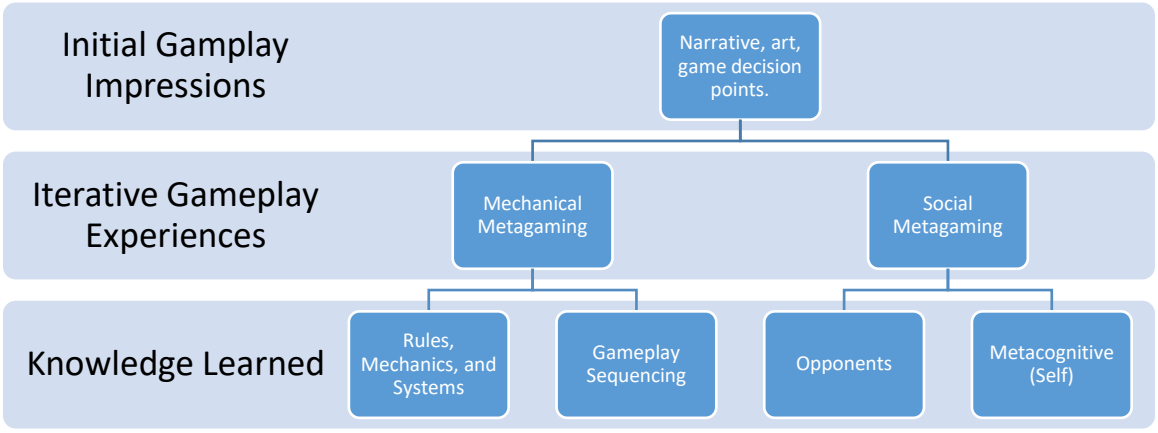
When learning a game for the first time, players are first required to understand the rules and systems employed during gameplay. This is effectively what makes a game, the required interaction between player and system. In many ways, these fundamental aspects serve as the *content* of the game, that is, the pieces of knowledge required by players to play and succeed (see

Figure 4.1). Awareness and understanding of game mechanics and systems allowed the participants to modify and customize their approach to play, which I categorize as *Mechanical Metagaming*. Participants looked beyond individual moments in gameplay and took a meta-perspective to approaching play.

Additionally, *Magic the Gathering* required participants to interact and interpret opponent play. In this manner, the game takes on a social element. To be successful, players must not only consider the best mechanical approach, but also determine the potential interactions and responses from their opponent. This knowledge is learned through social interactions, which I label as *Social Metagaming*. The focus group setting of this study permitted participants the opportunity to intimately interact with opponents, allowing them to come make conclusions about opponent deck construction, bluffing, and likely decision points. Additionally, there was an element of self-reflection and awareness discovered during the six-week study.

**Figure 4.1**

*Knowledge Learned Through Iterative Gameplay*



## Mechanical Metagaming

As participants interacted with game systems through multiple playthroughs, they began to identify and evaluate mechanics. I identify this aspect of the content as *Mechanical Metagaming*, or the learning which occurs when a player interacts directly with the game. After the player has garnered fundamental knowledge of the game of how the game works, the player is able to manipulate game rules, mechanics, systems, and processes to improve performance and success chance. This required participants to engage in meta-level analysis and synthesis of gameplay mechanics and sequencing. With this information, participants improved their personal gameplay and deck construction. Player 8 noted during the last focus group interview, "I didn't know that each deck has its own attributes, which it makes sense now… I didn't know about that necessarily, it makes sense now but before that I was just like, 'All these cards are going to be about same; they just have different colors depending on your preference.' But it definitely applies to different play types, so that was kind of nice." By the end of the study, participants constructed more powerful individualized decks, demonstrated awareness of potential cards opponents may play, and sequenced their gameplay decisions more efficiently.

### Knowledge of Game Rules, Mechanics, and Systems

Early in the study, participants were primarily concerned with learning and understanding the rules employed in *Magic the Gathering*. Participants shared that it was important not to be overwhelmed when learning rules for the first time. The paper rulebook for *Magic the Gathering* is 242 pages long and includes rulesets for multiple play variants. Fortunately, *Magic the Gathering Arena* has a tutorial program designed specifically for new players. The tutorial walked participants through specific rules interaction, requiring them to make the right choice before moving on to more complex mechanics. A few participants found the tutorial taxing,

noting it required mindless behavior. Player 8 commented, “So you're like playing it ten different times. When you're about to do something really stupid they're like, "Do you really want to do that?" Player 5 noted in their participant journal the value of the tutorial in teaching skills which are not directly apparent:

> I am not usually thinking about what may be coming up next and as a result I would have lost a game in the tutorial. It forced me to wait and draw another card which allowed me to draw the right card. While scripted I believe this is a valuable lesson learned. Be aware of the cards that you have in your deck alongside the ones in play.

*Magic the Gathering* is an extremely complex game; even after learning basic rules and interactions, the game continues to evolve as new card sets are released, usually every three months. Even Player 6, a veteran player who had years of experience, mentioned learning new mechanics during our second focus group: “I've played it for years now and I'm still learning new stuff. It was just yesterday or the day before I learned a whole new interaction with a card in my deck that I didn't know about.”

After finishing the tutorial program, the *Arena* client game participants the option to play against players or the artificial intelligent (AI) bot. Matches against the AI allowed participants to play more slowly, giving them the opportunity to consider other lines of play and forecast potential outcomes of choices. Player 8 commented in the second focus group interview:

> I was able to think about my moves a lot more without risking, like, ‘Oh if I escape this turn then they're going to demolish me’ which a lot happened with like the player games. Where I was like, ‘Oh I kind of want to use this but I better save it in case something happens.’ It was like very low stress.

As participants experienced more and more games against the bot, they began to notice similarities in deck compositions and play choice. This suggests additional meta-level analysis and synthesis, in this instance, recognizing the potential scripted play from an AI opponent. Player 8 hypothesized in their participant journal the potential cards in the bot's deck, "The bot Sparky always pacifies my flying monsters too as there is an abundance of those in the bot deck." Player 6 made game decisions based on observations of previous games against the AI, "Because I could predict how Sparky was going to block my attacks. The majority of the time Sparky blocks, so I would just swing in with like a deathtouch to where, you know, block with a 6/6, I swing in with a 1/1 your 6/6 still dies. So, it just felt very predictable."

Participants even realized the bot scripting could be manipulated, allowing them the opportunity to *farm* their daily quest rewards with little to no effort. Player 6 noted in focus group interview 2 that they found a short-cut around the monotony or repeated gameplay,

> Yeah, to start the unlock process you have to, I would say beat the bot, but you don't beat the bot. I found out that if you just play the bot and then immediately concede in your opening hand before you choose to keep or mulligan, you get the mastery orb for that color.

Participants also discovered there were limits to the AI in tutorial modes, likely to assist newer players in winning. During the third focus group interview, Player 6 mentioned outside of the study that Player 4 had described the bot's play as "bad". Player 4 followed up clarifying, "Oh, I had a counter of one hundred, no it was sixty-four thousand. Sixty-four thousand. I was playing the bot so that I could like get my daily done, which was like cast red spells or something like that, and so I prolonged it excessively." Player 5 used their working knowledge of how the bot

worked to experiment with pushing the game system to its limits, noting they received a warning to stop from the game:

> I got the warning to stop because I just sat there, and it like, gave up, it straight up gave up after a while. It summoned a monster and it couldn't attack with it, so I'm like, "Wow it really has given up." I went against the AI, it didn't summon a single card after that. So, I'm just like, "How far can I make this go?" So, I just kept drawing cards, and I had an engine going. I kept stacking counters and counters and counters. I think by the end of it, when I had to like finish the game, there was a like six-hundred or so life difference between me and the AI. But yeah, eventually it was like, "If you take this action one more time, the game will end in a draw." And I'm like, "All that for nothing?" The game told me that if I kept going on, and I still had cards chaining off each other, so I'm like, "Did I just sit here for like twenty minutes, doing nothing?"

Using a digital platform also meant players were able to get in significantly more games than if they were learning via paper *Magic*. Participants believed the more games and experiences they had with the cards, the better their learning. Pace of play is a major factor for Player 6, who noted during the second focus group interview, "In Arena, the games, for the most part, quicker paced because you're not physically step-by-step walk through the motions. For the most part it does that for you. It is a lot faster, until you run into the opponents that run out the timer." This suggests direct experience was a major element in learning.

The user interface of the program presented some learning opportunities of its own. Additional information about player decks can be found, including statistical analysis of its composition, mana ratios, and curve. Players realized they could cut cards from their decks, trimming them down to the minimum requirement of sixty. *Arena* also employs unique systems

which allow players to craft new cards, both free and paid currency systems, ranking structures, and server run events which allow players a more competitive environment. Players learned to navigate the program and these systems primarily through discovery and peer collaboration. Overall, participants agreed that the digital format did an exceptional job of translating rules and presenting gameplay. Player 3 noted in the second focus group meeting, "It's so much better with the digital stuff because it's keeping track of everything. On the physical, you have to remember everything. At the end of every physical game, we just argue about, just what happened. Whereas Arena, it's fantastic because it does everything for you."

When shifting to paper *Magic*, participants were forced to adapt their playstyles to that setting which required learning new forms of communication specifically derived for trading card games like *Magic the Gathering*. Much of the game which was automated now required player interaction: shuffling of decks, announcement of triggers, resolution of interactions. Players learned how to communicate game states with paper cards often through social negotiation with their opponent. For example, during the final focus group session gameplay, Players 6 and 8 quickly discussed the concept of tapping.

**Player 8:** What does tapping it do?

**Player 6:** It's just, it signifying it attacks.

**Player 8:** Oh, okay.

**Player 6:** Because it doesn't have vigilance it's tapped.

In many regards, the game produced its own language and methods which participants were familiar with because of their interactions with the game itself.

Player 3 shared they arrange their paper *Magic* setup based on their years of experience playing *Yu-Gi-Oh!*, suggesting potential carryover between similar games in a genre. Player 4

made connections to a previously played card game, noting in their participant journal, “I’m definitely liking the game, I didn’t realize just how similar it was going to be to *Hearthstone*.” The conceptualization of shuffling was a unique discussion topic. In paper *Magic*, Player 6 believed it directly impacted game events, particularly noting, “that over-shuffling or under-shuffling causes mana pockets like that and it's a problem.” They also observed the possibility that mana issues occurred more during play on the digital platform, as though the computer program had a glitch and did not truly randomize player decks. Responding to the potential mana conspiracy suggested by the more experienced player, Player 5 remarked, “I didn't experience mana flooding in Arena as much but I would be kind of frustrated if it was a machine, because it could still give it to me random but...” This is likely due to the larger sample size of games played on *Arena* compared to paper *Magic*. It seems to happen more often because games are played more quickly. Again, these observations suggest the development of knowledge which bridges beyond individual games to a working understanding of the entire game system.

Participants identified the primary mechanics used in a game of *Magic the Gathering* early on. Some compared it other similar games they had previously played. In our second focus group meeting, Player 8 recognized “…the land mechanic acts sort of like a currency. I just think that's defining in a way because you don't get that in, like, *Yu-Gi-Oh*.” It was not until after they had logged more games, however, that they began to realize how those mechanics actually functioned.

**Application of Game Knowledge**

One of the primary evolutions in participant learning during the course of the study was how each player interpreted and evaluated cards. Card evaluation and deckbuilding requires players to have extensive working knowledge of the game. In terms of *Magic the Gathering*, this

includes familiarity of available cards, awareness of potential interactions and mechanics which could serve as a functioning strategy, sequencing of gameplay which maximizes card effect, and how to construct a deck which consistently produces hands with a mix of mana and spells. This suggests an ongoing developmental process in understanding how the game functions both on an immediate and meta level.

As participants unlocked additional cards for the preconstructed starter decks, the were able to modify and personalize their decks. Initially, some participants were drawn to big, expensive, flashy cards. Other players were drawn to the mechanics of the card and how it synergized with existing cards in their deck. Player 7 noted,

> I was able to look and see what were the best cards, I guess I would say. And I like the mix of having cards that one, can't actually die. Two, will bring cards I like back. And then three, have enough power to destroy something else or knock up the power of something I have as well.

This level of reflection demonstrates a deep-level of understanding, synthesis, and analysis during card evaluation. After obtaining new cards, Player 7 shared they always test them out against the bot first to assist in learning how they function.

Early in the study, participants were drawn towards cards which they identified as powerful. In this regard, players associated power level of the card on an individual basis, without considerations for how it functioned with other cards around it. From a design perspective, *Magic the Gathering* attempts to use signpost cards to assist players in identifying potential synergies and deckbuilding strategies. Participants quickly became aware of *card rarity*, an assigned value by the designers designating how often the card is found in physical *Magic* packs. Card rarity is visually distinguishable on card set symbols: black for common,

silver for uncommon, gold for rare, and orange for mythic rare. Initially players associated power level directly to card rarity. Player 6 remarked during the final focus group their strategy for building a deck from their pool of paper *Magic* cards came directly from reading the individual card. “Honestly, I have no idea. I was like, ‘This card's good, we're just going to put it in here.’ I mean, there's a lot this stuff for mana, make it bigger.” The two cards which started their deck building process were both rare cards which offered unique effects. This demonstrates that even with Player 6’s history with the game of *Magic*, if cards are unfamiliar, players may start deckbuilding based on card rarity. If they had more familiarity with the cards, they likely would have constructed their deck differently. As it was, however, they started this process by simply interpreting and identifying which cards were independently powerful in a vacuum.

After finishing some games, some participants began to realize the importance of synergy between cards in their deck. Synergy is the positive relationships between cards via game mechanics. *Magic* has a wide range of keywords, triggering mechanics, and interactions which allow for deck synergy to be exist. Instead of being powerful on an individual level, the card instead is powerful given the cards around it. Depending on player preference, a deck can contain a variety of different synergies, each potentially excelling in a specific situation or matchup. Player 5 made this association early in focus group session 2 commenting, “I created an all-knight deck and I just stacked it full of knights. And it wasn't very good because they are related, but they don't all do the same thing, so you couldn't get reliable synergies going.”

Furthermore, players viewed certain mechanics as superior to others based on initial gameplay with preconstructed decks. Player 6, the most experienced player, noted after playing the tutorial,

> “I mean, your life total is probably the most important resource. I've been playing a life gain [inaudible] and I've noticed once you start gaining life, for the most part, your opponent just can't do anything about it. You get up to forty, and at that point they're just like, ‘Well’. Because I know that's how I feel. Opponent gets to 40 and I'm just like, ‘I'm going to concede.’ I can't outrun it. You're going to have to swing all in and then they're just going to kill you.”

Many participants noted life gain as a powerful mechanic. During the gameplay tournament portion of focus group meeting 3, four of the eight participants built decks designed around life gain, including the player who went undefeated during play. Player 4, who played a different deck, noted, “Gosh, you guys are all running the exact same deck. Everybody in this room has the same deck.” It can be assumed then that new players are drawn to life gain mechanics because they view life total as the most important resources in the game of *Magic*. Historically, more experienced players avoid life gain strategies because they do not have the same value as card draw, mana ramp, or other game mechanics. Additionally, seven of the eight players played black as one of their deck colors, suggesting they value being able to remove creatures.

*Magic the Gathering* is challenging because it provides the opportunity for many decision points during the course of a single game. Each of these decision points requires careful consideration by the player in determining the best potential line. The first major choice participants were confronted with was the option to keep or mulligan their starting hands. At the start of a game, Player 5 debated whether they should keep their hand. Their opponent, Player 6, offered their personal opinion on approaching on mulligans, suggesting “Usually, if you have to question it you don't want to keep it. That's my rule of thumb, anyways.” This decision point has a sizeable cost; the player is required to put a card on the bottom on their deck for each mulligan

they have taken, resulting in less cards available at the start of game play. Evaluating opportunity cost of decision making is vitally inherent in games of *Magic*.

Additionally, *Magic* presents the player with a large number of variables which potentially influence the choice. For example, consider this exchange of potential lines of play which occurred during the focus group session 3 tournament:

> **Player 6:** You won solely because I wanted to keep the 1/1 alive. I didn't even realize that, yep. They won [Player 8]. I didn't throw the 1/1 in front of the 4/5 because I wanted to attack with it but I didn't catch that I had to block.
>
> **Player 8:** It wouldn't have blocked, I would have murdered it.
>
> **Player 6:** No, if you would have shocked the 1/1 I would have been dead even if did that.
>
> **Interviewer:** Actually, here, you could Shock his face. They were at two life and you can cast, Shock can hit any target including them. So, you could have just Shocked their face.
>
> **Player 6:** I didn't even think about that, too.

Each individual interpreted the decision point through their own lens, determining which potential line of gameplay they would have taken. In the end, all four proposed plays resulted in the same conclusion, victory.

By the end of the study, participants effectively learned to value *Magic* cards differently. They viewed them as are more than the art depicted, game mechanics employed, and rarity level issued. Participants procedurally developed a meta-level consciousness of evaluating cards, synergizing deckbuilding, and maximizing gameplay choices. This knowledge was learned through repeated experience with the gaming environment, allowing players to experiment and discover personal understanding of how the game works. Furthermore, players commented on

the value of cards during focus group sessions, suggesting that in paper *Magic* settings, the financial value of cards is also weighed in determining their overarching value.

**Social Metagaming**

In addition to interacting with the game, participants also interacted with each other and opponents while playing *Magic*. Social metagaming is the knowledge of opponents, teammates, and the local setting where gameplay occurs. It develops when players engage in repeated game play sessions within the same environment. For our purposes, the eight participants formed their own unique *local* metagame group. Each participant influenced that metagame based on their deck building decisions and personality. On a larger scale, a *global* metagame exists around the digital players on *Magic the Gathering Arena*. Larger social metagames vary depending on its members; what is popular amongst bronze-ranked players may not be prevalent in gold-ranked settings. As players interact with opponents and peers in these social settings, they learn about their opponent personality and game preferences.

As gameplay occurred, participants began to inquire into opponent deck selection in an attempt to hypothesize what cards or strategies they sought to employ. This constitutes what I will label the local social metagame: the conceptualization of the group's overarching approach to game play composed of participant's personality, strategies, and deck preferences. To succeed in complex, competitive card games such as *Magic*, player success is dependent on how well a player can anticipate opponent gameplay choices. Currently in the standard *Magic* format, there exists 2,133 legal cards, not including basic lands. Participants realized card power level depends on the setting, especially in comparison to the cards the opponent presents. Player 6 reflected in their participant journal, "Hard to deal with a deck that is playing 5 mana fliers for 2 mana

because they are able to cheat out creatures via other creatures. not [sic] a deck I [sic] have encountered often and therefore will not make a change to counter this deck."

Foundationally, the social metagame is derived collectively from player personality within the group. Understanding self as a player was an important first step in learning the game of *Magic* for participants. In reflecting on their approach to the game, Player 8 wrote in their participant journal, "I take a lot of risks and sacrifice monsters without thinking about the defense though." Player 7 was drawn to the red decks because of aesthetics, "I think I just like the red deck because all my characters are fire characters that I chose so I'm going to choose the fire deck." Player 6 noted their preferred strategy during deck building in focus group session 3, "I can tell that the true player in me has come out, though, in deckbuilding… I looked at the vampire, and I was like, 'I should build this as a sacrifice deck.' … My true roots are sacrifice, though." These personality backgrounds laid the foundation for the decks and strategies participants would use for the remainder of the study, which would largely influence the development of the local social metagame.

Participants naturally began to inquire into the local social metagame through evaluation of opponent deck lists in repeated game settings. The relative size of the study group allowed participants to gain intimate knowledge of each other, information which could then be used during deck construction and game decision points. This requires meta-level awareness not only of the mechanical aspect of the game, but also of the social setting where game play takes place. Player 5 demonstrated this process in their participant journal when constructing their deck for tournament play during focus group session 3,

> I also need to prepare for the other player who has played this game many times and I remember him mentioning his strategy is heavily front loaded. A healing deck may be a

> good counter to this, however I need to stay vigilant of cards that can help me in this, such as a Frost Lynx as it is small, synergizing well with the starter white deck and it, in conjunction with copies of itself are useful for stun locking an opponent.

Player 5 specifically identifies Player 6 as potentially the most intimidating opponent because of their previous experience with *Magic*. They then reflect on the types of deck this player prefers, citing aggressive strategies. Next, Player 5 identifies potential solutions to aggressive strategies which they have experienced in other game sessions. This procedural method proves successful, as Player 5 would go undefeated during the tournament.

Social metagames continue to evolve over the course of gameplay sessions. What may be effective approaches to deckbuilding one week may radically change by the next. In response to the success Player 5 had, Player 3 attempted to counter their strategy by modifying their own deck to include specific cards. “Blue is there because I know a lot of people, because I know Player 5 was going to be using that same concept as mine, so used blue as a way, to like, stop him from drawing more cards, or negating.” Coincidently, the success Player 5 had influenced other participant’s decks, which further legitimized the decision of Player 3 to modify their deck to counter that specific strategy. Player 4 noted the homogenization of decks negatively skewed the results for their deck choice, lamenting “It's over. Everybody is playing the deck that counters me. Every single person in this room is countering me so hard.” It is unfortunate the study did not go longer to potentially demonstrate the evolution of the local social metagame.

Knowledge and reflection of potential opponent deck composition also influenced decision processing during games. As participants became more aware of possible opponent reactions, their gameplay decisions changed. Player 8 developed this skill early in the study in games against the bot. In their participant journal, the wrote:

"I was nervous though because he was using the swamp deck, so I was prepared to have him murder or smite one of my high-level monsters. I used this knowledge to make sure I was keeping enough monsters on my field and reserving a few in case he demolished me. As part of the scripted program for learning, the AI plays primarily creature cards and removal to keep the gameplay straight forward for new players. Player 8 recognized this and made game decisions around the high likelihood that the bot opponent would have answers. This process required meta-level knowledge in attempt to forecast likely information on opponents.

Participants demonstrated this meta-level knowledge during gameplay portions of focus group meetings, especially during the tournament setup of the third focus group session. During gameplay, participants identified similarities between opponent's decks which influenced game decision making. Player 7 decided to deal with an opposing creature because "I kept hearing people talk about the cats, and I'm like, 'Oh, I must need to get rid of the cats.' because I played them last. I almost beat them, then they beat me…" Player 8 came to similar conclusions about the same card, *Ajani's Pridemate*. They immediately killed the creature as soon as it was cast, quipping "I don't fuck with Pridemates."

The disclosure of information was important to participants who sought to keep their deck lists and strategies secret from opponents. When playing online via *Magic the Gathering Arena* against either AI or players, concealing information is done automatically. There is no communication from which details can be potentially gathered. Games are randomly assigned and often against new opponents, so opponent deck lists were often complete secrets until certain cards may be played. As cards are played, potential similarities to previous games may arise which suggest to the player the potential contents of the opponent's deck. Participants believed

bluffing and deception was an important skill in face-to-face games, even when played on the digital platform. Player 5 described the role of bluffing during focus group session 3:

> I think that should be another element that needs to be taken into account. I was definitely bluffed by Player 8. Last time we played they totally bluffed me and it wouldn't have happened in a faceless game. I was just like, "There's nothing that they have, I know from looking at this." But they seem confident, maybe they do.

In this manner, concealment of self or discovery of opponent's information is a supplemental skill learned during game play. Player 5 commented, "So, I can share my deck at the end of today" near the close of focus group meeting 3's play session. This demonstrates a willingness to reveal their deck building decisions with peers, but only after competitive play had completed. Player 6 echoed enjoyment for this additional aspect of gameplay, "It's a whole lot easier to read bluffs when you can see the person's face. Even then, it doesn't work that well. Which is a whole lot more fun." In competitive games-based settings, players not only face decisions related to game processes, but also social perceptions.

Concealment of information is more important in in traditional settings of *Magic*, in which matches are determined by the best of three games. In between games, players are allowed to *sideboard*, that is, swap cards from their main deck with fifteen previously declared cards. This format requires players to make decisions about deckbuilding directly in response to what their opponent reveals. During focus group session 3, Player 6 commented on how this influenced their decision to not play cards during the first game:

> I was running a green-white deck last night. It was enchantment based, enchantment and enchantment creature based, so I had a spell in my hand that prevented all combat damage except by enchanted and enchantment creatures. I thought about playing it in the

first game, but decided against it because they get to sideboard, so they could have then played around it and added more enchantment creatures or enchantments. So, I held it my hand to keep the knowledge private.

This again demonstrates the development of meta-level awareness in playing games of *Magic*. Not only is the player concerned with and aware of the mechanical aspects of their own decks, but also how their opponent receives and interprets information which could be beneficial during game play.

Participants attempted to conceal information during face-to-face games which occurred in focus group meetings. Attempts to glean information of opponent's deck lists were a regular skill employed by players. Though the gameplay setting was competitive, attempted inquiries into opponent decks were generally friendly and collaborative. For example, in this conversation between players, the opponent attempts to extract information from Player 7:

**Player 6:** How do you feel about Bloodthirsty Aerialist?

**Player 7:** I love that card, personally.

**Player 5:** How many do you have in your deck?

**Player 7:** I'm not going to tell you. [laughter, friendly-tone]

Other methods of obtaining information about opponent decks were done during social conversation which occurred naturally during gameplay. Players inquired into how previous games had gone, and in doing so, asked specifically about the contents of opponent decks. This information was useful in preparing for future games, giving players a baseline idea of what strategy and cards their opponent was using. During focus group session 4, Player 8 asked Player 6 about what cards to expect from their opponent for the following round.

**Player 8:** So, does his deck, do they have artifacts and stuff?

**Player 6:** It's red-green artifacts.

**Player 8:** No artifacts?

**Player 6:** I don't know what theirs is. It didn't really, they drew a lot of land that is about all they did.

Some participants presented false commentary along with their gameplay in attempts to confuse opponent and muddle decision points. In a game against Player 8, Player 4 asked for clarification on Player 8's creatures, "Are those hexproof too? Both of them are hexproof?" From this line, Player 8 deduced their opponent had removal spells, remarking, "Now I know not to summon any creatures." The entire exchange was overhead by Player 6 who was observing the game. They deduced the question from Player 8 was purely deception, "They could be bluffing." These exchanges are common in games of *Magic*, where competitive players negotiate and interpret social interaction with opponents for additional information to improve gameplay decision making.

It should be noted, some participants were keenly aware of the existence of a metagame from previous gaming experiences. Player 4 particularly was interested in researching deck lists which are considered to be *meta-decks*, that is, decks which have statistically proven to perform well in the current format. This is called *net-decking*, a process that generally substitutes the natural learning, analysis, and synthesis which occurs during iterative game play. In their participant journal, Player 4 commented, "My latest endeavor was actually doing some internet research (as I typically do), and I found some really good cards to build with all the wild cards that I had built up." Instead of personally discovering effective strategies, the player instead begins with what is considered an effective solution and learns to play that specific deck.

Interestingly, the processes employed in researching and understanding via net-decking offers potential academic benefit.

## How Does Learning Occur During Iterative Gameplay?

In addition to the content learned during iterative gameplay, participants also observed a variety of skills which were employed in learning. One of these primary skills are critical thinking. Participants described a procedural method by which they identified problems, analyzed card information, synthesized available information for deck building and game decision points, and made ongoing evaluative determinations. Additionally, problem-solving was required by participants including employment of a certain level of awareness of mechanical metagaming in deckbuilding, anticipation of potential opponent deck composition via social metagaming, and the use of data-driven decision-making during game decision points and through gameplay sequencing. These skills can be classified via Bloom's Taxonomy as higher-order cognitive skills. They required participants to be actively involved in a reflective learning process through an inquiry-based approach to exploring the game, which I label as games-based inquiry. In this section, I describe how participants used these skills to make game and deck decisions, the procedural thinking which informed these decisions, and lastly, how these processes indicate participants utilized an inquiry-based approach to learning the game.

### Card Analysis and Deck Synthesis

Participants noted the importance of being able to correctly evaluate *Magic* cards for determining correct gameplay sequences and ultimately winning the game. Card analysis required players to have a solid foundational understanding of game rules, mechanics, and processes. When participants tried to engage in analysis before having this knowledge, they

struggled to incorporate and deduce meaningful conclusions during gameplay. Player 3 noted attempting to learn how to play and analyze card value was cognitively overwhelming:

> My problem was, my only experience was paper *Magic*, and paper *Magic* obviously you need to know everything, the triggers, the rules for each individual card. And so, that's one thing I definitely picked off on which made the game more fun me, because like playing Arena, everything is automatic for you. And so, playing off Arena with seeing all the rules and what happens with your abilities, what goes first, it's what probably helped me learn best. Be more focused on the rules more than the game.

Card power level and synergies were not always immediately clear for participants either. They required direct experience in the game setting to properly evaluate. Player 6 remarked during focus group session 3 they used a wildcard but didn't have the results they wanted even though the card was great against them, "Which is why I used my one mythic wildcard to put a god into my deck. That I've gotten to play once, and it did me no good. I just know it's really good because I hate playing against it." There simply were too many potential interactions they had not considered. Card power level and synergies fluctuated depending on timing, game board state, and opponent and player deck compositions.

Card analysis was an on-going developmental process. Some participants mentioned their perspective of a single card would swing drastically after single games. In some moments, the card is exactly what the player needs. In others, they card is useless. Player 8 quickly realized how specific wording on a card can drastically limit its potential targets, noting, "Does it [a card that specifically targets creatures with Defender] be one with defender? Gosh, I'm so screwed. Damn."

Additionally, participants identified the importance of being able to analyze game board state in setting up potential plays. Some cards provide additional benefits if played in a particular order. Others allowed players to setup future plays with added payoffs or increased power levels. Colloquially this is referred to as *finding lines*, that is, identifying the correct path or potential sequence to maximize game success chance. Player 6 reflected with their opponent after a game during focus group meeting 3, noting a singular game decision to play a card in a specific order enabled a follow-up play, which ultimately won the game, "Yeah. If I wouldn't have drawn the swamp, I couldn't have played the Citadel [Bolas' Citadel] playing the Dreadful Apathy because it was topdeck." This demonstrates a complex level of direct higher-order skill practice. Reading and evaluating game board states requires active analysis and synthesis of information from a variety of sources, including cards in hand, cards in opponent's hand, creatures and other permanents which are active, mana available, and potential card draws.

During the latter half of the study, participants engaged in personal deckbuilding in both digital and paper settings. Not only did deckbuilding require participants to have knowledge of individual cards, but to also synthesize how the cards would best fit in a sixty-card deck. Player 4 described the complexities of deckbuilding in *Magic* by describing their personally constructed *Arena* deck, which was built around a single card, *Fires of Invention*:

> I have three Fires of Invention... And I would honestly make a deck that has every color in it, because it doesn't matter what color you're playing. As long as you don't have to use a specific color, like your X cards, because if you're using an X card you can't use Fires of Invention. Yeah, you can't use it. If you have an X card you have to use your actual mana. So, I would stay away from those cards but I would straight up build a five, just so I could have everything.

The single card enabled Player 4 to play cards of any color, except it directly limited cards with variables in their casting cost, the X referred to in the passage above. After playing a few games with the deck, they realized there was another major limiting aspect to *Fires of Invention*, you can only play spells on your turn. In response to this, Player 4 has made deckbuilding choices that allow them to avoid this drawback:

> Exactly, a lot my blue is draws, is draw cards. And then I have some dispels just because I like having, like Negate and stuff. The only problem is if you use Fires of Invention, you can't use spells not on your turn. So, if I have a bunch of those in my hand, I need something to be able discard those.

During the focus group meeting 3 tournament, Player 4 made further reflections of their decks because the local social metagame was primarily filled with aggressive, fast decks. When playing outside of the study group online, Player 4 suggested they won 95% of games which took longer than ten minutes. When asked what changes they would make if playing against study participants the following week, Player 4 commented, "I would probably bring less spells but I don't use them as much as I used to and I just drastically, really, really, really badly need more small ones." This *Fires of Invention* example demonstrates a deep level of on-going deck analysis and synthesis, which in this case, revolved around a singular card or strategy.

With experience and familiarity, participants were able to deduce card mechanics and abilities through context clues such as card name, color, cost, and set which it was released in. Player 5 noted the increased difficulty in deck building because the cards came from different sets,

> …playing in Arena, you're playing with a bunch cards from the same set, so as I was playing that I noticed the Ajani's and I was like, 'Oh. This is all like working together.' I

> was able to look at, just from playing the tutorial, be like, 'I know how I could really use this system and make it work to my advantage.' Whereas it's just, when you have a bunch of cards that are like from all different sets, it makes it more like, "Okay...?"

This suggests within the game of *Magic* varying degrees of analysis synthesis is required depending on format and card pool. Player 5 liked the increased complexity of having a limited card pool from which to build their deck, remarking, "That's like the best combination of everyone is on the even playing field and you also get to try and experiment a bit more. You have to work through and build your deck. The deckbuilding aspect is something..." In this manner, even before games are actually played, the participant was presented with a *puzzle* which must first be solved during deckbuilding.

**Inquiry or Discovery Learning**

After forming a foundational level of knowledge about the game systems, participants described that they inquired into the systems in procedural method to deepen their understanding of how the game functions. This procedural approach aligned with traditional scientific method and allowed each participant to pursue learning through their own inquiries. Inquiry-based approaches to learning require learners to identify questions, hypothesize potential solutions, analyze data, synthesize test results, and reflect upon their successes or failures. This hands-on approach to learning was beneficial for Player 6, who commented at the final focus group meeting,

> I learn by doing. A lot of the way I learned to play *Magic*, is I'll play stuff, realize it wasn't the most opportune time or may not have been the best thing to do out of my hand and I'll just make mental notes of that for the following games. Each game is independent from its own, but usually the rule of thumb sticks.

Discovery methods of learning required participants to directly involve themselves with the content and systems of the game. Participants shared their experiences which depict a process of exploration, experimentation, and reflection. Player 6 described their exploration processes during focus group interview 4:

> I've been playing for several years, but this six-week study I've played more decks that are out of my comfort zone than I have in my entire life playing. It's honestly been a lot more enjoyable and I definitely understand the game a lot better. I get where the other decks come from. I still am going to stick with what I feel comfortable with, but I've definitely at least broadened my horizons.

After opening new cards, Player 5 experimented with a particularly powerful, expensive, rare dragon creature by including them in a variety of decks.

> In those decks I also got Drakuseth [referring to the *Magic* card Drakuseth, Maw of Flames] which wins games. I mean, I think it was, yeah, and that game [against Player 7] was heavily in my, well not heavily in my favor, but it was in my favor, and then Drakuseth just, I mean, he just crushed me. I've won, I could not count on two hands how many matches I've won because of that card. Like, that card turns the tide of battles. Yes, that is why I will probably never have a deck that doesn't have red. Just because that card is just too good dude, it's too good.

Player 8 reflected on game decision points in their participant journal, noting, “I usually go about destroying most of the stronger creatures on the field primarily, so when they placed a 2/3 monster down I used my “Murder” card to destroy it. I should have saved that card because soon I realized that I was drawing just lands with hardly a creature to defend myself.”

The discovery process is continual and required participants to not finalize conclusions because the nature of the game setting was continually evolving. After playing their very first game with the paper *Magic* decks in focus group meeting 4, Player 3 immediately began reflecting on their deckbuilding decisions, “I regret everything I’m making.” They had logged a total of one game turn before they began making these reflections and hypothesizing what potential changes would be necessary to improve the deck. Player 6 was the only participant who took interest in using a 3rd-party program to track statistical information of gameplay. This access to data proved beneficial for Player 6, who commented in the final focus group meeting, “…I downloaded that Untapped deal [3rd party program]. Seeing 2% before I draw any my cards like on my entire deck, it's like "Wow." And then you've got 40% chance to hit land, I needed that land.” The additional information was useful in making in-game decisions because it demonstrated the probability of specific game lines working.

**Discovery-based Deck Design Example (Player 4)**

Player 4 illustrated how they derived at their final digital deck, highlighting continuing reflection and discovery which occurred in a spiral-like method (see Spiral Learning, Chapter 2). Throughout the course of the study, Player 4 designed, modified, and refined their personal decks using information from a variety of different outlets (see Figure 4.2). These outlets included personal style and information discovered through research, personal experience, and gameplay reflection.

**Figure 4.2**

*Information Sources Employed in Player 4's Deck Refinement*


Early in the study they were unable to dedicate large amounts of time and commented that none of the preconstructed decks stood out. They reflected in their participant journal, "I will admit, there was never a time that I disliked this game, but it just hadn't quite captured me yet, until yesterday. I've played about 8 hours in the last 28 or so hours." This change in approach was immediate after Player 4 personally constructed their own decks instead of copying meta-decks found on the internet.

They determined which cards were powerful from the additional packs they opened after focus group meeting 2. Player 4's card evaluation was rooted in previous gameplay. They mentally assigned values to certain mechanics, interactions, and synergies. Player 4 personally valued powerful game-winning cards, counter magic, and ways to prevent your opponent from interacting with your creatures. As a result, they built a red-green deck which "a couple of big

time cards (Drakuseth, Gorgos, and Questing Beast) that win me games late". Additionally, they built a red-blue deck because they "…really liked the blue deck and how many counterspells it had and how many flying creatures it had, but I feel like I just have to play red decks when Drakuseth wins me so many games."

Player 4 experimented with both of their personally constructed decks against online opponents via *Magic the Gathering Arena*. During gameplay, they noted which cards opponents played which were particularly powerful against them. Player 4 shared how one card specifically stood out in their participant journal:

> I just recently got a really dope enchantment card that adds a +1/+1 counter when it is summoned and then every round it doubles the current enchantment on it… This card, when used right is awesome, and the effects stack… I found this card actually in a game where it was used against me and a player amassed a 167/167 creature using that card and a (something) tentacle that added a counter every time he drew a card.

Player 4 later incorporated that card into their own decks, using the information discovered during the course of actual gameplay. The result was a blending of their two previous decks, incorporating both strategies.

In their final reflection, Player 4 noted the additional inclusion of cards identified from internet research on meta-decks to incorporate into their deck. They reflected,

> I ended up building a lot of these cards and ended up putting them in my RBG [red-black-green] deck and it's actually a lot better now. I'm winning a lot more games and I've got some good cards. It's actually a pretty big deck, I'm running about 90-95 cards at a given time with this deck, but it seems to be doing okay."

They used their wildcards on the *Arena* client to directly craft the cards they wanted, unlike other participants who were worried about using them. Through both internal and external metagaming, Player 4 was able to refine their deck, improving their success during games.

**Inquiry-based Analysis, Synthesis, and Design Example (Player 5)**

Player 5 detailed their inquiry-based approach to deckbuilding at length in both focus group interviews and their participant journal. This participant had only brief previous experience with the game of *Magic*, but quickly became regarded as the player to beat by other participants. After playing games during the second focus group session with middling success, Player 5 reflected, "…the biggest thing that I've learned from this whole couple weeks of games is every card needs to have a purpose. Because before I was just kind of like, 'Oh, I'll just throw knights in. That's cool, I like knights.'" In this manner, they identified a problem with their deck and hypothesized a potential solution. Player 5 believed they could improve the performance of the deck by setting the aesthetic flavor of cards aside and building to maximize synergy.

Player 5 noted in their participant journal, "Obviously every card needs to synergize and work together to be competitive". Their deck had some basic synergies, but there were multiple synergies present with little overlap between them. Player 5 noted, "Because there was a disconnect between these two types, the full capacity of strength for my deck was altogether smaller than it could be if i [sic] had taken more copies of some cards that worked in a similar fashion."

Player 5 collected and analyzed data during gameplay sessions against both online opponents and other participants. The following passage was shared by Player 5 during the debriefing portion of focus group interview 3. It demonstrates the ongoing nature of analysis and synthesis required by participant in making final determinations in upgrading their deck lists:

> So, the first game that we played, the first series of games that we played, I knew what I had was really strong, but I also took, what I saw in Player 6's is that it was trying to do multiple things. So, I was like, "Okay, I need to not do anything but this one thing." And so my entire goal of going into rebuilding the deck from the last time, was just pure monsters, and anything that was lifelink, or could be life, that drains life, gives life, and I kind of combined that into an engine I had, Dawn of Hope, which gives you, every time you gain life, you can spend two to draw a card. Or just as like as a regular, you can spend four mana to summon a 1/1 lifelink. So, I combined that with the whole Ajani's Pridemate, Bloodthirsty Aerialist, and yeah, that's the whole engine there, just building on those guys.

Player 5 identified which primary synergy they wished to build upon and set out to make a deck that could function as an *engine* providing reoccurring value to gameplay. Refining their synergy allowed the deck to be more consistent, reducing the potential impact of elements of randomness and luck in games.

Through their inquiry-based approach, Player 5 was able to deduce which cards best aligned with their principle synergy, aggressive creatures which increase in power via the life gain mechanic. They did consider adding creatures with flying, but noted it resulted in an increased mana cost, making the deck slower. This awareness demonstrates how knowledge of mechanical metagaming influenced deckbuilding choices. As an alternative to fliers, Player 5, “decided my solution is more ‘foder’ [sic]”. Additionally, they cut expensive, rare cards from their deck in an attempt to lower the average mana cost of spells.

Player 5 also refined the creature-to-spell ratio of their deck in calibrating their overarching deckbuilding strategy. Instead of playing cards which were non-creature, they

replaced them with cheap creatures with lifelink. In this way, they still had the pay-off interactions of gaining life with the added benefit of the creature being on the board to deal damage to the opponent. They finalized their approach in their participant journal, stating:

> My win condition then is flooding the field with monsters that do nothing but heal me and overwhelm my enemy, alongside this is ajanis pridemate [sic] and Bloodthirsty Aerialist that can stake from all of this. My deck now has the most expensive card being the Aerialist at 3 mana. Hopefully this deck will perform a bit more to my liking.

All of the thought and consideration done by Player 5 paid off, as they went undefeated during the tournament of focus group session 3. Throughout those games, other participants asked Player 5 what cards their deck played, how they designed their deck, and why it was better than the three other similar decks. The level of cognition employed by Player 5 demonstrates the potential power of a school curriculum designed around a games-based approach to inquiry.

### Inquiry-based Deckbuilding with Paper *Magic* Cards (Player 5)

Towards the end of the study, participants were given the opportunity to build paper *Magic* deck from a limited pool of cards. This required participants to do an extra level of card analysis and deck synthesis because the 145 cards in their pools were mostly unknown. Their card pools consisted of cards from a variety of sets, meaning there was no overarching mechanic or strategy readily identifiable. As participants reviewed cards, they attempted to find potential synergies between them. Most participants decided to run cards based on their inherent power level, that is, cards that are strong on their own. Participants noted the importance of balancing creatures and spells with mana cost restrictions. Although these were new cards for the players, many reverted back to their preferred colors and strategies. Being somewhat comfortable with how the strategy worked replaced the potential power increase in unfamiliar cards.

Player 5 provided a procedural example of how they went about inquiring into deckbuilding from their paper *Magic* pool. Player 5's personal approach to *Magic the Gathering* is designing decks around synergistic strategies and tried to identify a mechanic to build around. They commented that they lacked enough good cards in any two colors to make a true two-colored deck. They then turned their attention to artifact (cards with no color association typically) synergy. After pulling potential cards which aligned with artifacts, but quickly lost track of how many cards they had. In Player 5's participant journal they commented, "Because I kind of got lost and looking back, keeping these notes really only confused me because i [sic] would forget to update them. i [sic] went for a more visual approach on my second attempt." Player 5 sorted them physically via mana cost on a table, as seen below in Figure 4.3:

**Figure 4.3**

*Player 5's System for Deckbuilding with Paper Magic Cards*

*Note*. Cards are organized by converted mana cost (CMC) to demonstrate when they are likely to be played.

By sorting the cards in this method, Player 5 was able to see the potential costs of their entire deck. In this manner, the game allowed them to employ their preferred learning style during inquiry. They noted that mana cost is a significant resource which players need to balance and manage for games to be played fluidly. Player 5 then began to trim the deck down to thirty-six cards, the generic total without land in a sixty-card deck. They quickly realized certain colors could be cut, leaving only red-green artifacts. They reflected in their participant journal, "…there was a lot more synergy between green, red, and artifacts through out my deck so it just made sense. No need for a bunch of extra colors."

After making final cuts, Player 5 noted one last potential difficulty for their deck, there were not enough creatures. To synergize, many of the artifacts Player 5 had elected to keep in the deck required creatures to be utilized. Additionally, the creatures were typically expensive in mana-cost. "The solution i [sic] found was adding many spells that would bulk up my smaller monsters, and later serve to bulk up my larger creatures." By adding cheap spells which powered up their smaller creatures, Player 5 believed they could live long enough to play the bigger creatures. The reflected after playing a game in their participant journal, noting, "This work perfectly in my first game with [Player 3], where i [sic] was able to use my enchantments to create a fairly cheap and early threat that he could not counter." They concluded the choices they made during deck-building assisted in making the deck more functional and powerful. "I feel like artifacts were a good adhesive to my deck. Without the artifacts my deck would just be a bunch of different red and green cards mashed together."

## Why is Learning Effective During Iterative Gameplay?

In making considerations for the potential inclusion of a games-based approach to inquiry in classrooms, it is important to understand why learning is effective in such settings. During

focus group interviews and in their journals, participants shared why they thought the structure of the study was beneficial to their learning of the game of *Magic the Gathering*. For most, it was their first experience playing *Magic* in a group setting on a regular basis. Coding revealed the game allowed for a highly personalized experience, enhanced learning through social contextualization within a non-hostile environment and elicited emotional response to gameplay moments. Coincidently, these reflections from participants align with constructivist learning theories discussed in Chapter 2. Additionally, participants shared their final reflections on the potential curricular and pedagogical implications of the study, which are included at the end of this section.

### Highly Personalized Experience

*Magic the Gathering* as a game system is complex and diverse enough to allow for different approaches for successful gameplay. The variety of different formats allow players to play competitively, cooperatively, or collaboratively with the same cards and rules systems. Individual players can find purpose and satisfaction in approaching the game in their own ways. Some participants identified themselves as competitive, with their primary goal to defeat other participants. Other participants found satisfaction in going through game processes, building decks, and socializing with peers. In games like *Magic*, there are no definitive right answers to deckbuilding or game decisions. This array of potential interactions and learning opportunities are unique in games and what really enables deep, personal inquiry. Each participant shared their own unique experiences with the game system, demonstrating what and why they were drawn to studying the game of *Magic*. In general, participants were engaged with gameplay because they found it intellectually stimulating, socially engaging, and unpredictable.

#### Player 1

Unfortunately, Player 1 did not have much of an opportunity to engage with the game. This participant logged the least amount of time of game play because of outside commitments, but still found pleasure in the social aspect of the game. Player 1 uniquely sought learning opportunities through direct social interaction with other players. They noted, "Played some more but need more experience and some more explanation because the tutorial didn't do a good job at explaining the game to me." Their unique relationship with Player 7 as roommates allowed them to play together outside of the study. This social aspect of game play strengthened their personal willingness to learn the game deeper. Additionally, it seemed as though their relationship could improve or be highlighted through *Magic*, that is, the shared memory of playing with one another. In their participant journal, they reflected, "[Player 7] helped me make a better deck and i [sic] feel comfortable with the deck and cant [sic] wait to play with it more." Even though they were unable to play as much as they wanted, Player 1 did begin to identify and inquire into game mechanics, noting synergy of the lifegain deck, "Yeah. I could take the, like the vampire that like takes you health from my opponent, brings it to me, and I get other [inaudible] and brings more health, it really meshes together well."

**Player 3**

Player 3 approached the study from a light-hearted, friendly, fun-oriented stance. Their primary goal was to learn rules interaction to improve their ability to play games of *Magic* in paper form outside of the study. They remarked that they enjoyed the Commander format of *Magic*, a multiplayer format where each player plays for themselves. Politicking other players is required in this format, forming alliances, and evaluating personal stance in a complex board. From a strategic perspective, Player 3 identified a deckbuilding approach which enhanced a single creature through enchantments. In the second focus group meeting, they shared they

included the color green because, "…they have a lot of spells that can enhance your ability." This was a unique approach; they were the only player to really attempt to incorporate this strategy into their *Magic* decks. After seeing the success of Player 5 with the white-black life gain deck, they switched to that strategy but did not have success. In reflection, they noted, "We battle each other with our own custom decks. I lost all 5 times till 1 win… I need to work on deck more." Player 3 highlighted the importance of social interaction with opponents as being their primary reason for play. Though more competitive than Player 1, Player 3 maintained a positive collaborative approach to learning with other players. They were the most complimentary player of the group, acknowledging game decisions made by opponents. During the course of a single game in focus group meeting 4, Player 3 remarked to their opponent, "Whew, beautiful play." and "Well done, I can't block it [opponent's enchanted creature]." In all game play sessions, Player 3 struggled to win games but still found satisfaction in playing the game.

**Player 4**

The thematic setting of *Magic the Gathering* was an important pulling factor for Player 4. Their familiarity with fantasy settings was welcoming and provided additional associations beyond the bounds of the game. In their participant journal they wrote:

> I like the world, I didn't realize until our last meeting that MTG was created by WotC [Wizards of the Coast], so it is very D&D [Dungeons and Dragons] related which I like quite a bit. The monsters align with something that I'm very familiar with and that adds a level of interest for me.

Player 4 primarily approached learning the game of *Magic* in ascertaining which strategy and combination of cards resulted in the most powerful decks. Complexity of the game was also an

important selling point for Player 4, who noted, in their participant journal, “Typically games that are more complex are more of a pain to learn, but once you learn them, they are usually better.” Game mechanics, processes, and rules allowed Player 4 to deeply explore those systems, which the participant found rewarding.

After finishing the tutorial, Player 4 used their previous experience with other games to use the internet to find meta-decks. This was a unique approach compared to other participants and demonstrated Player 4 was intensely competitive. Additionally, Player 4 enjoyed the deckbuilding process through discovery. They employed external metagaming strategies to seek data-driven deck lists which had a history of performing well in the format. Player 4 incorporated internal metagaming strategies, reflecting on cards opponents utilized which offered potential upgrades to their own deck. These processes were described at length in the previous section. While in conversation during a game in focus group meeting 3, Player 6 noted to Player 4, “There’s a whole meta-deck built around it [Fires of Invention].” Player 4 replied, “Yeah, I know. That’s a card because I researched. And I build nice things.” Consequently, this aligned with their content approach in as a secondary education science major.

**Player 5**

Designing and employing a game engine was the primary motivation for deckbuilding for Player 5. This represented a fundamental shift from how they had previously approached the game of *Magic*. They reflected in their participant journal, “I used to build decks for aesthetics, attempting to keep them all one type. Cards would be similar but lack total unity.” Player 5 was able to incorporate a deep inquiry-based approach in learning the game systems with the ultimate goal of designing a powerful deck from those mechanics. Compared to other participants, Player 6 approached *Magic* as more of a puzzle to be solved than a singular instance of gameplay. After

identifying power mechanics, Player 6 focused on minimizing and maximizing those interactions. “Deck synergy can take out the random aspect of the game. Statistically I am more likely to draw cards that I need because they all serve the same function.” Comparatively, Player 5 seemed less interested in individual game results as they were with refining and fine-tuning their deck list. They found deep satisfaction in the design process.

**Player 6**

As the most experienced player in the study, Player 6 began with an unparalleled knowledge and familiarity of the *Magic the Gathering* game system. In this regard, Player 6 was not primarily concerned with learning the game or the novelties of the program. Instead, their primary goal during the course of the study was to engage in the game setting with peers. Player 6 entered the study already deeply enjoying the game. Unfortunately, the local game store had closed and finding people to play with was difficult. During the final focus group meeting, Player 6 commented on why more players do not play in the area:

> I think that's what a lot of people run into issue-wise because there's, for whatever reason, a negative stigma to just pull out a sixty-card deck and play in public. That's why my cards have been at home this entire time because, I don't really, I didn't really know anybody that played, now I do. And plus, it's a whole lot easier on here [Arena].

This study offered them the opportunity to log a significant number of games and potentially find an ongoing play group for when the study finished.

**Player 7**

From the start of the study, Player 7 described themselves as primarily a competitive player who enjoyed defeating opponents. They took aggressive game play lines and enjoyed attacking. In focus group meeting 3 they commented, “I just love that "oof" [sound from hitting

opponent].” Player 7 found great satisfaction in being able to respond positively to opponent game decisions. They were particularly drawn to being able to interact with opponents, and as such, approached deckbuilding primarily concerned with cards which served as creature removal or enabled graveyard recursion. Player 7 was drawn to advanced game play decisions which required complex set-up. During a game in focus group meeting 3, they explained on a decision to an opponent, “See, I did that [referencing Player 8 killing own creature, 1:12:02] but I did it on purpose because it was blocked.” In another game, they sarcastically responded to an opponent killing one of their creatures by saying, “It's okay, I can bring the card I just lost back. And you know this, I've done it.” Formulating responses to opponent play was very satisfying for Player 7, who especially liked concepts of bluffing and reading opponents during gameplay.

Additionally, Player 7 was attracted to the aesthetics of the game. Throughout the study, they commented on art style, card names, and narrative devices which had no immediate impact on gameplay. During focus group interview 2, they commented that they were initially drawn to the red deck because “I think I just like the red deck because all my characters are fire characters that I chose so I'm going to choose the fire deck.” In game play against other participants in focus group meeting 3, they remarked, “Oh, it's your girl [the card matched the opponent’s avatar], that's your character. I got really excited.” In another game, they commented, “I still really like the way your character looks I think she's very pretty.” Player 7 also enjoyed the creative nature of naming decks, mentioning, “I like the name of this deck. The one I named.”

**Player 8**

As primarily a competitive player, Player 8 enjoyed gameplay aspects which required interaction between themselves and opponents. During focus group meeting 4 they reflected on their personal style, “Because I like to attack and set traps and other people probably like to set

up an army. It definitely makes gameplay interesting." They were drawn to black decks for the creature removal and effects which required opponents to discard cards. Card effects like *Duress* which allowed them to look at their opponent's hands seemed especially strong. "The Duresses [sic] kind of helpful I think, almost unfairly so…" Player 8 later realized the drawback to the card, when they could not select a card for their opponent to discard. "What do you mean, 'No card to choose'? [unable to select a card from player's hand - nonland, noncreature]"

Additionally, Player 8 preferred to learn game systems and mechanics through discovery. When constructing decks, they first tested them against the AI. This allowed Player 8 to identifying potential weaknesses, but more importantly, learn how the card functioned in real game situations. During the last focus group, Player 8 reflected on their approach to learning *Magic*:

> Because I don't really care about playing a lot of pieces on the board and it feels like a lot of them have side-effects. It's complicated for me and it's something I would have to have a lot more experience with, not just one night of playing or I might get addicted and start going to *Magic* nights at [local game store].

There were moments during game against other participants that Player 8 inadvertently killed their own creatures or produced a negative effect because they did not realize how the mechanic or interaction would resolve. During focus group meeting 3, Player 8 made a mistake, "*audible gasp* What? I killed my own monster! How did I do that?" These direct experiences improved their understanding of the game, allowing them to hypothesize how to better use the effect in future situations.

**Social Setting and Environment**

Collectively, participants believed the social setting of the study greatly impacted the effectiveness of their personal learning of *Magic the Gathering*. One of the initial draws for participants who had previous gaming experience in joining the study was the opportunity to play *Magic* socially. By engaging in social interaction, participants described a better understanding of game mechanics, card evaluations, and deckbuilding strategies. The social setting itself was inviting and non-threatening, which are often major barriers for new players to overcome. Learning was significantly better in a face-to-face setting rather than via the digital tutorial because the learning was situated within the social environment; participants could ask and receive direct feedback to their questions. This generated a type of social negotiation between players in understanding game systems.

Participants also noted how the casual, familiar atmosphere of the study was beneficial to their learning experience. As a whole, the participants felt a sense of comradery and connectedness because they belonged to a group. This sense of belonging extended beyond the game of *Magic*; participants shared personal stories, reflected on other course work, and generally formed potentially lasting friendships. The overall tone of games played against each other echoed respect and a general collaborative attitude towards improvement. If an opponent missed a card draw, or misinterpreted a mechanic, participants politely corrected the mistake. Participants complimented one another on game play and deck choice. For example, during a game against Player 8, Player 3 remarked, “I like your deck, Player 8.” Even the tournament setting resulted in friendly play and banter. Player 6 needed Player 5 to lose a game to be tied for first place, remarked, “You've got one turn to figure out the puzzle my friend. Can somebody beat Player 5 once so I have at least have a chance to break even? [ended with laughter; friendly

competition]" As members of a group, there was a general consensus of empathy towards opponents when card draws were poor or something unfortunate occurred.

This varied greatly from game play sessions against digital opponents, for whom participants had no associations or care for. Participants who had experience playing against other players prior to the study noted how welcoming the environment was compared to the traditional local game store. Player 8 observed the potential hostility of playing *Magic* in paper settings during the final focus group session:

> Yeah, and surprisingly too there were a lot of people that I would like talk to them about this study and they'd be like, "I'm playing *Magic*, too you know! I have nowhere to go and play because a lot of people at like [local game store] have been playing for a while. And so it's intimidating to them and so like a few of them added me on MTG Arena, but since it's online I can't play a lot with them. It was kind of cool to tell them about this because they were also new. *Magic* isn't waning necessarily in popularity so it's not like a dorky game, I guess you would say. It's more of like a, like I just don't have a lot of people to play with.

During games played in the study, participants felt no fear of being a *newb*, that is, a new player unaware of the rules. The low-stakes environment provided the opportunity for participants to feel more free to experiment with card and deck decisions.

The study also provided an opportunity for Player 8 to reconnect with an old friend with whom they had previously played games of *Magic* with. During the final focus group meeting, they reflected on how the social discourse between the two of them assisted in learning game mechanics and strategies:

> Honestly, it's probably been about four years since I actually played at like a shop. The shop closed down and a few of my friends still like made time to get together but not consistently ever. I had a friend that helped advise me a little bit on which decks were considered more powerful and like what generally they were about... So, he kind of helped guide me in making some of those decisions but I think also playing here gave me a lot more confidence that we're all beginners. Because like a big problem I had going to that shop was everyone there was super seasoned.

As most participants shared a similar background with the game rules and mechanics, they were able to approach learning collaboratively. This was particularly evident during the paper portion of the study, when players were unfamiliar with cards. Player 4 asked, “What does that do?” to which Player 6 quipped, “I was going to say, there's going to be a lot of asking that question.” Though players may not have direct knowledge with how the card worked, they were able to work it through collaboratively, deriving meaning and potential interaction on the given board state. Player 8 summarized the general strategy for approaching new cards during a game of paper *Magic* during focus group meeting 4: “Okay, so let’s read it.”

Within the hierarchy of the group, the researcher fulfilled a role of content expert, an individual who participants could refer to for help understanding rules, mechanics, and interactions between cards. This outlet provided participants with an expert with whom unresolved socially negotiated questions could be answered. In this manner, the researcher fulfilled the position of teacher. In a games-based environment within a school system, the teacher would need some level of familiarity with the game, both the mechanics and logistics, to assist students as a facilitator to their learning. Player 6 filled this position to a lesser extent and was viewed by other participants as a mentor.

Participants noted a general difference between playing on the digital *Magic Arena* client and engaging in a face-to-face setting with paper cards. In general, gameplay changed within the more welcoming environment of paper *Magic*. Participants modified their purpose, methods, and strategies to gameplay to be more collaborative in style. Learning also improved in paper settings. Player 8 remarked during the final focus group meeting on the amount of time required for game decisions in paper *Magic*, personally noting how they interpret the passage of time differently because there is a player actually sitting across from them:

> And the timer doesn't run. Like if you guys are taking a long time, it's just like, "Alright, you're taking a little bit of time." But like on there [Arena]. they just keep prolonging the timer over and over and you're sitting there like, "Come on! Let's go! What are you thinking about?" It's a lot different.

Player 6 noted the difference in time perception in paper *Magic* as well, noting they did not feel as rushed into making decisions in a paper setting. “You also have a lot more time to think about your plans. Especially in my game, there were times where I was just sitting there thumbing through my cards, like ‘This doesn't solve the problem.’” It should be noted games of paper *Magic* took significantly longer, resulting in fewer total games played. From a teaching perspective, this could be viewed as the proverbial learning breadth versus depth approaches to learning.

Player 5 noted the difference in how serious they took games, concluding games on the digital client against strangers just felt more competitive. “I got blown-out and I was like, "If I was playing with someone face-to-face, this would be so okay, cool." and this would kind of like, destroy that, there's just more competitive nature.” Familiarity with opponents drastically

changed the attitude and hostility towards opponents. Player 6 observed how the different setting resulted in a totally different emotional response, noting during the final focus group meeting:

> I definitely feel that paper *Magic* is better for that because even if you do get blown out of the water, you can still have that conversation. Whereas, when I'm sitting in front of my computer screen if I am mana-screwed, it's horrible. Like, I don't even want to play. There was one day I was playing, lost like five games in a row, so I'm just done for the day. I was getting frustrated, I was getting angry, I'm like, "I can't." In paper *Magic*, you can at least hold a conversation to make it a little more enjoyable.

Player 4 echoed a similar feeling towards playing games of *Magic* in a face-to-face setting, "I would definitely say paper because there's not a social contract online as there is in paper." Participants unanimously agreed the existence of this social contract strengthened overall learning, reduced feelings of anger and hostility, and ultimately resulted in a more memorable experience.

### Examples of Social Negotiation during Face-to-Face Games

As an observer, I was astounded at the sheer amount of conversation which occurred during gameplay. During moments of gameplay, the recording of the session was never quiet. Players continually explained card mechanics, shared game decision points, hypothesized on potential game lines, and socially negotiated how game rules and triggers should resolve. Communication is especially vital during games of paper *Magic*. In this setting, opposing players are responsible for explaining decision points, accurately portraying their board state, and resolving triggers in a legal method. Consider this exchange from the final focus group meeting in which Player 3 and 5 engage in a game of paper *Magic*:

**Player 3:** Dual Shot, one damage to target creature or person.

**Player 5:** So, who are you doing a damage to?

**Player 3:** Oh wait, alright, Dual Shot deals one damage to each of up to two target creatures. So, it's only your creatures. I did it these guys here.

**Player 5:** Okay, so this guy dies, and that guy [inaudible].

**Player 3:** That's a?

**Player 5:** 1/3, or 2/4.

**Player 3:** 2/4? Alright. And then it took a damage.

**Player 5:** Yeah, for the turn. The damage resets though right?

**Player 3:** Yeah, yeah, but when it's your turn. So it was a 2/5 before?

**Player 5:** It was a 2/4.

**Player 3:** It was a 2/4? So it goes down to a 2/3.

**Player 5:** And it stays that way during my turn?

**Player 3:** It reverts back on your turn but on my turn it's a 2/3.

**Player 5:** Oh so it's....

**Player 6:** It stays damaged until the end of that turn.

**Player 3:** Yeah, yeah, I was making sure, sorry.

**Player 5:** No, sorry, I was confused.

**Player 6:** It's better to ask thirty-seven questions than get it wrong.

**Player 3:** Yeah. So, this is a, that's a 2/3. That creatures a 2/3 so add +2 to it, so it'd be a...

**Player 5:** So it's a 4/5.

**Player 3:** 4/5. And I'll attack you for four damage.

**Player 5:** I'm just going to take that.

**Player 3:** Okay. Cool. And that's my turn.

These exchanges between participants fostered game understanding through social negotiation of rules and game play.

In addition to negotiating instances during game play, participants engaged in shared collaborative reflection at the conclusion of the game. This was especially evident during games played with paper *Magic* cards. As games ended, participants naturally began engaging in conversation about what game decisions or moments impacted the final result. During the final focus group game session, Players 5 and 6 deduced the exact moment which resulted in ending the game:

**Player 6:** Honestly, I think the whole game-changer was the Peel from Reality.

**Player 5:** Man, that was a good game.

**Player 6:** It was. You definitely had me in the tank there for a minute.

**Player 5:** I think it went very back and forth. I didn't feel in control that game at all.

**Player 6:** You were in control early game and then once I returned your creature it all went downhill. There's that too, he had a lot of lands and I barely had enough.

This level of deep, collaborative reflection resulted in a better understanding of deck choice and game play decisions for both players. In digital settings against anonymous opponents, this level of thinking is impossible. When making considerations for designing the best games-based environment in schools, teachers need to offer and encourage reflective social interaction between students.

### Emotional Response to Gameplay

During focus group interviews and in participant journals, there was a prevalence of participant comments that suggested the development of powerful personal feelings when

playing games of *Magic*. Participants notably experienced a range of emotional response during gameplay, ranging from anger to extreme levels of satisfaction. In general, this thematic pattern was the most surprising revelation of the study. Whereas typical games were somewhat unmemorable, if an emotional response was triggered, participants were able to elicit detailed memory of game situations and events. During coding, three particular emotions seemed prevalent: initial fear or anxiety towards engaging in the gaming environment with opponents, anger towards opponents and game mechanics, and extreme satisfaction of overcoming improbable odds.

Towards the beginning of the study, participants noted feelings of angst and anxiety when preparing to play competitive games against each other. Participants shared their fear of playing against peers during the beginning of tournament play during focus group meeting 3. Player 4 lamented, “Oh no, I'm like terrified right now. I feel like I'm going to throw-up. Oh, gosh. Oh, I'm terrified.” Player 1 added, “I'm terrified right now because I don't know what's going to happen.” Even though the tournament was a low-stakes event, each player would receive the same number of paper cards, it added an additional layer of anxiety. Player 6 announced, “I get really nervous in tournament play. You've just added so much more pressure.” Player 4 was concerned immediately with their first game, even though the tournament was seven rounds long, “What? I don't want to play Player 6 first. I know for a fact his deck counters mine.” This suggests a level of social awareness in game results and how they are interpreted by peers. Though the games are generally friendly, participants wanted to finish well to establish their position in the social order.

The competitive nature of games such as *Magic the Gathering* can potentially trigger feelings of anger and agitation. Participants reflected these feelings towards both opponent

gameplay methods and the game itself. During the beginning of the study, participants used primarily weak preconstructed decks but were matched against opponents who potentially unlocked additional cards. In their participant journal, Player 8 complained:

> I was defeated by [random online player] who had a planeswalker in their deck. I have never played with one, but to be honest it is kind of shitty that the game would let someone with a planeswalker encounter someone just playing standard. Annoyingly, I was distracted by a classmate and really got beat.

Even the AI elicited feelings of irritation. Player 5 remarked during the second focus group session, "I had to mute it [the AI] … I can't even remember what it said, but it was just really passive-aggressive. I was like, 'Listen, you're a bot, like, I'm going to win this. So just sit back.'"

Participants collectively lamented playing against slow, control decks. The primary strategy of these decks is to kill all creatures the opponent creatures, prevent them from interacting in any beneficial manner, and winning the game with one or two actual cards, referred to as *win-cons*. Sometimes, it takes a while to find the win-cons, resulting in long games with very little gameplay actually occurring. Player 5 shared a moment of poor manners during a game against a control deck:

> **Player 5:** See, I got locked down, and I was like, "If I'm in prison, you're in prison." And I drew out a game til around like thirty minutes.
>
> **Interviewer:** Just because? Did you know you had no shot of winning?
>
> **Player 5:** No, but I knew that the entire time, it was just like, he would just counter everything I had, so I would just wait until the very last second, do my turns, and pass it over. I've only done it once, but it was to a similar situation.

Pace of play was a triggering mechanism of anger for Player 6, who preferred a quick pace of play and expected similar from their opponent. In their participant journal, Player 6 reflected after a digital game against a random opponent, “Most annoying match so far, opponent would play a card just enough to not be forced to concede.”

The variability of *Magic* is one of the major aspects of the game. Randomness and luck play a major role in how games are resolved. Many games come down to a single card drawn at the right time instead of a land. To this end, participants attempted to address deck variability during deckbuilding. Player 8 demonstrated how their agitation with a single card resulted in a deckbuilding change, “Every time I pull these cards, I always get this Meteor Golem, what is it's deal? Why is it always inside my opening hand? I only have like two in there. It's like every single time.” After the game finished, they remarked, “I got rid of that one [Meteor Golem] because I didn't like it. It didn't have any... I already have one that takes seven [mana] to get to, so I'm like, I don't need two.” Strong emotional responses caused participants to quickly react to situations, spurring them to immediate action because of the singular, frustrating instance of failure when compared to the non-memorable moments when the card excelled.

Though the face-to-face games against fellow participants produced a less hostile environment, they still elicited comments of agitation with game play. These feelings were primarily caused by variability of lands in player hands, colloquially called *mana screw* or *mana flood*. During a game against Player 5, Player 8 vented, “You're just going to end up wearing me down here. *audible sigh of frustration* Ahh, you got a plain [sounds like the beating on a keyboard]. You are so fucked if I get a red card.” As the game continued, Player 8 was motivated to overcome the mana obstacles, “And I ain't going down without fighting. If I had a red card you would be so screwed, Player 5. Just remember that.” Though extremely frustrated, the face-

to-face setting and familiarity of opponent produced a light-hearted tone. The researcher noted during transcription, “Player 5 does not seem threatened, interpreted Player 8's frustration in a lighthearted manner. Laughed.”

The competitive nature of Player 4 resulted in a reoccurrence of agitation during gameplay. These feelings of angst were primarily the result of the deck variability. At times, Player 4’s deck functioned smoothly and produced powerful effects. During other games, however, it failed to get started, stumbling out of the gates especially against aggressive opponents. The following passage demonstrates Player 4’s agitation during a single game of *Magic* played in a face-to-face setting during focus group meeting 3:

> **1:06:47:** Gosh, dude, I'm just not getting the crap I need man. It's totally over because they've got that pacified, so I mean, I only have one creature I can summon and they're going to...
>
> **1:08:03:** I know what card I need right now and I need it right now. I need it right now. If I get it, I will bow on the ground. Nope, I didn't get it. Then I get that. Gosh, I was wanting to have that one but not right now. Ah, dude I got screwed.
>
> **1:09:03:** And dude, I haven't got my two best cards a single time tonight. That's actually, that's one of my best, for sure. And that is crucial to my other two best cards but I either, my one, I have one, the Hydroid [Krasis] and it's one of my best cards. It is a game-winner but I've been forced to play it way to early every single time. Oh my gosh.

The unpredictability of the game did lead to feelings of extreme satisfaction for participants when they found an unlikely answer to a formidable situation. During a game in focus group meeting 3, Player 4 echoed extreme satisfaction when they found a line to win against the odds, “That's the right card at the right time. Holy crap. I had this card in my hand from the very

beginning, it had haste. She attacked with all her creatures. Oh my gosh." These moments of satisfaction, of overcoming the odds, were intensely memorable for participants.

## Pedagogical or Curricular Implications

Though this study was primarily an exploration in how learning occurs in iterative games-based environments, participants were directly asked during the final focus group session to reflect on potential curricular or pedagogical implications. Player 8 immediately made associations between physical card play and multi-sensory approaches to teaching, "…we would see kids, especially kinesthetic kids who miss out a lot because they're trying to focus on the board and write notes, and they're not getting that movement and such." Player 8 also suggested the combination of image, text, and card mechanics on *Magic* cards had potential learning benefits.

> You can also visualize because the artwork, if this was a picture of a sample or a picture of the nucleus on a cell, you'd be able to memorize it more because you're actively thinking about how it affects your opponent. So, I think it would stick better in children's minds if we found a way to apply this kind of activity and competitiveness into teaching practice.

Participants also noted alignment with pedagogical and curricular theory from their undergraduate preservice teaching coursework. These theories included 21st Century Learning with an emphasis on skill practice, avenues for student creativity, and the potential merging of disciplinary content and game design.

### 21st Century Learning (Skills-based Curriculum)

When asked about potential classroom implications for games-based approaches to learning, participants immediately identified potential skill-based benefits. They noted instead of

curriculums organized around content, games-based approaches would better employ skill practice. These skills comprise those emphasized in 21st Century Learning theory (see Chapter 2) and include problem-solving and critical thinking. Player 6 concluded in their participant journal,

> *Magic* requires its player to have critical thinking and problem-solving skills. This is a very important and good way of thinking. These ways of thinking are used in everyday life on a day to day basis. By using them to play a card game, you are effectively strengthening your ability to think in these manners.

Player 6 believed the thought processes used in *Magic the Gathering* were beneficial for learning and thinking outside of game environments. That through training in a game setting, the individual could better prepare themselves to think in a similar manner in real world scenarios.

During the final focus group meeting, participants noted specific problem-solving thought processes which were required to be successful in games of *Magic*. Player 5 specified the importance of being able to identify problems, assess your current situation, and then hypothesize potential solutions. Players need "…an awareness of your situation and what you've done in preparation to solve that problem. Being able to see what you have and using that to its fullest." Player 6 believed iterative experiences with the game required players to consider other possibilities. "Sometimes your first thought process isn't the best one or the right one, and with *Magic* that is very much the case. You always have to stop and think about it. Think is this actually what I need to be doing?"

Player 4 believed games-based approaches allowed students to personalize their approach to learning, allowing them to engage in a hands-on style which encourages them to continue learning outside of the classroom. They noted in their participant journal:

> Stuff like this [games-based learning] is perfect for 21st century learning. There is so much information in the world right now that it is beyond impossible to teach students everything. It's beyond impossible to even teach students a fraction of what there is to learn. Like I mentioned above, this kind of activity gets students thinking and learning in their own way. With moderate guidance, but really, the learning is in their hands. The ability to facilitate their own learning is a key skill that all human beings need in this age of knowledge that we are currently in. If we encourage students to be lifelong learners (the notion that learning never stops), and give them the practice and tools to be able to learn without our help, each and every student should be successful in gaining knowledge far after our time with them.

The emphasis on this approach should be on assisting students to develop and practice processes which enable them to make complex decisions.

Player 6 suggested in their participant journal that the recursive nature of iterative gameplay allowed students, "…ample opportunity for the students to learn what they are doing wrong, but also allows for ample amount of time to correct what is being done wrong." They later elaborated on the importance of varied gameplay during the final focus group meeting,

> I feel like they're [games of *Magic the Gathering*] more enjoyable just because you're not seeing the same thing over and over again. I played the deck I brought tonight twice, two completely different hands played very, very different. It's just a whole lot more enjoyable that way because if I were to sit down and play Chess for as much as I've played this for the study, I'm pretty sure I'd fall asleep in the middle of the game because it's so repetitive.

When making considerations for potential game selection in a games-based curriculum, teachers should consider the replay-ability factor of the game. Does the game play the same each playthrough? Or does the game systems and interactions create new different experiences for the player?

Instead of teaching rote facts, participants believed a games-based curriculum could teach critical thinking processes. Identification of synergistic associations between cards was identified by Player 3 as a viable skill utilized in *Magic the Gathering* deckbuilding which could be employed in real world settings. “So, I think that aspect of just trying to think of what each card does and how it effects each other is one thing you can add when talking about pedagogy…” Player 6 added the skill practice of pattern recognition in card analysis which supports and drives synergistic strategies, “Yeah, I saw in set release you'll find patterns.”

Player 6 surmised these processes would be beneficial with traditional skillsets students need to be successful in schools. “Going through to actually maintain those thought processes and keep everything relatively in check would be very beneficial for students. Their homework and everything would be easier and they wouldn't have as many issues getting more complex stuff done.” Player 8 proposed modeling data-decision making via data generated in digital clients like *Magic the Gathering Arena*. This would potentially allow students to practice making data-driven backed choices in an environment which is readily observable to witness their effects. In the final focus group meeting Player 8 commented:

> And another on that struck me for a second, is that like the stats, when we build our decks on MTG Arena, it shows our stats for our decks. That's a nice way for students to compare kind of like what their thought processes are. "Oh, I want to build a black deck and this is like what I want to put in there." And then looking at those stats and being

like, "Oh, maybe I should add more of this." So, they can associate those with how well they're placing, like again the concrete information that they would be able to see very clearly on stats and information.

In this manner, players would be responsible for not only gathering and interpreting data but using data to employ impactful change in potential outcomes. Participants believed the skills practiced via in-game systems were transferable to academic work.

**Creativity**

Player 4 specifically identify the potential in a games-based approach to learning which enables and promotes creativity from students. In their participant journal, they explained why games-based approaches could be beneficial to pedagogical or curricular change:

> I think it's creative learning. Yes, there is a tutorial, but it is very limited it what it can teach you. Honestly, the tutorial seemed like its purpose was to teach you how *Magic* worked through their platform, not so much about the game of *Magic* itself. I think it took creativity to create your own structure of learning which is, after all, kind of what we want our students to do. Teachers are supposed to be facilitators of learning, not robots spewing out facts. We want to give students the tools they need to learn, but overall, in my opinion, have them learning on their own, for the most part, as building those skills is crucial to learning after graduation. Giving students the skills to be able to learn without us is more important than their time learning with us. After all, their time in school is a mere fraction of their life. This is the kind of leaning that something like this promotes. We had to find out own way to learn this stuff and that probably looked different for each individual. The tools to learn, but the freedom to do it in our own way.

Player 4 believed that through presenting an environment and system which allowed students to experiment would strengthen and promote transferable skills. These experiences with games would be carried over to self-learning moments which occur outside of school. During the final focus group session, Player 6 shared an example of how a friend utilized the game thematic to tell creative stories. “I've had friends build decks and create storylines for the deck that kind of tells the tale of it.” Player 8 added, “Oh yeah, especially with just the artwork. If kids have an open set of choices, I'm sure they would choose things that are more aesthetically pleasing to them.” The inherent flexibility and expansiveness of games allows individuals to personalize what they learn of the game and how they express that learning.

**Disciplinary Content via Game Design**

While participants had no problem identifying potential skill-based approaches for games-based curriculums, the question on teaching disciplinary content was more muddled. Player 8 believed it was possible, remarking during the final focus group meeting, “… as long as the content was very concrete… definitely do this with a math game where you like activate this spell if you knew exactly what the name of this formula… it would be a good, almost like a flashcard.” Next, participants began imagining how a game could be designed around disciplinary content. Player 5 proposed:

> I'm almost thinking of something where it's like, it's almost all about getting a combo going. Where it's some sort of ecosystem, it's kind of going off of your idea, but it's like the plains and the mountains, and you have animals. You can put animals in there, but certain ones will go after other ones and kill them, and you need to get this system going where it's chain reaction and it's working together. So, you could actually teach about

> ecosystems with that, like how delicate they are even. Like you make, put one card down and it chains off into all of this species is gone.

This proposal spurred other participants to elaborate and offer their own ideas on how the game could function. Player 8 added, "…if you did apply that to a game it'd be like a Dungeons and Dragons thing, but ecosystem. So, the teacher would have a list of, 'Oh a pandemic unleashed on the deer population.' What's going to be effective?" Ultimately, participants engaged in game design thought processes, suggesting there may be potential creative applications within game settings themselves. Having spent six-weeks playing *Magic the Gathering*, participants were prepared and willing to design a similar game applied in a different context.

# Chapter 5 - Conclusion and Implications

Games-based approaches to learning are not new in educational fields, though their inclusion in typical K-12 curriculums is widely absent. This study sought to explore what learning processes are employed by players of a singular game through iterative game play experiences. From these observations, I determined why these learning processes are beneficial for cognitive development of students, directly connecting them to existing constructive learning theories. Lastly, considerations were made inferring how these learning processes may potentially be applied through curricular and pedagogical implementation in classroom settings. I conclude that games-based approaches to learning yield effective practice of complex, essential higher-order skills necessary for student success in a modern world.

In this chapter I will unpack research questions by making final conclusions based on the qualitative data generated during the six-week study. From these conclusions, I offer specific connections to constructivist learning theories mentioned during Chapter 2. My hope is by aligning these cognitive processes with familiar and widely accepted learning theories, games-based learning will be viewed as a justifiable approach to teaching in public schools, especially in the 21st century. I have attempted to include arguments which classroom teachers may employ in rationalizing the use of games-based learning in their classrooms. Potential class applications are shared and how they align with other curricular trends presently occurring in schools in the United States. From these conclusions I propose a deeper approach to games-based learning which I have labeled games-based inquiry.

## Research Questions Unpacked, Theoretical Connections Made

This study primarily explored how a focus group of eight individuals learned to play the game of *Magic the Gathering* over a six-week period. It was designed to observe the natural

processes participants took when learning about games. The research questions employed were directly related to forming a basic understanding of what was learned through gameplay and how it was learned. From this foundation, participants postulated whether this type of learning was valuable in K-12 schools and how to potentially incorporate it into curriculums. In this section, I will unpack the three research questions and attempt to make direct associations to constructivist learning theories discussed at length in Chapter 2. The research questions for this study were:

1. What knowledge and skills are learned through multiple playthroughs of a singular game?
2. How do participants effectively construct knowledge through iterative experiences with a singular game?
3. What potential pedagogical and curricular implications do iterative games-based learning experiences pose?

By the end of the study, participants had engaged in learning processes via the games-based approach which aligned with each of the constructivist learning theories considered by the researcher. Thus, it can be implied that games-based approaches to learning incorporate widely accepted cognitive development processes. Further, it suggests effective and valuable learning occurs in games-based environments.

**Cognitive Constructivist Alignment**

Throughout the course of the study, participant cognitive understanding of *Magic the Gathering* progressively deepened. This aligns directly with Bloom's Taxonomic Model (Bloom, 1956) in which learners engage at varying levels of understanding with the subject matter. Initially, participants were primarily concerned with understanding the basics of game play, the game sequences, and general rules structures. This would constitute the remember and

understand knowledge piece of Bloom's and was necessary for player understanding of more complex, higher-order processes. As participants gained familiarity with game systems, they employed application, analyzation, and evaluation skills in improving their knowledge of the game. It's important to note that these skills developed naturally; participants were not required to engage at this level, but each chose to do so. The creation level of Bloom's was potentially explored during deck construction but would be expanded by the inclusion of game design elements into the games-based approach.

Participants naturally employed Discovery Learning (Bruner, 1961) processes during their inquiry into game systems and processes. Complex games like *Magic the Gathering* require players to understand a variety of different complex systems and interactions during decision making points. Games inherently offer a platform for players to engage in inductive reasoning when attempting to learn how these systems function. Participants used singular examples encountered during gameplay to generate and inform a greater understanding on game principles. For example, participants identified perceived weaknesses in deck construction and attempted to solve those weaknesses by modifying the composition of their decks. If opponent decks are primarily playing aggressively, players may bring in more creature removal spells with the assumption that the social metagame is largely aggressive.

Additionally, the discovery processes utilized in games-based settings require players to engage in Spiral Learning (Bruner, 1960) because the game environment is constantly changing. Participants began with a novice understanding of game mechanics observed during personal experiences playing. They then sought additional information and data to refine these previous understandings. Player 4 used internet research to explore what generalizations had been made by more experienced players. Player 8 discussed their more experienced friend potential deck

changes. With new information available, participants reflected and analyzed potential improvements. This resulted in the formulation of personal theories regarding game play decisions and deck construction. The discovery process culminated in game play with new, updated decks and game knowledge. When game play finished, participants engaged again in the discovery process, progressively improving their underlying knowledge of the game as theorized in Spiral Learning.

The personal development of knowledge during the course of the study exhibited stages of Perry's Theory of Intellectual and Ethical Development (1970). From this perspective, the researcher was able to consider how college-aged participants viewed the philosophical value of their games-based knowledge. As gameplay and learning occurred, a participant's personal reflection of *objective game truths* changed. Initially, participants believed there were hard certainties in *Magic the Gathering*, and that more experienced players had already made these conclusions. This aligns with a dualist approach to intelligence, the belief there are right or wrong answers to gameplay decisions. Next, participants transitioned to a stage of multiplicity where they believed all game decisions were equal and that perhaps no right choice existed. Participants soon realized the existence of context in gameplay decision making, resulting in a relativist perspective that under certain arrangements specific game decisions are always correct. For example, if the opponent's deck is aggressive, I should always block their attackers. With experience and understanding, participant ultimately moved to the commitment stage of the theory, in which each individual participant understood their own personal choice had meaning. The rightness of the game decision was derived primarily through the context of the situation the choice took place.

**Social Constructivist Alignment**

*Magic the Gathering Arena* provides a tutorial program which assists new players in learning the game through a series of steps which emulate the Zone of Proximal Development (Vygotsky, 1978). Participants were not immediately expected to build decks or analyze cards. Instead, the game provided preconstructed decks which were later supplemented slowly through the unlocking of additional cards. Gameplay decisions were also structurally produced to directly demonstrate to players what specific mechanics and interactions would occur. As players became more familiar with the game systems, the tutorial program relinquished more and more control and responsibility to the player.

Participants directly noted learning through peers via Social Learning Theory (Bandura, 1977) during focus group meetings. During the tutorial system, participants were introduced to game rules and mechanics through direct modeling by the AI. Later, specific situations were posed for tutorial players which required them to mirror previous game lines practiced with the AI. In this manner, the game itself serves as a social conduit for learning, though it provides little personal feedback. Some participants explicitly remarked how the face-to-face gameplay sessions were more beneficial than digital ones because of the social interactions between players. Instead of attempting to self-identify and understand rules via the tutorial, participants were able to socially negotiate their meanings and interpretations. The previous extensive experiences with *Magic* caused Player 6 to be somewhat be viewed as an expert by novice participants. To this end, Player 6 made themselves available to explain rules, interpret game interactions, and assist in solving game board state questions. Newer players also noted Player 6's personal understanding of card evaluation and deckbuilding preferences and employed these are foundations for personal understanding.

Games-based approaches to learning also incorporate the tenants of Situated Learning (Lave & Wenger, 1991) as players learn through direct participation of the activity. In iterative gaming environments, learning of the game is directly applicable to future game play. Participants acknowledged previous game decisions influenced their how they approached similar events in later games. For example, if a player attacked an opposing player who had mana available, they may suspect a reaction from their opponent. If this occurred earlier and resulted in a blowout, that is, a dramatic change of advantage, the participant reconsidered their decision to attack. Participants are able to make these deductions because their understanding of the game occurs in authentic context activity. Game experience influences and instills knowledge for future game play, providing a formal structure for reflection. Additionally, games-based approaches occur in social settings, providing reinforcement of situated learning through peer interaction and feedback.

**Metacognitive Alignment**

Participants engaged in a variety of metacognitive practices while learning and engaging with *Magic the Gathering*. Players engaged in self-assessment which caused them to make determinations as to what kind of player they are and how their individual preferences align with color choice in *Magic*. This aligned with Flavell's (1976) definition of metacognition where by players engaged in gameplay via "active monitoring and consequent regulation and orchestration of these processes in relation to the cognitive objects or data on which they bear, usually in service of some concrete goal or objective" (p. 232). Cognitive goals allowed each participant to individualize their purpose of play. They recognized the importance of metacognitive knowledge and how it directly related to personal awareness of games tasks and strategy. Participants were also able to engage in metacognitive experiences which are unique to iterative games-based

settings. Through mechanical metagaming, participants noted which strategies, card mechanics, and game processes were most powerful in specific formats. The social metagame of the study group formed an environment for players to evaluate which card and deck choices would be most powerful in that context. Holistically, games-based environments provide rich, interactive experiences and settings for players to formulate meta-level conclusions.

On a meta-level, participants engaged in thought processes similar to Kolb's (1984) Learning Cycle conceptualized through Experiential Learning Theory. Initially, participants interpreted concrete experience during moments of game play in both digital and face-to-face settings. From these experiences they made observations and reflected on the results of their gameplay decisions. Next, they conceptualized how and why the events occurred, making abstract determinations related to both mechanical and social metagames. From these conclusions, players actively experimented with both their deck construction and game decision making processes in subsequent game sessions, starting the entire process over. Through utilization of the cycle, participants holistically engaged their cognitions, behaviors, experiences, and perceptions of game play creating a metacognitive outcome.

## How Games-based Learning Fits Existing Curriculums

In this section, I formalize how games-based approaches to learning may be employed in existing school systems. Inevitably, questions will be asked of how a games-based approach to learning assists in disciplinary content instruction. The development of technology has provided an exciting opportunity for the wider inclusion of games in school systems. The invention and expansion of the internet has extended access to what is sometimes referred to as the *collective human intelligence* (Berditchevskaia & Baeck, 2020), that is, basic factual information that is easily accessible via internet search. Many traditional school curriculums emphasized the

delivery of these basic facts, information that an individual could historically not access without a book or teacher. Since this information is now so readily available to students, school curriculums are being modernized to equip students with skills necessary to exist in a complex global society, surrounded by an abundance of information, data, and forms of communication. Games-based approaches can serve as the vehicle to enable students an opportunity to practice these new skills while still be exposed to disciplinary content, reading, and writing.

Of note, participant engagement and participation exceeded my initial expectations. Participants wanted to play the game more. Some participants were disappointed they could not dedicate more time to the study. As a focus group, we met for a total of seven hours. Outside of our group sessions, a few participants logged tens to hundreds of additional hours. At the conclusion of the study, some participants remarked they planned to continue playing. A subsequent study could consider how the effectiveness of the games-based learning persists.

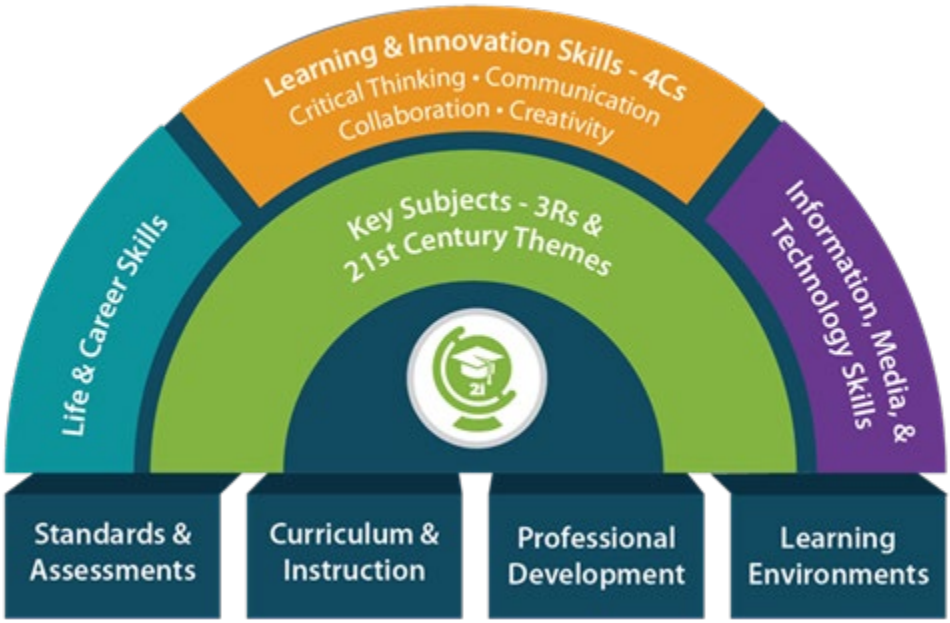
Additionally, modern games are increasingly more and more complex, requiring players to engage even more extensively to achieve a level of mastery. Multiple systems exist within the same game, sometimes interacting between systems providing an even deeper canvas for exploration. Some games are constantly evolving, receiving new content and updates to existing systems via patches and expansions. Depending on the game platform, games may address a variety of traditional disciplinary content: narrative, scientific processes, mathematical expression, historical events, economic simulation, etc. I conclude that games-based approaches align with previously established curricular structures and hold the potential to further improve deep learning within each. Specifically, I will consider how data from this study supports the inclusion of games-based approaches in 21st Century Skills, New Literacies, and STEAM structures.

### Association with 21st Century Skills

In public schools across the United States, a transition from objective-based content assessments to skills-based curriculums has begun. Skill instruction and development requires the learner to engage in integrated, complex processes including metacognition. The pedagogical shift caused by *No Child Left Behind* legislation originally passed in 2002 has been supplanted by calls from educators, parents, and business leaders for modern curriculums. When corporate executives were surveyed about future knowledge and skills needed in the workforce, the top results were problem-solving skills, information technology application, collaboration, and creativity (Casner-Lotto & Barrington, 2006). Published in 2006, *The Partnership for 21st Century Skills* called for a modernization of traditional curriculums, enhancing customary content instruction with technology integration, higher-order thinking processes, and life skills.

**Figure 5.1**

*21st Century Learning Framework*




*Note*. Image retrieved from Partnership for 21st Century Learning: A Network of Battelle for Kids, 2007 (https://www.battelleforkids.org/images/default-source/content-page-images/rainbow-01.png?sfvrsn=447aa5f1_2).

Though these modern proposals for curriculum emphasize skill instruction, they do not completely dissolve subject. Instead, content knowledge is enhanced through the use of 21st century skills which are valued by the school, workplace, and community (Bellanca & Brandt, 2010). Key subjects, including the traditional 3Rs (reading, writing, arithmetic) still form the foundation of school curriculums. What varied was how students interacted with the content matter. Instead of traditional methods which espoused rote memorization of fact and standardized assessment, schools are encouraged to have students engage with content through skill practice (the outer ring on Figure 5.1). These so-called 21st century skills include learning and innovation skills commonly referred to as the 4 Cs: critical thinking, communication,

collaboration, and creativity (Partnership for 21st Century Learning, 2019). Additionally, information, media, and technology skills are promoted to ensure modern students can navigate life and work environments in a technological society. Alternatively, the *enGauge 21st Century Skills* (NCREL & Metiri Group, 2003) proposes four areas of similar emphasis: digital-age literacy, inventive thinking, effective communication, and high productivity.

Games-based learning approaches to education provides a framework for learners to accomplish these high-order knowledge and skill expectations. Often, teachers experience difficulties in providing the environment for students to engage routinely in complex skill development. It is much easier to lecture, assign chapter readings, or have students fill-out worksheets. As demonstrated by participants during the course of this study, the game *Magic the Gathering* provided the medium for employing 21st century skills. This directly aligns with the previously mentioned 4 Cs. Consider these examples as evidenced by participants during this study:

**Critical Thinking:** Participants engaged in a variety of critical thinking processes, including evaluation of cards and mechanics, synthesis of game board states and how they impact decision making at specific moments, gathering and evaluating data to determine game play decision points, and forecasting potential game lines resulting from choices made. Iterative experiences with the same game system required participants to engage in problem-solving processes. Each game evolved and presented unique problems for participants to solve.

**Communication:** *Magic* requires opposing players to communicate their gameplay decisions and to express their game board state clearly for opponents. Without communication, rules may be misinterpreted, and conflict created. The game also offers

opportunity for social discourse related to the game, giving players from various backgrounds a commonality from which to begin conversation. Participants noted how their association through the game extended social circles and provided the foundation for friendships.

**Collaboration:** Throughout the study, participants noted how the small, familiar setting enhanced their learning. Instead of learning the game on their own, the associations formed within the group allowed for social negotiation of rules and game interactions. Games played against peers had a more personable, collaborative tone which allowed participants more confidence to experiment with. Participants were genuinely interested in what peers were playing, how they approached deckbuilding, and how they could assist each other in learning the game. *Magic the Gathering* also provides multiplayer formats which require collaboration with other players to collectively build decks to compete against other teams.

**Creativity:** Participants directly evidenced their approach to learning the game through creative methods and approaches. Games like *Magic* do not have definitive answers to card evaluations, deck construction, or game play decisions. Players cannot master the game because no personal determination is wholly accurate. Additionally, the game mechanics and processes allowed participants to approach problems in different ways, often resulting in different routes taken. As players learn game systems, they can then conceive their own creative designs to customize gameplay further.

### Association with New and Multiple Literacies

As participants engaged with one another regarding *Magic the Gathering*, they found themselves using specialized vocabulary derived from the game setting itself. Games-based

learning has application possibilities with so-called *New Literacies*, a modern approach to reading and writing which extends beyond traditional print literature. Lickteig (2015) defines new literacies as the "use of new technology (including computers and handheld devices, the Internet, and various other forms of media) to help create, distribute, and consume information." In this manner, games-based approaches may serve as the foundation for students to engage with reading and writing through the context of the game setting. As Player 6 noted during the final focus group session, players may derive narrative from gameplay themes and aesthetics. The mechanical aspects of games also provide a rich field for informative literary work, providing students an environment from which to derive their own conclusions through direct interaction.

The generation of new vocabulary terms from technology and games-based settings suggest potential connections to literacy and the development of the modern English language. As games become more widely used by the general public, schools will be forced to address the language used surrounding their use. Games-based approaches to learning are filled with deictic terminology, words dependent on the context of the game for meaning. Leu et al. (2013) distinguish between two types of new literacies, citing a lowercase (new literacies) and uppercase (New Literacies). The lowercase level explores specific areas where literacy is being employed, especially regarding its interaction with technology. Researchers theorizing via the uppercase level of New Literacies seek to make connections between these smaller, individual new literacies. Individual games and platforms cultivate new literacies, which in turn, influence language use during play of other games. In this regard, games and their social environments have become a large, emerging subfield for development and use of New Literacies.

Pedagogical strategies for employing new literacies in schools is not without concern. Rueda (2013) notes one of the major paradoxes in considering 21st century skills through reading

and literacy is providing incentive for students to engage in such activity. “Motivation (for students and teachers) is rarely emphasized in conversations around 21st-century skills, although it is critical for learning in general and for literacy specifically and may be especially important for the outcomes of the groups who are the focus of this chapter [students of diverse language and cultural backgrounds]” (p. 1262). The engaging nature of games have historically been used as a motivator, particularly with students who may not enjoy traditional school settings. Furthermore, games can serve to bridge the gap between home and classroom, providing a potential extension to learning opportunities beyond the school day.

Additionally, games-based approaches to learning have the potential to engage students in *Multiple Literacies*. From this perspective, students improve literacy skills not only through reading and writing through technology but also through varied disciplinary lens. “Multiliteracies encompasses new literacies because multiliteracies includes using technology to promote “reading” of and “writing” about a topic, but multiliteracies are also multimodal (visual, auditory, spatial, etc.) and multidisciplinary (visual literacy, disciplinary literacy, critical literacy, financial literacy, etc.)” (Lickteig, 2015, p. 7). Games are naturally multimodal, often engaging players to use three or four senses during the course of gameplay. Literacy within the context of a games-based environment is rich in presentation, bringing a variety of different subject matter together through varied interdisciplinary connections. For example, a game may have an overarching narrative which tells a historical story through the simulation of past events. In this manner, the player not only learns plot elements, but also makes direct connections to factual happenings through varied lens. Cervetti, Damico, and Pearson (2006) noted the purpose of new and multiple literacies are “both attempts to reframe literacy in relation to modern ways of life” (p. 379). Well developed and produced games can have meaning, real world meaning. Games-

based approaches therefore potentially allow students the opportunity to produce purposeful meaning during their gaming experience.

**Association with STEAM**

Perhaps the most direct association for applying a games-based approach to learning is through the developing fields of *STEAM* (Science Technology Engineering Art Mathematics). These programs have traditionally existed as standalone courses, preventing a holistic understanding of how science and math relate. STEAM emphasizes the processes used in these fields, exhibited primarily through project-based approaches to student learning. The evolution of traditional STEM fields to STEAM was primarily an attempt to bring sciences and arts closer together for student understanding. The result has been the development of courses and programs which allow student-led choice in approaching real-world, complex problems. As a form of media, games provide the canvas for rich deep study by which individual students can directly relate. It may be difficult for a 6$^{th}$ grade student to make connections between designing a bridge of toothpicks. A video game concerning bridge design could simulate elements, wind, weight, and other real-world events the learner would otherwise be unaware of. In this manner, games enrich the existing STEAM structure.

Games-based learning aligns directly with STEAM because games themselves require holistic understanding to master. Mechanical metagaming as posited in this study is derived from student engagement with mathematical expressions, algorithms, and systems used in games. Games provide context for students to see the math at work, to experience how manipulation and modification of numbers directly changes game environment. Participants during the study used a scientific approach to understanding *Magic*, they identified problems, hypothesized solutions,

gathered and analyzed data, and formed conclusions which informed subsequent inquiries. Thus, games-based approaches can serve as the vehicle for scientific study.

Game design itself is a complex endeavor requiring a variety of different talents and skills, many of which align directly with STEAM fields. The potential inclusion of game design as a capstone activity of a games-based approach would allow students to engage in creative thinking. Games provide an environment for creative expression, from which students can generate new mechanics, systems, or interactions within the game setting. By engaging in game design, students actively take part in higher-order thinking skills necessary in engineering. Games as a media also have a unique potential incorporation of sensory artistic expression including visual, audio, and tactile devices. A game design approach to STEAM poses a potential avenue for future research.

## A New Approach: Games as the Object of Study

Historically, games-based learning has primarily meant the use of games to supplement an existing curriculum. Games are incorporated into the course as a form of media, something to stimulate student interest. Unfortunately, this results in a singular experience with the game. The student only briefly engages with the game systems, developing only a brief understanding of how the game functions. They are unable to make connections as to how the game and the content are associated. Game choices made by the student do not have any resolution because often they are not able to complete a full playthrough of the game. The result is a brief moment of doing something non-traditional before returning to memorization of fact, lecture, and assessment. Instead of a brief momentary interaction with games, I suggest making games the basis from which instruction occurs.

**Games-based Inquiry**

Games-based inquiry is the next logical extension of classic games-based learning in schools. Instead of using singular use games to illustrate content, I propose we encourage students to inquire deeply into the game. Games are designed to be highly engaging and incorporate complex systems by which inquiry can occur. This allows students the opportunity to practice higher-order skill development with purpose; they can see immediate results from their discoveries. Additionally, student connections and understanding are enhanced because they are engaging with a form of media which is often familiar to them. It is significantly easier for a modern student to approach a video game than form understanding of the cultural and social connotations of a Shakespeare play. Games-based environments are non-hostile and promote collaboration between students and teacher. Ultimately, I posit that through iterative experience with a singular game, students discover, inquiry into, and master the unique complexities present in gaming environments which is more beneficial to their cognitive development in a 21st century than other traditional classroom approaches.

Initial gameplay fills the player with a sense of wonder as the experience the game environment for the first time. The narrative, art, and decision points heavily influence players initial thoughts about gameplay. Through repeated play, the player becomes familiar with the systems and begins to see the game through a different lens. Players turn their attention away from story and graphical elements and towards the systems employed by the game. They inquire into how the game systems, algorithms, and processes interact with each other. In this manner, the game becomes an object of study.

Instead of gameplay occurring on a singular instance, games-based inquiry requires students to engage with the game system repeatedly and on a deeper level. The iterative nature of

gameplay encourages students to inquire into how the game functions. They are able to see how game play decisions and choices resolve. This is significantly different than traditional games-based approaches, where students experience the game superficially but fail to understand how it works. Disciplinary content knowledge is expressed and interpreted through gameplay. In this manner, traditional content knowledge is learned interpreted through game environments. This allows students to see big picture ideas through interdisciplinary lens. Games also provide the form for students to contextualize content knowledge because they experience it. The game becomes a vehicle from which the content is expressed and contextualized.

Theoretically, traditional pedagogical approaches can be employed with games that classroom teachers have incorporated with other forms of media, such as books and film. Similar methods may work for games, replacing the novel study with a study of a particular game system. Games are a more powerful form of media because the student is required to interact and make choices within the systems. This provides an additional level of engagement and is something traditional forms of media cannot deliver. Additionally, games establish a variety of outcomes from play, creating unique personalized experiences for students.

## Future Studies

The exploratory nature of this study is purposefully meant to be a starting point for subsequent studies into games-based inquiry research. I believe it first important to generate a breadth of recorded evidence which supports the types of learning employed by learners in a games-based inquiry setting. This data will assist classroom teachers in making the case for the wider inclusion of games in schools. The current environment regarding the modernization of schools should be beneficial in this incorporation as many schools are adopting problem-based learning, STEAM, and skill-based curriculums. Next, I suggest future studies narrow their scope

to address specifics. Games-based approaches are very broad in their nature, and as such, offer the setting for a variety of potential academic connections. In this section, I briefly discuss three potential follow-up research avenues including prospective curricular and pedagogical approaches, philosophical underpinnings of metagaming, and possible association with game design.

**Curricular and Pedagogical Inquiries**

Given the wide range of games available, data may vary significantly between age groups, game types, and pedagogical approach. Educators considering the incorporation of games-based approaches need to spend significant time in considering which game is used. *Magic the Gathering* was used in this study after extensive deliberation because it provides a broad system from which gameplay occurs. Future studies should explore different genres of games to determine which are appropriate for student inquiry. Furthermore, research should be employed in determining how to structure games-based inquiry as a refined pedagogical approach. Though I posit a system which is primarily student-driven, considerations need to be made as to how teachers can organize inquiries, gather evidence of student learning, and assess learning.

Additionally, games are the culmination of a variety of influences, including art, narrative, technology, and mathematics. This means there is a broad range of potential routes from which inquiry can occur. I would suggest future studies consider potential disciplinary content connections through games-based inquiry. Doing so would ease the potential adoption of a games-based inquiry approach in schools because teachers would likely be more comfortable teaching traditional knowledge. For example, a language arts teacher is likely to be more familiar with teaching plot elements, characterization, and other literary techniques than evaluating the

algorithms used in a game like *Magic the Gathering*. Instead of doing a novel study, the teacher could incorporate a visual novel styled game as a direct replacement. This approach would allow the teacher to continue with traditional instruction while engaging students in a new media. Additionally, this opens the potential for students to engage in other inquiries related to the game, something traditional novel studies cannot do. Other content fields could take similar approaches to iterative use of games, emphasizing traditional content while presenting the material in a more engaging, deeper manner. In this way, future research inquires into how games-based approaches can be used in praxis by educators in specific disciplinary content areas.

**Inquiries into the Metagaming**

Subsequent studies could also emphasis and explore the phenomenon of metagaming in varying game settings. Employing mechanical metagaming principles would allow for students to theorize and deduce game mechanics. In this manner, they can *solve* game systems. Consider the extensive amount of mathematical, technical, and scientific methodology required by groups of students to make these determinations. The competitive scene of eSports provides a rich, constantly developing metagames which students could explore and attempt to predict. In tabletop roleplaying games, metagaming is consider negatively because it breaks the so-called Fourth Wall. Research into this area could seek to identify the transition between players approaching the game for success and for creative purpose.

Future studies could also consider the ramifications of players taking metagaming approaches to learning games. Does having an awareness of meta-level thinking in games stifle creativity? Player 4 noted using the internet to quickly solve their deckbuilding questions. Instead of making individual determinations through experience, players could take a shortcut and look for widely accepted answers. By approaching games for study, does that lessen or

weaken the initial emotional response to playing the game? Instead of viewing the game as a work of art, it becomes a science. As players engage in similar styled games, do they skip over narrative, art, characterization, plot? At what level does playing a game become work?

### Game-Design Connection

Lastly, I believe some levels of potential association with game theory and game design exists with games-based inquiry approaches to learning. These disciplines are quickly growing in post-secondary settings. Games-based inquiry could serve as an introduction to these fields in K-12 settings. If the incorporation of games-based inquiry is viewed as too difficult for disciplinary content teachers, it may exist as a stand-alone elective program. Game design could serve as the primary curriculum, preparing students to engage in the design process.

I also believe game design has the potential to be the final stage of a games-based inquiry, by which students design their own, creative elements within the game systems. This approach would extend the higher-order skills practice to include the highest levels of Bloom's Taxonomy. Student design may also serve as a culminating assessment strategy at the end of inquiry. Students are required to demonstrate their understanding of mechanical metagaming through the generation of something new.

## Conclusion

This study explored the natural learning processes utilized by players in an iterative games-based environment. The results aligned with widely accepted constructivist learning theories, suggesting games-based learning has the potential to be an effective instructional tool. Participants noted direct practice and employment of higher-order skills which are often difficult to reproduce in classroom settings. Engagement from participants resonated outside of the study and encouraged deeper inquiry into the game system and the social structures established during

gameplay. Data suggests games such as Magic the Gathering when employed in the use of learning environments can serve to strengthen problem-solving skills, perseverance of students, promotes a growth mindset, and promotes soft skills which are becoming increasingly more common in state curriculum standards. It is important to emphasize the results are dependent on game selection and student preferences. Educators who are interested in employing games-based inquiry in their classrooms need to devote considerable thought to which game to explore, what aspects of the game to emphasize, and how to structure the pedagogical processes which keep students learning, not just playing. Subsequent research should consider these avenues through the development of a games-based inquiry pedagogical model.

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# Appendix A - Email Solicitation and Informed Consent

Hi X,

I hope your semester has gotten off to a good start. I am emailing to check on your interest level for participating in my dissertation study, as mentioned in IT 360 last fall. My hope is to arrange a meeting with participants within the next week or so. This would allow the 6-week study to be done by spring break.

If you are still interested in participating, I would appreciate if you would respond with potential day/time combinations which would work for you to meet on campus for an hour or two. Just like last semester, I teach Tuesday/Thursday from 11 to 3:20, but otherwise should be available. I suspect trying to find a time that works for everyone may be difficult, but hopefully, we can find something that will work.

I want to thank you for showing interest in participating. I'm excited to get started, as I hope you are!

Let me know if you have any questions about the study.

Thanks again,
Lickteig

KANSAS STATE UNIVERSITY
University Research Compliance Office

Institutional Review Board (IRB)
# Informed Consent Template Form
comply@k-state.edu | 785-532-3224

**PROJECT TITLE:**

Metagaming: Cognition Through Games-based Inquiry

| **PROJECT APPROVAL DATE:** | 11.12.2019 | **PROJECT EXPIRATION DATE:** | 11.12.2021 | **LENGTH OF STUDY:** | 6 weeks |
|---|---|---|---|---|---|

**PRINCIPAL INVESTIGATOR:** Dr. Brad Burenheide

**CO-INVESTIGATOR(S):** Seth Lickteig

**CONTACT DETAILS FOR PROBLEMS/QUESTIONS:** (785) 532-5157; bburen@ksu.edu

**IRB CHAIR CONTACT INFORMATION:**

Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224
Cheryl Doerr, Associate Vice President for Research Compliance, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224

**PROJECT SPONSOR:** None

**PURPOSE OF THE RESEARCH:**

The primary goal of this study is to observe the naturally occurring learning processes utilized by players in games-based environments during repeated playthroughs. Utilizing this information, educators can develop games-based curriculums which emphasize critical thinking, collaboration, and logical processing.

**PROCEDURES OR METHODS TO BE USED:**

Participants will engage with the game Magic the Gathering over a period of six sessions. Half of these sessions will occur online, using the program MTG Arena, and the other half will be face-to-face. Online sessions will be played in an individual setting, requiring the participants to record their insights, emotions, and experiences in a journal. This data will be collected at the end of the study and analyzed to compare with peers. Face-to-face sessions will require participants to meet with the researcher in a public setting where they will play the paper version of Magic the Gathering. These sessions will primarily consider the social context of games-based learning environments and their role in making games-based decisions. These sessions will be recorded, transcribed, and analyzed to supplement and compare with the individual, online setting data.

**BIOLOGICAL SAMPLES COLLECTED (Describe procedure, storage, etc.):**

**None**

**Whole genome sequencing will not be included as part of the research**

**Not Applicable.**

**ALTERNATIVE PROCEDURES OR TREATMENTS, IF ANY, THAT MIGHT BE ADVANTAGEOUS TO SUBJECT:**

**N/A**

**RISKS OR DISCOMFORTS ANTICIPATED:**

No foreseen risks.

**BENEFITS ANTICPATED:**

Participants are preservice educators and after participating in the study will determine personally if learning through games has potential instructional use. Games are commonly used by K-16 students outside of educational settings. Tapping into their popularity, structure, and purpose will improve student motivation, retention, and higher-order thinking skills in traditional school settings. This aligns directly with the KSDE School Redesign philosophy.

**EXTENT OF CONFIDENTIALITY:**

Data will be stored during the course of the study. Names and other identifying factors of the research subject will be kept anonymous. After analysis, data will be securely maintained and stored by the researcher.

**The information or biospecimens that will be collected as part of this research could be used for future research studies or distributed to other investigators for future research studies without additional informed consent.**

**IS COMPENSATION OR MEDICAL TREATMENT AVAILABLE IF INJURY OCCURS?** ☐ Yes ☒ No

**PARENTAL APPROVAL FOR MINORS:**

| | | | |
|---|---|---|---|
| **PARENT/GUARDIAN APPROVAL SIGNATURE:** | | **DATE:** | |

**Terms of participation: I understand this project is research, and that my participation is voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.**

**I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.**

**(Remember that it is a requirement for the P.I. to maintain a signed and dated copy of the same consent form signed and kept by the participant).**

| | | | |
|---|---|---|---|
| **PARTICIPANT NAME:** | | | |
| **PARTICIPANT SIGNATURE:** | | **DATE:** | |
| **WITNESS TO SIGNATURE: (PROJECT STAFF)** | | **DATE:** | |

# Appendix B - IRB Approval

KANSAS STATE UNIVERSITY | University Research Compliance Office

Proposal Number: 9942

TO: Dr. Brad Burenheide
Curriculum and Instruction
261 Bluemont Hall

FROM: Rick Scheidt, Chair
Committee on Research Involving Human Subjects

DATE: 11/12/2019

RE: Approval of Proposal Entitled, "Metagaming: Cognition Through Games-based Inquiry."

The Committee on Research Involving Human Subjects has reviewed your proposal and has granted full approval. This proposal is **approved for three years from the date of this correspondence.**

APPROVAL DATE: 11/12/2019

EXPIRATION DATE: 11/12/2022

In giving its approval, the Committee has determined that:

☒ There is no more than minimal risk to the subjects.
☐ There is greater than minimal risk to the subjects.

This approval applies only to the proposal currently on file as written. Any change or modification affecting human subjects must be approved by the IRB prior to implementation. All approved proposals are subject to continuing review, which may include the examination of records connected with the project. Announced post-approval monitoring may be performed during the course of this approval period by URCO staff. Injuries, unanticipated problems or adverse events involving risk to subjects or to others must be reported immediately to the Chair of the IRB and / or the URCO.

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