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Games as an Artistic Medium:
Investigating Complexity Thinking in Game-Based Art Pedagogy

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"From the student interviews, the unit operations of MARC also provided a tactical framework for students to understand and connect interdependent systems within games and daily life."

This action research study examines the making of video games, using an integrated development environment software program called GameMaker, as art education curriculum for students between the ages of 8-13. Through a method I designed, students created video games using the concepts of move, avoid, release, and contact (MARC) to explore their understanding of complexity thinking. From this process of making games, students learned systems, deconstructing systems, and reconstructing systems using game-based art pedagogy. The findings of this study indicate that creating games expands the content of making in art education by being inclusive of the personal worlds and lives of students. Using the concept of MARC encourages students to think about the complexity of systems and how they work, identifying meaningful associations between students' understanding of their worlds and games.

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In recent years, academics have promoted video games as vehicles for learning (Gee, 2005) and teaching digital literacy skills (Jenkins, 2006), catching the attention of educational foundations and the United States government (Toppo, 2012).[1] Part of the enthusiasm has been geared toward using video games to teach content such as science, math, and history (Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005; Shaffer, 2006; Squire, 2004). Games, defined in this study as structured play, have precedence in the history of art through the works of many 20th-century art movements, such as Dadaism, Surrealism, Situationism, and Fluxus (Flanagan, 2009).[2] Artists and artworks from these movements used game-making methods to explore and expose rules of social, political, economic, and environmental systems as forms of structured play.[3] This article describes the implementation of an art education curriculum where students between the ages of 8-13 made games as part of an action research study. I argue that making video games provides an entry point for critically understanding complex systems and programmable media, offering new opportunities for artmaking in the contemporary art classroom.

Games, specifically video games, display potential to provide meaningful learning experiences for youth, yet most educational research using video games has related directly to the learning that stems from game-playing activities (Holden & Sykes, 2012; Jenkins, 2006; Spencer Foundation, 2006; Squire, 2004; Steinkueler & Duncan, 2008). Studies in disciplines outside of art education have concentrated on student learning from producing video games (Peppler & Kafai, 2007; Sheridan, Clark, & Peters, 2009), but most research has looked for correlations between game making and performance on standardized tests for math (Kafai, 1995), language (Pericles, 2007; Robertson & Good, 2005), or generating interest in computer science (Dalal, Dalal, Kak, Antonenko, & Stansberry, 2009; Seif El-Nasr & Smith, 2006). Yet, game-based curriculum has continued to influence pedagogical research at a school-wide level (DiVittorio, 2013; Mullaney, 2011; Quattrocchi, 2013). Art education research has advocated the value of making games as art projects (Bain & Newton, 2003; Gill, 2009; Keifer-Boyd, 2005; Peppler, 2010), or critiquing video games as visual culture (Parks, 2008; Sweeny, 2010); however, these studies do not look at the impact of making video games in the classroom.

New York City public school Quest to Learn began using a game-based pedagogy for its curriculum when the doors opened in 2009. Katie Salen, former professor of media design at Parsons, The New School of Design, began Quest to Learn to explore the philosophic premise that learning domains (math, language arts, etc.) and systems of all kinds (biological, governmental, transportation, etc.) can be taught as games through a series of quests, puzzles, and problems (Corbett, 2010). In Quest's game-based pedagogy, students have theorized, played with, and validated ideas to attempt to find core principles to systems in life, relationships, and discrepancies with other systems, and explore complexity within their daily lives. Quest to Learn has reworked the traditional academic disciplines such as math, science, and social studies, using the arts to support broad learning rather than as a medium for critique and self-expression. To distinguish my study, I developed it within a visual art context to devise, execute, and evaluate how a game-based art pedagogy provides a model for understanding and critically analyzing systems while offering creative, metaphoric, and interactive opportunities for visual self-expression by making games.

Complexity Thinking

This research relies on the use of complexity thinking as an umbrella concept for broad inquiry. Complexity thinking includes, combines, and elaborates on the insights of any and all relevant domains of research to understand how complex systems and behaviors work (Davis & Sumara, 2006). While systems theory is closed, limited by what is within a system, complexity thinking supports viewing systems as being open, connecting to other systems allowing for adaptive, dynamic change (Sumara & Davis, 2009). Unlike chaos theory, which focuses on unpredictable or erratic behavior, complexity thinking is a domain between deterministic order and randomness, as a collection of strategies or structures partially connected (Cilliers, 1998). Complexity thinking enables areas of inquiry to range widely, seeking commonalities with diverse domains of knowledge such as art, economics, physics, and biology, and acknowledging an array of methods simultaneously for transdisciplinary research (Davis, Sumara, & Luce-Kapler, 2008). For example, in the medical sciences, the circulatory, digestive, nervous, skeletal, and other anatomical systems are understood as working together simultaneously and dynamically and are studied to treat patients. Yet, microbiomes within the body and systems outside the body such as environmental, social, and economic systems should also be considered in medical health research and treatment (Angel & Angel, 2006; Human Microbiome Project Consortium, 2012; Lehrer, 2012). The complexity of how partially connected systems and methods interact and work together can also be found in art, education, and games.

Art educator Robert Sweeny (2008) explained how artists have used complex digital systems to create interactive works. Sweeny described how the artist Stelarc exemplified the complexity of control by allowing his telepresent audience to direct his muscle tissues with a series of electrodes in his performance piece, *Parasite* (1993). Sweeny also argued how the art collectives Etoy and TMark created the disruptive data-driven artwork, *Toywar* (1999/2000), by obstructing business for the Internet toy company, Etoys, through emergent, complex, dynamically networked community action.

Juan Carlos Castro (2012) described students sharing photographs through an online social network as having dynamic, emergent dialogues that can be documented, traced, and observed in his art education study. Using complexity to frame the student dialog, Castro argued how collaborative processes of student artmaking and discussion drew dynamically from sources in their daily lives, including historical, sociological, psychological, environmental, political, and physiological situations. From these examples used in art education, this article frames how game making provides a visual entry to teach concepts of complexity thinking by students creating games as dynamic, interrelated systems.

Complexity Thinking and Games

Complexity thinking is not limited to understanding systems of human health and behavior, education, or art. In his book *Emergence* (2001), Steven Johnson described how slime molds and ants organize themselves into complex colonies, adapting to their environment as a collective intelligence. Johnson stated that the complex, interconnected behavior of ants is also found in video games like SimCity (Wright, 1989), SimAnt (Wright, 1991), and The Sims (Wright, 2000). These video games are made to simulate complex dynamic systems, like cities, ant colonies, and the social, biological, emotional, economic, and environmental conditions of life. Because multiple variables for these programmed conditions run simultaneously in the games, the player does not have the same experience twice.

Of course, the coded structure of play in video games cannot address all forms of complexity. The algorithms and cultural biases of game code values limit video game systems (Bogost, 2007; Wark, 2007). For example, in the video game Civilization (Meier, 1991), a player must use methods of domination quantified as a "win state" supported by a late-capitalistic society algorithmic model (Galloway, 2006). Layering these algorithmic biases within the game directs players to perpetuate late-capitalist methods of domination as necessary for societies to thrive. By critiquing and making games through a game-based art pedagogy, students are exposed to biases in video game source code, developing their own capacity to critically read these programmed texts (Rushkoff, 2010), understand the limits of a game's complexity, and learn to write their own games as a form of visual self-expression. In the next section I expand how, in a game-based art pedagogy, game creation develops (1) an understanding of complexity thinking through the theories of unit operations (Bogost, 2006) and (2) strategies and tactics (de Certeau, 1997) as a way to foster a critical aesthetic toward game-based actions and the systems of everyday life.

Aesthetics of Coded Behavior

Object-oriented programming (OOP), a form of software programming often used for creating video games, uses code methods and data fields to form discrete, modular code as self-contained data structures (or objects). OPP allows for code objects to be flexible and have multiple meanings, giving programmers broad, creative parameters to make a functional video game. Bogost (2006) stated in his unit operations theory that an object-oriented programming environment provides game designers a system that enables and limits their abilities to create game environments, exposing biases of video game creators as described earlier in Civilization's game code. Because code statements can behave in subjective ways, Bogost argued that computer programs should be critically read like a text, analyzed for the code statements used, and omitted from a program.

In this game-based art pedagogy, it is assumed people adhere to systems of rules for their daily encounters (standing in line at the bank, crossing the street, having a conversation, maintaining personal appearance, graduating, etc.). The structured play of these social rules provides incentives and deterrents for an individual's response, predicated on a person's current social, economic, physical, or mental status and other known and unknown factors. Like the programmed game objects of unit operation theory, the rules of everyday scenarios are often determined by social norms (ordering within a queue, crossing at an intersection with a green light, maintaining formal personal space, taking turns speaking, wearing shoes in public, coming to school, etc.), forming a type of structured play for the procedural behavior in our lives. However, these rules and social norms can be broken or circumvented (budging in line, jaywalking, hugging, interrupting, going barefoot, truancy, etc.), but the deterrents or consequences, and social value placed on those consequences, may determine which rules and norms a person chooses to play by and to what extent. Video game makers also direct players with procedural code, providing immediate feedback loops such as health, points, animations, sounds, and light to engender player behavior to the rules and values of a video game space.

Society's rules and values were the basis for de Certeau's concept of strategies and tactics in *The Practice of Everyday Life* (1997). De Certeau linked "strategies" with structures and institutions created by the powers of society. "Tactics" are the methods individuals use to navigate within the structures of society, often influenced by the rules and practices of a culture, yet never wholly determined (de Certeau, 1997). Because tactics of an individual are not fixed by structural and institutional strategies, unit operations theory functions as enabling tactics toward game code—a response that defies the normative systems of games. Code or player's activities can be understood procedurally in game systems as normative or irregular, undetermined by the "win state" of a commercial game. Like the Dadaist, Fluxus, and Situationist games, de Certeau's and Bogost's theories ask individuals to question the values of acceptable procedural behavior within everyday society and video games through structured play. For example, boys from the Los Angeles area were observed abandoning the prescribed violent missions of the video game Grand Theft Auto: San Andreas (2004), to instead find simulations of their homes (Laurel, 2005). The creators of Syobon action (2008) intentionally defied normative strategies of play found in side-scrolling video games like Super Mario Bros. when creating the procedural behavior for Syobon's game world (Bogost, 2011). By making games within a game-based art pedagogy, students in the study learned that game rules and computer code are subjectively written and understood within the context of dynamic systems of play. The pedagogical goal of the research is to develop a curriculum that expanded students' knowledge of procedural behavior, introducing them to how the interconnected systems in games can be critiqued and mapped to the complexity of daily life. In the next section, I describe the action research design of the game making study.

Design of Study

Action research was chosen for the study model because of its strong design to support iterative and reflective teaching and curriculum development (Bresler, 1994). Action research is a reflective process of progressive problem solving and lessens the space between knowledge generation and the process of teaching (Noffke, 2009). Action research moves beyond reflective knowledge of outside experts to an active and iterative form of theorizing, data collection, and inquiry within an emergent structure.

At the beginning of this action research process, I reflected on my earlier observations and assumptions of art content that would engage students as a high school and summer camp teacher. Several years of gathering data, reflecting, and incorporating my previous experiences teaching games went into developing the study's curriculum, in addition to considering students' cultural contexts and interests in video games. The study included four classes of students enrolled in a game camp, ages 8-13, using approximately 25 hours of class time over a 5-day period. Each time the game class was taught, feedback from the students, other instructors, and my personal reflections modified the teaching strategy for the next day and the following camp iteration. This iterative action research process of gathering data, reflecting, and incorporating those experiences in the next round of participation is also found in the process of game design (Salen, 2007) and reflective teaching practice (Cochran-Smith, & Donnell, 2006).

During the weeklong class, students were introduced to the history of games in art and learned concepts and methods of game development by making physical, tabletop, and video games as forms of visual expression. Data for analysis included daily in-progress game files, in-class feedback from students and co-teachers, written and verbal course assessments, pre- and post-survey analysis, and interviews with a sample set of students and parents. The surveys consisted of Likert-scale questions about the students' experience with technology and games, confidence in understanding how a game is made, and the likelihood of making games in the future. My observations, survey data, and interviews with students, parents, and co-teachers provided feedback to develop the curriculum further as part of the iterative action research narrative.

When I examined my game-based art pedagogy, I considered how teaching game making as artistic production might engage students with concepts of complexity thinking, applying it to the students' understanding of how the world is interconnected. During the game development process of playing and making physical, tabletop, and video games, students were exposed to and explored how game rules and mechanics may be advantageous to some players, or in other cases, provide equity to all. In doing so, students learned how game structures like probability, speed, and consequences could correspond to the complexity of real world scenarios.

Students learned video game programming with the drag-and-drop visual interface of GameMaker software (YoYo Games, 2013). In the development of the curriculum, I specifically noted what game actions were common across many video game genres, creating a set of game terms using the abstract language of move, avoid, release, and contact (MARC). This was intended for students to broadly interpret what those game actions could mean in different contexts.[4]

In the introductory video game tutorial, students learned how to make a game using MARC as descriptors for the game characters they created. The tutorial described how to program the player to move up and down and release objects. Opposite to the player, students also created a computer-controlled character generating objects for the player to avoid and contact.

The abstracted concepts of MARC in the game-based art pedagogy have been framed as programmable game scenarios open to a variety of interpretations (see Table 1). Within the context of game-based art pedagogy, the broad concepts of MARC have enabled tactics for students to question, examine, and critique the rules embedded in social norms, rules, and systems as unit operations. The complexity of what the four programmable operations encompass in a game could expand or contract based on available class time and students' individual motivations.

The four concepts of MARC (see Figure 1), when considered as metaphors for procedural actions within different types of systems, provide a broad basis for connecting programmable video game unit operations with artistic metaphors for systems of everyday lives. The MARC concepts can be used as tools for game making, game criticism, and game play, intended to overlap, contradict, and be recursive with each other. For example, movement can be an act of avoidance and contact, while the absence of movement (stillness) also shares these same properties. Shooting, an action common in video games, is deconstructed through MARC as releasing or projecting, which may be translated into actions such as projecting your voice,

	Move	Avoid	Release	Contact
Social (*Making Friends*)	Move toward a desirable person	Get away from people not desirable	Remove friends from social circles	Take actions to become friends
Philosophical (*Aesthetics*)	Steer toward aesthetic preference	Steer away from poor aesthetic choices	Mask aesthetic mistakes	Combine to create beautiful or interesting aesthetic choices
Theoretical (*Semiotics*)	Use signs that have multiple meanings	Strengthen established meanings	Send signs to the vocabulary pool	Combine signs with other signs to create new meanings or remove meanings
Political (*Universal Healthcare*)	Get the health care bill passed	Negative press and losing votes	Messages to the public promoting the bill	Persuade and acquiring votes
Psychological (*Anxiety in Public Speaking*)	Give speech in front of the class, stand with confidence	Poor inflection, students laughing, being distracted	Say words at the proper time	Make eye contact, use inflection

Table 1. MARC framed within multiple game scenarios.

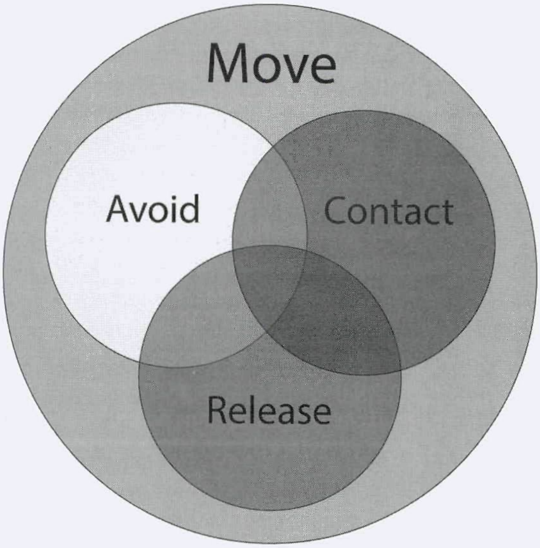

Figure 1. MARC.

projecting your views onto someone else, releasing your fears, or releasing your control.

These open metaphors provided the basis for producing games with multiple meanings. To demonstrate the interconnected and dynamic concepts of complexity thinking, game systems were compared in class to other systems or situations in life such as getting ready for school and the BP oil spill of 2010. When students moved beyond the introductory MARC video game tutorial, they individualized their games further by creating new rules, game objects, and programmed behaviors, changing the dynamic nature of their games and making their systems change in complexity. In the next section, I explain how MARC provided students a method to begin thinking about and understand complex systems programmed in video games and in daily life.

Results

Understanding MARC in Other Games

Three months after the classes ended, a sample set of students and parents were interviewed based on their availability to meet. From these interviews, it was clear the concept of MARC was understood and recontextualized outside the game course's framework by the majority of students. Sawyer, a 9-year-old boy, programmed a game called Box Ninja in which the player advanced by moving around and avoiding characters using a combination of levitation powers and gravity. Sawyer connected the MARC actions he learned from the course with actions embedded in the video game Infamous (2009): "So I was fighting a bunch of people and I'm thinking, you know I'm releasing (lightning)... So that day I made connections with what we talked about in the video game camp" (personal communication, November 3, 2010).

Sam, age 10, made a game called Alien Attack in which the player must avoid aliens. In the first level, a brick wall must be removed before the player can progress to the next level. While the player removes the wall, aliens release mines programmed to pass through the wall. On the second level, the player may retrieve an object that creates ice barriers to block the alien mines.

Both Sam and Sawyer saw how the programmable actions in their games were also in games they played at home. Sawyer realized that the games he plays at home contain objects programmed with unique characteristics interacting in independent, complex ways. Sam described how the player object works and interacts with other game objects, whether objects were programmed to be solid, permeable, or moveable—showing an understanding of the coding required to enable the unit operations of game objects. Connecting this understanding of MARC to the real world, Sam recognized game designers must thoughtfully create innumerable unique, dynamically interactive objects for a real world simulation. From this realization, Sam understood "it would take a million years" if he made a video game out of daily life (personal communication, November 10, 2010).

Other students discussed how MARC made games playable. Gale, age 12, centered her game, Ronald's Revenge, on the importance of eating healthy (see Figure 2). Gale programmed french fries and hamburgers as foods to be avoided in the game. If the player came in contact with the fried food, she visibly became larger and moved slower (see Figure 3). The player was programmed to return to a healthy weight and move at her original speed if she came in contact with broccoli. Gale saw MARC as being an important part of the mechanics of gameplay, noting MARC actions made a game fun (personal communication, November 15, 2010).

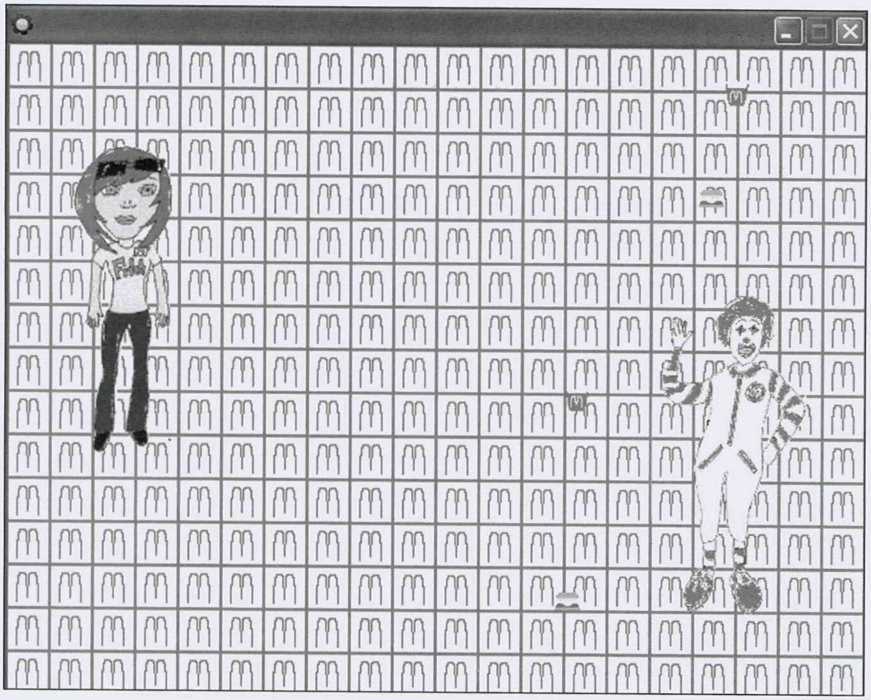

Figure 2. *Ronald's Revenge.*

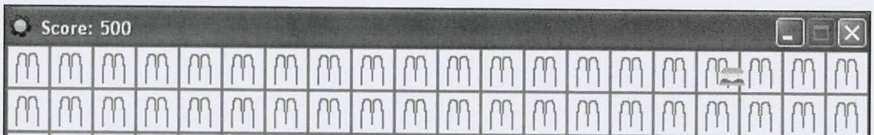

Figure 3. *Ronald's Revenge.*

Gina, age 11, made a game called iPod Touch vs. Robber. In her game, the iPod avoided a computer virus released by a robber. The iPod sent a 911 emergency message to stop the computer virus, receiving extra points and lives when the iPod made contact with iTunes credits and batteries. Gina explained that by making games, she now understood the balloon popping game Bloons as a physics problem that looks at trajectory, force, and speed:

> When I look at different, more complicated games, I try to figure out how long it would take and what kind of things they used [to make the game]. I was playing... a monkey game [where] you have to throw darts to hit balloons. [The designers] set the range of motion for the dart, and how long you hold [the dart] is how fast it goes. It was cool to actually know how it worked, before I have no idea how this works. (personal communication, November 8, 2010)

By learning how to make games and using the MARC concepts, Gina began seeing video games as a maker, glimpsing below the playing surface to understand how video games work with interdisciplinary knowledge, recognizing how computer code uses many different kinds of objects and variables. Thinking as the designer of Bloons, Gina also described the user experience, reflecting what information a player would need to play effectively.

Even though students only began learning programming concepts and structures, Sam and Gina acknowledged that the programmed and designed complexity of games varies according to what is needed for the game to function and what the player is experiencing. By using the lens of MARC, Gina and Gale saw how relationships between objects and actions develop the mechanics of game activities. Students like Sam, Gale, and Gina understood that in order for a game system to function properly, different game actions work simultaneously, connecting how each game object works within interdependent systems. By engaging in the game making as a form of visual expression, students were exposed to the procedural behavior between action and objects.

Mapping Tactics and Unit Operations in Everyday Life as Games

The majority of students stated in their post-interviews that the experiences of playing, critiquing, and making games stayed with them after the class was over. When students were asked if they saw games in everyday life, specifically the concepts of MARC, several described how they saw game experiences mapped onto everyday physical and social actions. Saddie, age 11, described using game tactics for grammar lessons, explaining how nouns and verbs, placed in the correct order, are critical for a clear sentence structure. While it is unknown if Saddie would have connected games to her schoolwork without our conversation, she could see how the systems of puzzle games can be mapped onto the systems of written language.

Gitka, a 13-year-old girl, created the game Quest for Ms. Meatball. The player was named Mr. Taco (after Gitka's favorite food). Mr. Taco tried to find Ms. Meatball and avoid Fat Boy, Grilled Cheese, and Turkey Sandwich. Mr. Taco has to get past the other characters before they ate or married Ms. Meatball. Gitka saw a relationship between systems in games and the efforts needed to make friends: developing an understanding of how the game (or person) operates; learning what behaviors are acceptable and encouraged, and which behaviors are viewed as unfriendly; receiving behavioral feedback from the person you want to be friends with; and the rewards that come with being a friend (like secrets). These are comparable to activities of a game.

Pre-Survey	
How likely are you to work on a game making project with a computer on your own?	
Answer Options	**Response Percent**
I am definitely planning to do this	14%
I likely will	37%
I might	21%
Not Sure	17%
Not at all	11%
Post-Survey	
How likely are you to work on a game making project with a computer on your own?	
Answer Options	**Response Percent**
I am definitely planning to do this	40%
I likely will	29%
I might	11%
Not Sure	19%
Not at all	2%

Table 2. Likelihood of Making a Game.

In Gale's interview, she noticed how game environments and systems of learning and education might be mapped onto each other. Gale asked me what I thought made a good game. I said commonly a good video game gets increasingly harder as the player gets better and has more experience. Gale quickly responded that school was analogous, where grade levels get harder but you "learn how to do it as you go" (personal communication, November 15, 2010). While developing relationships is a complex, emotional project, Saddie, Gitka, and Gale saw how societal structures and social behaviors could be interpreted through a game context.

Like thoughtful game design, the pedagogical structure of the curriculum supported a wide range of students' ages and abilities. As described earlier, students began with an introductory video game tutorial. Students were encouraged to "level up" when they were ready to take on more difficult content as a way to explore new ideas and refine their knowledge (Gee, 2004). This encouraged students to play and learn by taking risks or even failing within the structures of their experiences (Hicks, 2004). Of the 70 students in the game camps, each student completed a working video game. Only 16 students did not move past the introductory video game tutorial (23%). Additional curricular design and pedagogical strategies could facilitate advanced explorations of complexity by discussing the many ways that move, avoid, release, and contact can be realized in everyday life and creative, metaphoric ways.

Pre-Survey	
I can explain how to make or modify a video game level.	
Answer Options	**Response Percent**
I definitely know	11%
I know	14%
I'm not sure	25%
I might not know	11%
I don't know	39%
Post-Survey	
I can explain how to make or modify a video game level.	
Answer Options	**Response Percent**
I definitely know	27%
I know	57%
I'm not sure	11%
I might not know	3%
I don't know	3%

Table 3. Ability to Explain How to Make or Modify a Video Game.*

Pre-Survey	
How likely are you to take classes in the future that focus on computers or technology?	
Answer Options	**Response Percent**
I definitely would	17%
I would	48%
I'm not sure	15%
I might not	17%
I wouldn't	3%
Post-Survey	
How likely are you to take classes in the future that focus on computers or technology?	
Answer Options	**Response Percent**
I definitely would	27%
I would	25%
I'm not sure	21%
I might not	25%
I wouldn't	3%

Table 4. Likelihood to Take Future Classes That Focus on Computers or Technology.*

*Percentages rounded to the closest whole number.

In conducting pre- and post-course surveys as part of the study, a significant number of students left the course with a greater desire to make games (see Table 2). Of the sample set of 10 students interviewed 3 months after the course was over, seven attempted to make more games, showing continued interest in making games and using the lessons learned from the course. Of the students I spoke with who made more games after the course, many were unable to receive help from their parents or independently find additional resources to go further with their games. Other survey results showed that after completing the course, a significant number of students expressed gaining confidence using technology and knowing how games are made (see Table 3). Yet, they showed diminishing interest for technological careers and taking technology-based courses (see Table 4). Further research is needed to show (1) how students continue to develop forms of visual personal expression through game making and (2) how creating programmable digital media, like video games, in classroom-based art experiences provide meaningful educational exposure to technology.

Conclusion

As a result of this course, students expressed a greater understanding of how complex and interconnected systems work in games, developing their abilities to apply programmable concepts as a form of visual self-expression. From the student interviews, the unit operations of MARC also provided a tactical framework for students to understand and connect interdependent systems within games and daily life. Performing at an introductory level, the MARC concept was intended to support students in game making, allowing them to become creative producers of programmable digital media while providing a method to critically investigate game production. From this research, there is valued evidence that art educators should learn how to critique and make video games as a way to develop an understanding of the associations between objects and ideas, and how game interactions can be traced to reveal and critique complex relationships and systems within artistic and other life processes.

As forms of digital communication swiftly change, new opportunities for creative expression, exhibition, and critique appear in our contemporary culture. The addition of the media arts standards (National Coalition for Core Arts Standards, 2012) and the video game creation category in the Scholastic Arts & Writing Awards (Scholastic, 2010) show how the range of opportunities for K-12 art curriculum has expanded. Observing these cultural cues, we art educators should actively engage and respond to these changes. I propose the time is right for art educators to embrace making programmable media such as video games across the K-12 art curriculum.

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ENDNOTES

1 All digital games are described in this study as *video games,* which include games played on all types of display screens.

2 The structured play of games that I am defining include childhood games like Ring-Around-the-Rosie, Tag, Hopscotch; sports like Kickball, Polo, and Baseball; tabletop games like Dungeons and Dragons, Connect 4, Chess, Boggle, and Uno; and video games like Pac-Man, Super Mario Brothers, Grande Theft Auto, and Angry Birds. Unstructured activities like washing dishes or playing with blocks may become games with structures or limits put onto the activity (i.e. build a structure as high as you can in 60 seconds or using only red blocks).

3 Dada artists like Hannah Höch (1889-1978), Tristan Tzara (1896-1963), Francis Picabia (1879-1953), and Raoul Hausmann (1886-1971) engaged in wordplay, techniques of ironic juxtaposition, fragmentation, chance, and audience interaction as explorations of authorship and authority in their art. Dada and Surrealist artists like Sophie Taeuber (1889-1943), Hugo Ball (1886-1927), Max Ernst (1891-1976), and Hans Bellmer (1902-1975) built structured play activities like dolls, puppets, and masks into their art practice as ironic gestures to the culture of bourgeois society. Surrealists also used "automatic" drawing and writing to circumvent conventional logic in creating visual and verbal concepts related to contemporary culture. Most famously, the game Exquisite Corpse (1925), appropriated from the parlor game Consequences, was a collaborative method used for blindly creating compositions. Fluxus artists used everyday objects and a variety of art media such as performance art, video, and music, to develop their ideas of randomness in nature. However, Dadaism's use of chance and play arose from the destructive, bleak experiences of World War I while Fluxus artists used play for positive social and communal ambitions. Linked to Dada and Surrealism through the French avant-garde movement Lettrism, an international Marxist avant-garde organization, the Situationists suggested alternative life experiences that united play, freedom, and critical thinking through art. An historical account of critical play through twentieth-century art movements such as Dada, Surrealism, and Fluxus are described in detail in Mary Flanagan's book *Critical Play* (2009).

4 I developed MARC (move, avoid, release, and contact) as a way to abstract the actions of many video games into a language that shows commonalities across video game genres (shooter, action-adventure, role-playing, puzzle, strategy, etc.) that also describes events in everyday life within a game context.