Game Design as Problem Solving

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Abstract: In this paper we present how students at an arts immersion school in Canada, designed games using *Minecraft* as a design tool to represent Grade 8 curriculum content learnt in Social Studies. Our research was based on our theoretical framework on how game design could be an aesthetic process, which elaborates how a design commences with a problem and progresses as an iterative creative cycle towards finding a solution. Using this framework, we examined two groups of Grade 8 students' game design process. The groups represent unique approaches towards problem solving that incorporated content from the Aztec and Spanish Civilization in their game design. We have interpreted the representation of the content as the posed problem and analyzed how each group proceeded with their game making based on their ideas, experience at playing the game and feedback received from fellow classmates. Our findings highlight how the design process through *Minecraft* was a creative endeavour on their part. Through our findings, we re-emphasize how involving students in game creation efforts help them to experience an aesthetic learning process, allowing them to become protagonists of their learning. We argue for game design as learners' problem solving experience, through which they struggled to construct knowledge in social systems while developing fluencies both in gaming and technology.

Keywords: Aesthetic game design, *Minecraft*, Problem solving, Creativity

1. Introduction

A significant body of research in the field of learning sciences and technology have revealed how digital games advocate problem solving skills by creating opportunities to pursue new roles in virtual worlds that mimic real life scenarios (Gee, 2008; Gee & Levine, 2009; McGonigal, 2008, 2011). In fact, contemporary games have established a functional or pragmatic way of knowing through meaning making that occurs on account of direct interactions or responses of the player with the gaming world (Squire, 2011). In this paper we explore these interactions further by examining how learners or students in a mid-high school in Canada interact with digital games such as *Minecraft* to create and design their own games. *Minecraft* has no prescribed goals and players are free to explore a seemingly infinite virtual space for constructing or deconstructing the surrounding with blocks of materials (Johnson, Adams- Becker, Estrada & Freeman, 2014). Its compelling sandbox structure makes it a game with short term designer/player imposed goals (Duncan, 2011). Hence it offers opportunities for learning design skills and as players are often required to use programming skills to overcome challenges within the virtual world the game has been highlighted as a potential gateway to learning computer science (Johnson et al. 2014).

Learning to design games helps develop gaming fluencies for players/learners because it allows learners to become fluent not only in game design but also in the creative, critical and technical aspects of working with new media (Kafai, 2006). What is often overlooked in this area are youth explorations and participation in game production that expands beyond technical and critical considerations towards creative or artistic ends (Kafai & Peppler, 2012). Hence we have analyzed the games using the aesthetic game design cycle, which illustrates the creative process of game design (Gupta & Kim, 2014). The creative process suggests how games can be aesthetically designed by learners with creative responses to the theme, content or problem. Our analysis reveals how the learners were deeply engaged in seeking a solution to the problem.

The research was based in an arts immersion school in Canada where Grade 8 students participated in designing games towards incorporating content from their Social Studies curriculum as in the Aztec and Spanish Civilization. The entire process was viewed as a problem and the game design emerged as a solution. The data was collected using a connective ethnography research design that utilized direct

observations, audiovisual recordings, screen recordings of the game design process and semi-structured interviews with the designers.

2. Literature Review

Gee (2003) has argued that learning to play games could engage players in valuable practices relevant to and supportive of school learning and literacies. Extending the notion, Kafai & Peppler (2012) have suggested how learning to design games could engage youth in a variety of valuable practices. These practices evolve as complexly intertwined ecologies or types of meaning making systems that incorporate developing fluencies both in terms of gaming practices as well as technology (Kafai, 2006). From a constructionist perspective Kafai (2006) has also argued that when making games learners construct knowledge and their relationship to it.

Research in the field of gaming fluencies have situated game design in the field of new media literacies (Gee, 2010) emphasizing system-based or technical thinking (Salen, 2007) and critical engagement with media (Buckingham & Burn, 2007; Pelletier, 2008). The artistic and creative ends towards designing a game have also been taken into account expanding the palette of previously conceptualized literacies to include a broader spectrum of design activities that reflect youth culture (Kafai & Peppler, 2012). In particular Kafai & Peppler (2012) have argued how creative practices in youth game design are reflected through their artistic representation using any particular modality (visual, audio or kinesthetic) or through multimodal sign systems that combine two or more modalities to express an artistic idea. Hence from this perspective game design could demonstrate the ability of the youth to depict objects and ideas as a combination of stimuli that becomes an important aspect of meaning making and learning. It is also pertinent to note that computer games, in comparison to other multimodal texts, offer added complexity both in terms of player and designer including the challenge that the player, anticipated by the designer could move around inside the world of the text and experience it from more than one visual, spatial and textual perspective (Robertson, 2011). Hence game making becomes a complex design task which requires a range of creative skills including problem finding, problem solving, evaluation and communication (Robertson & Nicholson, 2007; Robertson, 2011). Elaborating upon the evaluation and communication, Robertson (2011) emphasized how both are inherent parts of the creative process as these involve the ability to constructively evaluate elements of the game such as storytelling, visual design, level of challenge or defining clear goals.

Egenfeldt-Nielsen, Smith and Tosca (2013) while elaborating on game design have defined the elements that constitute a game as the rules, geography and representation, time and number of players which they call as aesthetics. Kafai & Peppler (2012) have similarly stated that youth perceptions of a game include gaming artifacts such as a set of rules, core mechanics, components, considerations of space and goals, are deeply rooted in the aesthetics of the medium in which they are produced. Hence to illustrate this creative component of game design we have examined how learners design games using the aesthetic game design cycle (Gupta & Kim, 2014) (See Figure 1).

The development process of designing a game usually consists of a conceptual phase, a design phase, a production phase and a testing phase (Egenfeldt-Nielsen, Smith & Tosca, 2013). However, we have visualized this design process as a creative and iterative problem solving process, which in itself is an aesthetic experience (Gupta & Kim, 2014). Our discussion of analysis, therefore, focuses on how the learners' design work is a problem solving process, showcasing the aesthetic nature of game design. Games are representations of problems providing multimodal environments for embodied experiences in which players take on new roles and identities to solve problems while managing complex semiotic domains (Dickey, 2006; Gee, 2003, 2008). In our effort to use this cycle to explain the process of game design, we have shown how game design commences with the problem of incorporating curricular content in the game and ends with game creation as an aesthetic learning experience (Gupta & Kim, 2014; Parrish, 2009).

Problem-solving can be aesthetic learning experiences emerging like plots in a narrative (Parrish, 2009). Problem-solving as a cognitive activity generally emerges as learning experiences for designers/learners to engage in (Jonassen, 2000). The design as problem-solving, however, becomes an

aesthetic learning experience when the learners are immersed in the learning activity as protagonists of their own learning (Parrish, 2009).

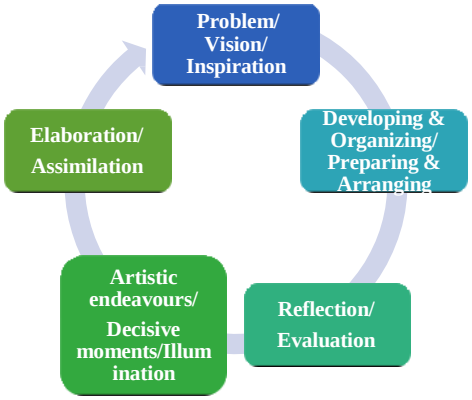

Figure 1. The Aesthetic Game Design Cycle

As stated in our recent work (Gupta & Kim, 2016) learners could become designers of their own learning using digital sandbox games such as *Minecraft*. Research on *Minecraft* has revealed how the game draws in players who become entrenched in the worlds, developing a skill set that leads to a sense of ownership which in turn fuels the challenge of free and creative play (Robertson, 2010). Creativity also springs from joyful explorations of the worlds that are procedurally created in the game allowing the players to concentrate on their unique creations (Duncan, 2011). The emergent gameplay of *Minecraft* thus is viewed less like a game but more like a creative platform for producing user-generated content (Duncan, 2011). Since user generated content is of primary importance in *Minecraft* it has afforded opportunities for development of games that does not require altering the code of the game (Duncan, 2011). This could be referred to as soft modding or socio-technical modding (Gee & Hayes, 2010) but with later versions *Minecraft* emerged as a valuable platform for learning programming skills within the virtual worlds (Johnson et al. 2014). Hence *Minecraft* as a design tool allowed the learners to engage in creative production by offering the technical and critical aspects of new media.

3. Aesthetic Game Design Process

Using the aesthetic game design cycle we have analyzed the game design process of two groups of grade 8 students from an arts immersion school in Canada whose goal was to design or create games using *Minecraft* as a game creation tool or platform that would help learn more about the Aztec and the Spanish Civilization. One group consisted of three girls who designed a maze that also functioned as a trivia game on the content they had to cover while the other group consisted of two boys who incorporated the content within the game design by creating a game that was based on a game played by the Aztecs. We have focused on the design of both games as problem solving efforts to elaborate how the game design process in itself was aesthetic in nature contributing towards an aesthetic design for learning. For the purpose of this paper, we call the all girls' group as Team Tree and the all boys' group as Team Ball Game.

The problem or the goal for the class in general was to represent the content learnt in Social Studies through a game so that others can learn about the Aztec and the Spanish Civilization through a wide variety or genre of games. Team Tree approached the problem by deciding on creating a trivia game within a maze that would generate a rollercoaster experience using content from both the Aztec and Spanish Civilization whereas Team Ball Game decided to incorporate the basic elements of a ball game that was played by the Aztecs as in the *Meso-American Ball Game*, to create a game that would help learners experience the culture of the Aztecs. We have described the process emphasizing how learners interacted with each aesthetic element of the game to visualize the theme or the narrative, sustain the engagement and anticipation of

players and introduce patterns, routines or motifs to illustrate the aesthetic learning experience through their design (Gupta & Kim, 2014).

3.1 Alice in Wonderland Maze

Team Tree defined the problem as using content from Aztec and Spanish civilization in a game by designing a maze within *Minecraft.* Their goal was to create a trivia game based on the Aztec and Spanish civilization. Using visual concepts or images of a tree and the abstract world of "Alice in Wonderland", they formulated a game theme that would generate a rollercoaster experience for the players (Figure 2). Hence their game space took the shape of a two storeyed house with an underground or basement floor (Figure 3). In the game, the players would have to move from one end of the building to the other much like a rollercoaster ride. The rollercoaster experience is thematically emphasized by the totally abstract, unexpected sections, areas or rooms that the players have to move through in order to proceed with the game.

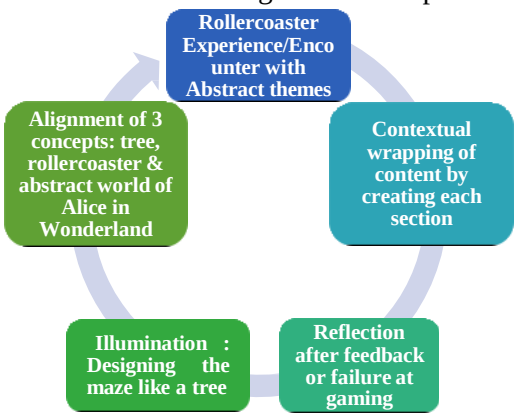

Figure 2. Alice in Wonderland game design process

Team Tree commenced the design by identifying how they would embed the content in the form of trivia questions and then attempted to wrap it contextually (Clinton & Hokanson, 2011) by creating sections that would engage the players both visually and kinesthetically to express the complexity that engages the players in solving the problem.

Figure 3. Exterior view of the maze

Figure 4. Rollercoaster ride in the maze

Team Tree emphasized the theme by creating a narrative similar to the story of "Alice in Wonderland" by L. Carrol in consideration of the aesthetic elements of the game. According to all three members of Team Tree (Winona, Gabbie & Elora), the visuals were designed to portray the abstract experience of "Alice in Wonderland" which changes spatially by sections or rooms. In the process they incorporated the conflicting information or the tension (Parrish, 2009) that marks the progression of the

narrative. For example, the game commenced with the player entering a small foyer where the player had to press the right key for the right answer to get inside or get killed by hot lava.

The theme also emerged from aesthetic elements such as the rules of the game. According to Winona, their maze unlike other mazes had a few trap doors or entrapments and the player had to get the right answer to proceed in the game. As a maze within *Minecraft* the game had its own specific "rules or limitations" (Egenfeldt-Nielsen, Smith & Tosca, 2013) that determined what the players could do. And as designers, Team Tree was guided by these rules (for e.g. creating red stone trap systems, getting buggies for rollercoasters) (Figure 4) and were creative within the given parameters.

Spatially the design spoke to the narrative and the theme through the abstract details of every section or room. The physical space or geography of the game had been conceptualized to unfold as an interesting and engaging rollercoaster ride. As Team Tree claimed during interviews and class presentations each section was developed by one of them and they took the creative liberty to conceptualize the spatial arrangement, choose the colours and the general appearance of the game space. Each one of them went through several iterations of developing, organizing and preparing the sections. As a team they also decided how the arrangement should look like (e.g. creating an extension passageway from the initial structure with glow stones after the long ladder ascension) before they divided up the work based on their individual level of expertise with *Minecraft*.

It was apparent that there were stages of reflection and evaluation because the team had to present their game in the class and get direct feedback from the teacher and other students. There was also feedback on platforms such as *Sesame* from other students who had played their game and commented on aspects of their design. Team Tree acknowledged during interviews how they had to rethink and evaluate entrapments or aspects of the game when the mechanics failed during trials. Besides the feedback that they received on *Sesame* regarding improving the buttons for the traps or setting the buttons where missing helped to re-evaluate and reflect upon their game. Positive feedbacks on the design and pattern of the game as well as on the content (questions) also reassured them about using abstract visuals in their game design.

The artistic endeavours or decision making with the game creation had been iterative in nature ranging from conceptualizing each section for an "Alice in Wonderland" experience to adding minor details such as clarifying some of the passageway directions through red stone marks. Illumination within the design process occurred through efforts to mark continuity of the gaming experience through vibrant visuals and new kinesthetic experiences for each section. Specifically, it involved the iterative alignment of two visual concepts (tree & abstract visuals) with a kinesthetic experience (feeling of riding a rollercoaster) throughout the design process. According to their discussion in the video recording, these were meant to sustain the engagement and anticipation of the players.

At each stage or level of the game (although the levels were not clearly demarcated as the game felt more like a rollercoaster ride), Team Tree worked towards sustaining the engagement of the players by introducing new tensions or complexities (Parrish, 2009) through augmentation of unexpected turn of events (Gupta & Kim, 2014). Each death trap or complication through a wrong answer was a unique experience (e.g. death by molten lava or a whirlwind fall through tunnels or free fall through dark zones) as each experience was varied through the visuals in terms of size, shape and colour as well as time allotted for death. Similarly, the player was rewarded with achievements towards anticipating what came next. Such anticipation and engagement through introduction of intrigue and resolution could bring about unity in the learning process leading to consummation of learning (Parrish, 2009).

Routines such as the frequency of trivia questions (beginning or ending of a section with entrapments, the sequence of death) could help to comprehend the connections in the theme or the narrative (Parrish, 2009). In games, routines and motifs are yardsticks for measuring progress and establishing continuity and connection with new situations. It becomes easier for the player to comprehend the sequence or growth of the narrative with such repetitions over time or through the actions of players (Gupta & Kim, 2014). The repetition of patterns created over iterations such as the long and winding passageways or tunnels with various colourful representations could help the players comprehend the turn of events.

Time as an aesthetic element was considered in the game only during the death stages. The death experiences became progressively longer as the game progressed although there was no specified time limit

to the game. This sequence of death span emerged as a pattern introducing intrigue and anticipation in the game. Motifs such as red stone marks on the tiles in the passageways or tunnels and direction banners further helped to mark progress within the game (Gupta & Kim, 2014). Team Tree designed a single player game which is clarified through the in-game directives to the players.

Figure 5. Basement room made of glow stones

Figure 6. Colourful passage way

Team Tree experienced several aesthetic moments that unified their game design process adding meaning to the game. These include the moments of ideation and decision, such as extending the notion of the branches/tree through the visuals of passageways (Figure 6), creating a new death experience to mark the end of each section, creating a vibrant environment in every section through the visuals (multi-coloured glass passageways to a library or a room floating atop lava) (Figure 5) and embodying new kinesthetic experience (e.g. jumping through a waterfall, sliding down through openings in passageways, a real rollercoaster ride). These moments added up as the gaming experience, and hence the design experience became unique, memorable and holistic.

3.2 The Meso-American Ball Game

The Meso-American Ball Game was created by a group of two boys (Baz & Floyd or Team Ball Game) who began their game design after researching the actual *Meso-American Ball Game* that was played by the Aztecs. Here again the problem was defined as the inclusion of the disciplinary content from the Aztec and Spanish Civilization within a game. According to Baz and Floyd, information on the *Meso-American Ball* game was not easily available other than the fact that it was played with a lead ball in a big open space or field and that players often died while playing as the game involved high impact physical contact. Hence they reconceptualised the game in *Minecraft* while incorporating and adding cultural aspects of the Aztecs.

Team Ball Game revealed in their interviews that they made an effort to have originality in their design by incorporating the Aztec nature of gameplay involving high physical impact. Team Ball Game acknowledged that the nature of game play would recreate the experience showcasing the dark side of the game. Therefore, they designed the game space as a box shaped court resembling a "dungeon" and subsequent efforts to develop, organize and prepare the game led to the emergence of a ball game concept with multiple players in two teams (Figure 8). Thus the theme or the narrative emerged directly from the content highlighting Aztec cultural practices. In order to win, the players of one team had to throw the ball through a net. The game commenced with the ball being dropped at the centre of the court and the players of one team grabbed the ball and ran to net the ball. The game continued with subsequent ball drops and the players had to try and stop the opposition team members through a "Player versus Player" element of *Minecraft* that would allow the players to use their "fists" or "mushrooms" to create a "knockback" effect.

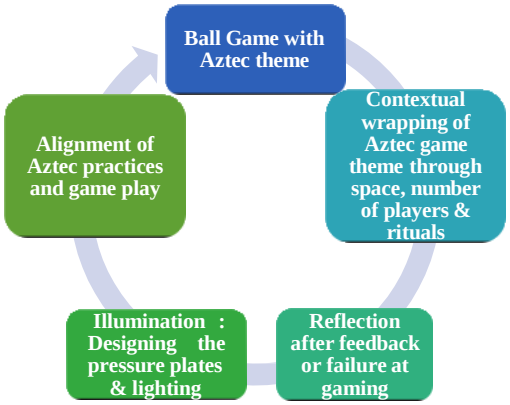

Figure 7. *The Meso-American Ball Game* design process

It is apparent that they reflected upon the game design as both the boys claimed that they created prototypes and conducted trials to check if the concept worked in practice. The prototypes also generated feedback from their classmates which helped modify the flaws they had overlooked such as team colours while playing the game. Both Baz and Floyd later explained that the game had turned into a "slaughter house" at first since every player started attacking the other without understanding the rules. They had put up the basic rules outside of the court but since none of the players could get out once they were inside, the banner did not serve its purpose. However, based on the feedback Team Ball Game received on their game design both in class (as revealed through video recordings and observation) as well as on *Sesame*, they realized that they should have clarified the rules of playing the game within *Minecraft* which would have elaborated on the narrative by sequencing the steps (Gupta & Kim, 2014). The elaboration of the narrative occurred but only conceptually when Team Ball Game shared their game through a class presentation and subsequent interviews to explain how they ran out of time to create a sacrificial room in which the winning captains were supposed to be teleported in order to be sacrificed to the Aztec gods.

The artistic endeavours or illumination of the aesthetic game design cycle (Figure 7) were iterative throughout their game design process occurring in the form of creating technicalities for the game such as lighting beneath the hoops/nets on the side walls to signify scoring of points and success in netting the ball (Figure 9) The illumination stage was also apparent through the creation of the levers on the floor/court which the players had to run over to get a block to automatically rise up from the floor. The player could then jump upon it and net the ball. Such complexities created the necessary tension in the game that marked the progress of the narrative.

As stated earlier the game space or geography consisted of a covered court built out of grey stone entirely with hoops on the right and left side of the court for netting the ball. The ball dispenser was placed on the ceiling and the teleportation button was placed on the front wall for winning captains. The court was divided into two halves with a red line to show the demarcation. A dark grey carpet was placed in the centre below the ball drop zone to mark the beginning of the game. The entire court was lit up with fire pits and red lighting. Such an arrangement helped portray the dark theme of Aztec games that involved death and helped create the mood for the story to unfold (Gupta & Kim, 2014). In this case it could also be said that Team Ball Game as designers opted to make it a multiplayer game with two teams in order to add a social component to the game (Gupta & Kim, 2014).

Team Ball Game went through several stages of iterations of the creative cycle, as acknowledged during interviews, to arrive at how the game needed to be played. Both Baz and Floyd revealed how they ran out of time to create a "Jump boost" for players which would have made the game even more exciting. Introduction of new complexities or minor complications through the form or structure of the game such as the jump boost would have enhanced the process of sustaining player engagement. The teleportation to the sacrificial room and an elaborate death sequence could have brought in an unexpected turn of event through game play establishing continuity and connection in time with the Aztec cultural practices.

Figure 8. The court for playing the game

Figure 9. The hoop or net with in-built lighting

Further patterns and routines in the game such as "fist" fighting with "player versus player" access or stopping opposition team members in order to net the ball could have special significance towards comprehending the brutality of the Aztec sport where people could die while playing the game. The routine of netting the ball could be a yardstick for measuring progress in the game as it signified scoring points. The pattern was reemphasized through visual lighting that further added to a sense of achievement sustaining the engagement of the players.

The aesthetic moments in this game design process were several highlighting their moments of coming up with ideas on how each design could result in a memorable experience for the gamers while embedding the Aztec notion of gameplay. These aesthetic moments surfaced through the design of the technicalities (pressure plates) to net the ball, the conceptual use of a dungeon as the physical space for the game, the incorporation of the post-game rituals as well as thinking through and modifying the rules of the actual Aztec game to make it playable. These moments lent continuity and meaning to the game, making the design process a holistic experience for Team Ball Game.

4. Discussion

The design process of both games (*Alice in Wonderland Maze* and *The Meso-American Ball Game*) emphasize how the process of game design engaged the students in valuable practices of coordinating the creative, critical and technical dimensions of gaming (Kafai & Peppler, 2012). Learners can become designers of their own learning through participation, collaboration and communication through *Minecraft* which as a digital game-based learning environment became the design tool for their activities (Gupta, Rasporich & Kim, 2016). Their creativity in envisioning the problem, preparing and organizing multiple smaller design ideas that add up to the larger design conception, reflecting and evaluating through artistic modifications or decisive changes in order to elaborate upon and develop the gaming experience reflects how their work resembled an aesthetic design cycle (Gupta & Kim, 2014). This process was also very similar to the technical game design process involving conceptual, design, production and testing phases as defined by Egenfeldt-Nielsen, Smith & Tosca (2013).

We have also seen how the learners navigated the added complexity of analyzing the game from a dual perspective of a designer and a player while creating and experiencing the game from a visual, spatial and textual point of view (Robertson, 2011). The process of game design therefore became a complex design task that incorporated finding the problem from the content as in aspects of the Aztec and Spanish Civilization that was represented in the game, ways to solve the problem through the game, and evaluating and communicating with fellow classmates in the process (Robertson & Nicholson, 2007, Robertson, 2011). Evaluating elements of the game such as the theme or the unfolding of the narrative (rollercoaster theme compounded by the "Alice in Wonderland" experience for Team Tree or the dark and latent theme of violence and death in the *Meso-American Ball Game* accentuated by the dungeon feel and the teleportation to the sacrificial room) and subsequently deciding upon the visual design (colourful vibrant and abstract look of the maze as opposed to the grey and dark dungeon) or clarifying the goals through the selection or

type of a game (maze and a ball game) as stated earlier re-emphasized the constructive approach and creativity of the learners (Robertson, 2011). As a creative and constructive design process the learning experience had plots that unfolded through the problem solving experience (Parrish, 2009). In the *Alice in Wonderland* maze the plots were featured as a steady stream of unexpected abstract events, each having its highs and lows through introduction of new tensions or complexities to sustain the engagement and anticipation of the players. In the *Meso-American Ball Game* there were clear demarcation of plots as in beginning, middle and ending of the game through spatial arrangement (starting in the middle of the court and teleportation to the sacrificial room for death) with rising anticipation for netting the ball and scoring points. As a learning experience the learners were the protagonists of their learning through their own personal experience of the game which was evident from their interviews (e.g. Gabby, Winona & Baz) where they revealed how they improved their gaming practices and learnt to rethink and redesign games. Hence it can be stated that the learners were not only undergoing an aesthetic learning experience (Parrish, 2009) while creating the games but developing fluencies through critical engagement with gaming practices, technologies and systems based thinking (Buckingham & Burns, 2007; Kafai, 2006; Pelletier, 2008; Salen, 2007).

In addition, the aesthetic elements of games as in the rules, geography or physical space, audiovisual representations, game time, and number of players (Egenfeldt-Nielsen, Smith & Tosca, 2013) established the game theme, created sustained engagement and anticipation, and marked the progress and novelty through patterns and motifs (Gupta & Kim, 2014). In our description of both the game design processes we have previously illustrated how, for each game, the designers/learners interacted with the aesthetic elements that played a crucial role in the creative game-making process. The game theme emerged through iterations of setting the rules and creating the game space and visual characteristics as seen in both *Alice in Wonderland Maze* and *Meso-American Ball Game*. Adding the social component was a decisive factor for creating a single player (*Alice in Wonderland Maze*) or multiplayer game (*Meso-American Ball Game*). In *Alice in Wonderland Maze* fixing the death time added novelty to the game. Thus the games developed through the careful iterations of aesthetic elements which created tension and anticipation in the game play and sustained the suspense and engagement through patterns, routines and motifs (Gupta & Kim, 2014). The aesthetic moments in the design process also helped to bring about unity and memorability to their game design. The iterations further highlighted how the learners reflected upon and modified the game designs based on feedback (in class and through *Sesame*) and their own gaming/testing experience as players. Kafai & Peppler (2012) have called this a creative process because youth perceptions of a game include gaming artifacts such as a set of rules, core mechanics and components, considerations of space etc. which are rooted in aesthetics of the medium (as in *Minecraft*) in which they are produced. Hence *Minecraft*, as a design platform with its own set of aesthetic elements, has also contributed to the challenge of free and creative play for making these games (Robertson, 2010).

5. Conclusion

In this paper, we discussed how learners were immersed in an aesthetic experience while designing a game. Their work became a complex design task requiring a range of creative skills that included problem finding and problem solving. This research demonstrates the potential benefits of using *Minecraft* as a pedagogical design platform that allowed for creative "sandbox" time towards envisioning and solving the problem creatively. Establishing curricular connections for their games helped develop the narratives that represented the problem. The narratives provided a creative framework for the students to employ, organize, develop and refine a thematic material using their own perceptions of a game but rooted in the aesthetics of *Minecraft*. Our study showcased how the learning experience became aesthetic in nature lending meaning and continuity to the learning process. The game design activities helped with developing gaming fluencies that highlighted the creative, critical and technical aspects of handling digital media. The research elaborated how digital games such as *Minecraft* could be used for game design activities to engage students in problem solving beyond curriculum content.

References

Buckingham, D., & Burn, A. (2007). Game literacy in theory and practice. *Journal of Educational Multimedia and Hypermedia. 16*(3). 323-349.

Clinton, G., & Hokanson, B. (2011). Creativity in the training and practice of instructional designers: The Design/Creativity Loops Model. Educational Technology Research & Development. *60*. 111-130.

Dickey, M. (2006). Game design narrative for learning: Appropriating adventure game design narrative devices and techniques for the design of interactive learning environments. *Educational Technology Research & Design.54*(3). 245-263.

Duncan, S. (2011). Minecraft beyond construction and survival. *Well Played*. *1*(1). 1-22.

Egenfeldt-Nielsen, S., Smith, J.H., & Tosca, S.P. (2013). *Understanding video games: The essential introduction*. New York, N.Y.: Routledge.

Gee, J.P. (2003). *What can video games have to teach us about learning and literacy?* New York, N.Y.: Palgrave MacMillan.

Gee, J.P. (2008). Learning and games. In K. Salen (Ed.), *The Ecology of Games: Connecting Youth, Game and Learning*. (pp.21-37). Cambridge, MA: The MIT Press.

Gee, J.P. & Levine, M.H. (2009). Welcome to our virtual worlds. *Educational Leadership.66*(6). 49-52.

Gee, J.P. & Hayes, E. (2010). No quitting without saving after bad events: Gaming paradigms and learning. *Sims International Journal of Learning and Media*.*1*(3). 49-65. Retrieved from http://dx.doi.org/10.1162/ijlm_a_00024.

Gupta, D., & Kim, B. (2014). Aesthetic design for learning with games. In Liu, C.C. et al. (Eds). *Proceedings of the 22nd International Conference on Computers in Education*. Nara, Japan : Asia Pacific Society for Computers in Education.

Gupta, D., Rasporich, S., & Kim, B. (2016). An Emergent Design for *Minecraft*. In M. Takeuchi, A.P. Babb, & J. Lock (Eds.), *Proceedings of the IDEAS: Designing for Innovation Conference 2016*, Calgary, Canada: University of Calgary.

Jonassen, D. H., (2000). Toward a design theory of problem solving. *Educational Technology Research & Development.48*(4). 63-85.

Kafai, Y. (2006). Playing and making games for learning: Instructionist and constructionist perspectives for game studies. *Games & Culture*.*1*(1). 34-40.

Kafai, Y.B. & Peppler, K.A. (2012). Developing gaming fluencies with Scratch: Realizing game design as an artistic process. In C Steinkuehler, K. Squire, & S. Barab (Eds.), *Games Learning and Society: Learning and Meaning in the Digital Age* (pp.355-380). New York, N.Y.: Cambridge University Press.

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. U.S.A: Penguin Books**.** U.S.A : Penguin Books.

McGonigal, J. (2008). Why I love bees: A case study in collective intelligence gaming. In K. Salen (Ed). *The Ecology of Games: Connecting Youth, Game and Learning.* pp.199-227. Cambridge, MA: The MIT Press.

Parrish, P.E. (2009). Aesthetic principles for instructional design. *Educational Technology Research & Development.57*(4). 511-528.

Pelletier, C. (2008). Producing difference in studying and making computer games: How students construct games as gendered in order to construct themselves as gendered. In Y.B. Kafai, C. Heeter, J. Denner & J. Sun (Eds.), *Beyond Barbie and Mortal Kombat : New Perpectives on Gender and Games*. (pp.145-161). Cambridge, MA: MIT Press.

Salen, K. (2007). Gaming literacies: A game design study in action.Journal of Educational Multimedia and Hypermedia. *16*(3). 301-322.

Robertson, M. (2010). Five minutes of ….*Minecraft*. *Gamasutra*. Retrieved from http://www.gamasutra.com/view/feature/6179/five_minutes_of_minecraft_php

Robertson, J. (2011). Making games in the classroom: Benefits and gender concerns. *Computers and Education*. *59.* 385-398.

Robertson, J. & Nicholson, K. (2007). Adventure author: A Learning environment to support creative design. *Interaction Design & Children*. Aalborg, Denmark: ACM Publishing.

Squire, K. (2011). *Video games and learning.* New York: Teachers College Press.