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Critical Thinking with Aesthetic Elements of Minecraft

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Abstract

This paper describes how interactions with aesthetic elements of digital games (*Minecraft)* might help foster critical thinking skills. We argue that interactions with aesthetic elements of games enable aesthetic experiences facilitating holistic understanding and critical thinking towards the problem. Using a theoretical framework for visualization of aesthetics of digital games, we analyzed how learners in an arts immersive school in Canada interpreted and interacted with the aesthetic elements of *Minecraft.* Our analysis delves into their construction of meaning and critical thinking skills at work. Specifically, we considered the aesthetical elements of geography and representation of *Minecraft*. *Minecraft* uniquely supports user-generated geography and representations. Hence we focused on how learners created aesthetic elements based on their interpretation of the content and how the creation process triggered their critical thinking skills.

Introduction

Present definitions of digital game-based learning environments have stated how games are systematic data-driven pedagogies that enforce critical thinking and problem solving skills (Johnson et al, 2014). Recent developments in research also show how there have been efforts to review cognitive processing, transfer from computer games to external tasks, use of games for evaluation as well as game design to determine how video games could be effectively used in classrooms (Tobias, Fletcher & Wind, 2014). There have been studies on game aesthetics (e.g., Squire, 2011) elaborating on rhythmic immersion of games and how game aesthetics could be an inspiration for learners to commit to academic content. We are also aware that aesthetic learning could be highly engaging for learners (Eisner, 2005; Parrish, 2009). Hence we have previously argued how aesthetics of digital games (Egenfeldt-Nielsen, Smith & Tosca, 2013) reveal the core learning concepts and provide complexities for deeper engagement (Gupta & Kim, 2014). In this paper we delve into the concept of aesthetics further and try to establish how interactions with aesthetic elements of games help create an aesthetic learning experience thereby fostering critical thinking skills in learners. Critical thinking is the ability to solve problems effectively (Snyder & Snyder, 2008) and our analysis highlights how the students investigated and dealt with the problem towards

finding a solution. Our research was based in an arts immersion school in Canada where students started using *Minecraft* to achieve curricular outcomes in high school Social Studies.

Literature Review: Aesthetics and Games

Discussions around aesthetics in games have come up mostly around design concepts in connection with the mechanics and dynamics of game design (Aleven et al, 2010). Salen & Zimmerman (2004) first used the term aesthetic trappings in relation to game design to clearly distinguish game aesthetics from game mechanics but Niendenthal (2009) emphasized how games are aesthetic, social and technological phenomena adding three detailed perspectives to the definition: aesthetics as the visual, aural, haptic or embodied sensory phenomena that players encounter in the game, as the commonalities that emerge or are shared with various art forms and the experience of the game as in pleasure, emotion, form giving, sociability etc. Egenfeldt-Nielsen and colleagues (2013) extended the definition of aesthetics by stating that aesthetics of digital games is not how a game sounds or looks but how all its characteristics contribute towards showcasing the experience of "how it plays" (p. 117). Aesthetic experience emerges through the interactions with aesthetic elements that the players encounter while playing the game. Aesthetic elements such as geography and audiovisual representations, number of players or temporal characteristics may have direct influence on the players depending on the design of the game whereas rules may exert an indirect influence on the players. Kirkpatrick (2007) similarly argued how play as an intrinsic part of aesthetics is incidentally present in digital games and works through the imaginative and cognitive faculties towards creating an aesthetic experience.

Studies on the aesthetical design of video games have reiterated the pragmatics of human experience that emerges out of human-computer interactions (Wright, Wallace & McCarthy, 2008). In this proposition, aesthetical experience emerges through the interplay of user, context, culture and history and the relations between artifact and viewer, subject and object, user and tool (Wright et al. 2008). Although aesthetic experience is continuous, the integration of the sensory and intellectual faculties brings forth unity or wholeness that is fulfilling for the user (McCarthy & Wright, 2004).

Aesthetic Experiences and Critical Thinking

Dwelling on various notions of aesthetics, an experience becomes aesthetic through whatever one is doing and the pervasive quality marks it out as a whole, continuous, and meaningful (Dewey, 1980). Aesthetic quality is not a specific part of the experience but remains ingrained throughout the experience. In the overall consummatory experience, Dewey (1980) focuses on the instrumental nature of the meaningful experience and appreciates the intelligence in the aesthetic. Psychologists like Norman (2004) point out how aesthetic experiences are sensory phenomena that evoke behavioural and visceral responses in addition to the cognitive responses understood in terms of the emotional design. In his opinion, the aesthetic representations of the games contribute to the flow state. Educational theorists like Eisner (2005) or Parrish (2009) also claim that aesthetics initiate the learning process through a problem and create anticipation for consummation of learning experiences through highly engaging conditions to entrap the learners. We therefore assume that aesthetic experience signifies a holistic understanding of the problem that mobilizes the cognitive powers which makes critical thinking a part of learners' aesthetic experience. By critical thinking we are referring to the skills that enable students to "deal effectively with social, scientific and practical problems" (Shakirova, 2007, p.42). Snyder & Snyder

(2008) claim that critical thinking requires only six steps to solve a problem using effective thinking. The problem is identified and evaluated within the context and upon framing of the problem the solutions are assessed based on available options. The most effective solution is chosen after an in-depth analysis. The problem solving technique enables students to utilize collaborative practices towards assessing and acting upon real world problems (Snyder & Snyder, 2008). Stanton et al, (2011) take a similar approach when they assert that critical thinking skills incorporate both thinking skills and metacognitive critique and is best represented when critical thinkers fuse domain expertise and situational problems with interpersonal characteristics of persistence, creativity, reasoning and organizational skills.

Aesthetic Experience with Minecraft

As a digital game the aesthetics experience with *Minecraft* is defined by how the five elements play – rules, geography and representation, time and number of players (Egenfeldt-Nielsen, Smith & Tosca, 2013). Here, we have analyzed students' use and creation of geography and representation in *Minecraft* using our theoretical framework to show how learner interactions and interpretations within the game foster critical thinking skills. While geography represents the physical space within the game, representation refers to the audiovisual characteristics of *Minecraft*. Although the visual aesthetic of *Minecraft* is blocky (Duncan, 2011) what is unique about the game is the random generation of the landscapes that the players get to reinterpret, recreate or change based on their creative endeavors. Researchers (Duncan, 2011; Robertson, 2010) in fact assert how creativity is not something afforded by the game's elements but is something integral for creating anything within the game given its sandbox nature. Hence both the geography and representation (visual) of the game changes or emerges depending on the gameplay or the interactions and reinterpretations of the learners based on what they intend to show.

Theoretical framework

Our theoretical framework of visualization of aesthetics for digital game-based learning environments highlights how learners visualize the aesthetics of digital games and draw meanings from it using emotions as their resources for learning. Our theoretical framework comprises of visualization theory (Brodlie et al. 2005) which embeds a macro-cognitive model of sense making (Klein, Moon & Hoffman, 2006) and distributed emotion in the design of learning technologies (Kim & Kim, 2010). We understand the process of visualization of aesthetics of digital games through the following principles:

1. Learners, while playing digital games visualize the aesthetics of the games and extract and create meaningful information as data.
2. As the learners visualize the information they start making sense of it from a data frame perspective. The frame initially commences with some data or information and from that perspective other information starts making sense.
3. As the learners make sense of the information, their emotions act as resources for their learning resulting in the cognitive experience of problem solving.

Visualization theory (Brodlie et al. 2005) refers to a process of extracting meaningful information from data and constructing a visual representation of the information. In the field of visualization this process is generally understood in terms of three different yet interrelated semantic contexts. The first semantic

context relates to displaying the data through a digital environment while the second semantic context relates to the process of specifying, depicting and conveying visual representations to the gamers. The third semantic context deals with the process and cognitive experience of interpreting received information in one's mind. Interpreting this theory from a game-based perspective the learners visualize the game data which represents a problem. As they play and interact with each aesthetic element of the game (rules, geography, representation, time and/ or number of players) they form their own unique understanding of the game or problem. This process of understanding or sense making occurs through a data frame perspective (Klein et al. 2006) or viewpoint. This frame defines what counts as information or data and the frame changes as more and more information is acquired. While the learners interpret the information their emotions act as resources for their learning resulting in the cognitive experience of problem solving (Kim & Kim, 2010). Specifically, in digital game-based learning environments, emotions pertaining to concept, storyline and game play are usually distributed in the objects, events, characters and contexts and depending on their aesthetic capacity, they serve as emotional anchors of learning enriching the relational meaning and providing meaningful experience to learners (Kim & Kim, 2010). The unique visualization process provides for deeper engagement resulting in critical thinking and problem solving by the learners.

Research Context & Design

The research was carried out in an arts immersion school in Western Canada while using *Minecraft (Paanaria server)* to achieve Grade 9 curricular outcomes in Social Studies. The project included working both on *Minecraft* and offline towards creating artifacts that would test the application of their geographic and historical skills, communication skills as well as critical and creative thinking skills. It involved illustrating learner ideas about immigration laws and the process against the Canadian perspective while embedding curricular connections to forms of government and economic practices. For this paper we chose to focus in-depth on the work of one group (Team Red) of four students from a Grade 9 class during one session (Dec 7) of social studies for analyzing how the students interpreted and interacted with the aesthetics of the game to reconstruct their understanding of the topics. This particular date was chosen because the group had worked on *Minecraft* with each player taking the lead on re-interpreting or re-conceptualizing the game aesthetics (geography and representation) in representing the theme of dictatorship through their construction. The students were recorded at work on video. Selected screen recordings of their work and semi-structured one-on-one interviews were carried out with all members of the team after the completion of the project to capture the essence of their gameplay. They built welcome immigration booths and a flag for a fantasy world or island in *Pixel Playground*. Their immigration booth had to reflect the type of government and/or economic system while artistically borrowing or deviating from the geography and flag of a province of Canada. Three of the group members (Tracy, Tim & Maya) played on *Minecraft* while one (Jennifer) occasionally took turns but mainly concentrated on research for other offline activities such as narratives of immigrants for their island based on real immigrants to Canada, creating point systems for immigration. All names used in this paper are pseudonyms.

A Brief Overview of the Group Work

Our analysis revealed that the group metaphorically represented the theme of dictatorship through their creations on *Minecraft.* Here we provide a brief overview of how the group worked together. We observed their critical thinking process (Shakirova, 2007; Snyder & Snyder, 2008, Stanton et al. 2011)

in the interactions with the aesthetic elements they recreated in *Minecraft*. As they utilized their content knowledge and collectively dealt with the situational problem of creatively representing and elaborating the theme of dictatorship in their creation, they showed persistence, reasoning and organizational skills.

The class project was initiated with a quiz on *Minecraft* about Canada's immigration system and groups that completed it could claim any piece of land based on availability. This activity was named, "Land Rush". Team Red was third in the land rush and claimed a piece of land not too far from the spawning area in *Pixel Playground*. As it was not as close as they would have liked it to be, they reinterpreted the structure of the booth such that it caught the attention of the villagers as they walked into *Pixel Playground*. Visually the landscape represented a cold physical space (geography) with vast areas filled with snow and water (Figure 1). Team Red had chosen Quebec as the province and used a political uprising to draw inspiration from and establish a link to reality. The students had worked on a tall dark grey structure with eight sides for their booth. It had a flat roof with a red glass facade near the entrance (Figure 1).

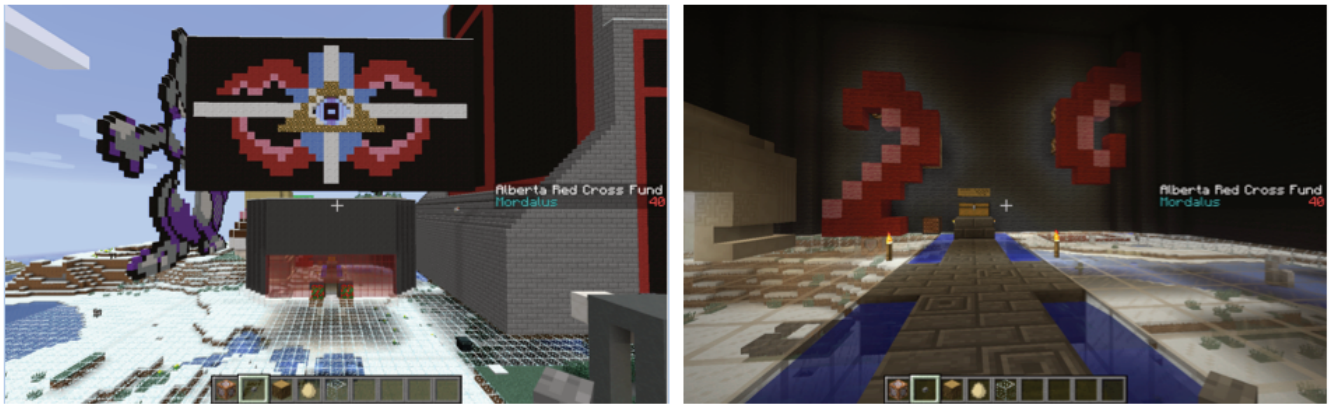

Figure 1. (left) Exterior of welcome booth. Figure 2. (right) Interior of welcome booth.

During this particular session they were in the process of creating their flag to be positioned on top of their roof. While Tim & Maya were working on the flag Tracy was working on the interior of the booth. Prior to this session, they chose the colours, height and size of the building to make the structure look dark and imposing because, according to Maya "dark colours can be used to represent evil". Black represented "darkness" whereas red represented "bloodshed". And both these colours "popped" against the generally white and blue background as well as against the lighter shades that other students had used in nearby booths. The structure was also sizable and tall because they felt that it would help catch the attention of the villagers who wanted to immigrate. The slight modification (adding angles to the four corners) of the rectangular structure was brought on for aesthetic reasons initially but modified to correlate with the notion of control that was represented through the flag as well as the interior. It was made octagonal in line with the notion of eight tentacles of the octopus to show the extent of control over all facets of ZLO.

The white cross in the flag was an extension of the Quebec flag that divided the flag into four quadrants. A light blue hand was placed vertically along the centre of the cross to signify control (drawing analogies from military imposed dictatorship). At the centre of the cross they placed a watchful eye – the eye of the illuminati to show "the negative stigma in the real world", according to Tracy. Clasping tentacles in red and pink specifically with analogies drawn from an octopus, were placed in all four quadrants. The interior was recreated with white stained glass floors to mark the "shifting transition" to an "alternate

world" that metaphorically represented a pathway floating on holy water. This pathway led them to the narratives of their world "ZLO" along with access (teleportation) to their world. The floating metaphor illustrated how people did not have a voice under a dictatorship. It also represented how some people liked the experience, considering it holy and willingly gave up their voice. ZLO was portrayed as an evil world where most of the inhabitants loved the form of dictatorship because it had brought progress marked by technological advancement and fast paced life. The contradiction was represented by "dim lighting", yet "shiny and see through effect" of the interior of the booth (Figure 2). Tentacles on the walls (Figure 2) showcased fluid movement and the lighting behind the tentacles implied possible improvements (i.e., light behind darkness). The students had also started on an underground passageway from the booth to establish control over other worlds – either by setting up black market operations or through military exercise. Thus we find that learners were engaged in form giving (Niendenthal, 2009), by directly interacting with the geography and representation of the game (Egenfeldt-Nielsen et al, 2013). Through their creative representation their play became an intrinsic part of their aesthetic experience (Kirkpatrick, 2009) that evolved out of the construction of relations between the user/viewer and the artifact (Wright et al., 2008).

Findings: Critical Thinking Through Visualization of Minecraft Aesthetics

With designs that the group chose to focus on (e.g., the flag of ZLO and the interior of the booth) during this class session, we have explained how the learners interpreted the theme of dictatorship. They had created the outline of the flag in black, the white cross and the eye against the blue hand in the centre prior to this session. These initial creations became data for them to reinterpret the theme and add details that elaborated and gave meaning to their framework. We also observed how their emotions helped them with their cognition towards physically representing their notion of dictatorship in a 3D format. During this class session the group decided to complete the flag and the interior with representation of tentacles and illuminati as required. While Tim and Maya worked on the flag, Tracy focused on the interior. This highlighted their collaborative effort towards identifying and evaluating the context to frame the problem and then assessing and acting upon the problem through their interactions with and interpretations of the geography and the representation of the game (See Table 1).

Seq	Screenshot	Students' utterances/work	Data	CT
1	Flag (Figure 1)	Tim works on tentacles	Top left and right quadrant tentacle generated in red and pink	Using metacognition with creativity
2	Clasping tentacles on Flag (Figure 1) Fluid tentacles in the interior back wall (Figure 2)	Maya starts work on top right quadrant. Looks at tentacles and creates tentacles extending out of the flag. Then clarifies with Tim as to how the tentacles should be represented. Tim explains the clasp with reference to illuminati. But Tracy considers the fluid movement and creates tentacles in the back wall.		Dealing of situational problems collaboratively with reasoning and domain expertise
3	Flag (Figure 1): Illuminati	Tim creates the illuminati borrowing artistic representation of pyramids.	Eye of the flag and clasping tentacles merging in the hand.	Using creative thinking skills
4	Interior wall: Lighting behind tentacles (Figure 2)	Tracy decides to place light behind the tentacles to show there is hope behind the darkness.	Construction of tentacles and illuminati	Metacognitive critique with creativity
5	Interior floor (Figure 2)	Tracy decides on dull white light on floors to show "shifting transition to alternate world".	Clear glass floor of the world (Geography)	Using creativity, reasoning & thinking skills
6	Floor Specifics (Figure 2): Tiled pathway over water.	Tracy works on tiled pathway and asks if floating effect would make it better. Maya & Tim acknowledge and start helping by creating a second layer of floor to pour the water into.	White stained floor of the booth, Clear glass floor of the world & Façade of the booth (Red stained glass)	Persistence, creativity, reasoning & organizational skills with metacognition

Table 1. Visualization of information according to Data Frame Perspective

Table 1 shows the sequence of Team Red's progress in *Minecraft* which clarifies how Maya looked at Tim's tentacles to create her own and then came up with the idea of branching tentacles. In sequence 2 in Table 1, Maya's representation of the tentacles on the flag revealed that she was unsure whether the tentacles should branch out in different directions. The discussion that followed clarified that the tentacles should be made to look "clasping" because it better represents the clasp of power. Tim, who was also working on the flag (the illuminati section marked by glow stones) and had chosen the colors (red and pink to draw analogies with an octopus), explained that the clasp might signify how the illuminati exerted its' power. Tracy who was working on the interior of the booth added that they could however incorporate the fluid movement of tentacles in the booth as that would make more sense. Hence the metaphor of clasping tentacles (in the flag) and fluid tentacles in the interior emerged from the initial idea of having tentacles on the flag. As the work progressed, the illuminati was created in the form of a triangle with glow stones to highlight the power and the "negative stigma" associated with it. Tim worked on the illuminati with reference to the eye in the centre and in his opinion this was the best way to represent how a few elite members of ZLO had power and control which would be seen on either side of the flag (Sequence 3). Tracy walked out of the interior of the booth a few times to have a look at the tentacles while building the tentacles at the back wall of the booth. She later revealed during her

interview that the tentacles were placed in the back wall so that they were visible to passers-by "as they investigate" what the booth represents. The two tentacles were created in different shapes to show the fluid movement of control within ZLO. Glow stones were then placed behind the tentacles to create lighting effects for expressing the idea that there was light behind the darkness or as Tracy explained "room for improvement or uprising" (Sequence 4). During the session, Tracy initiated a discussion on the floor as a "shifting transition to an alternate world". She changed the clear glass floors to white stained glass floors (Sequence 5). She also mentioned how they should have "light but not too much of it" so that it would create an eerie effect – where the villagers would feel as if they had lost control. Team Red agreed that a floating effect would best represent the feeling of losing control. In Sequence 6, Tracy started building a tiled pathway from the entrance while Tim & Maya joined in to create a second layer of glass floor below the pathway. The second layer of hollow glass blocks were filled with water and the notion of "holy water" (revealed later during the interview) emerged to show how in a dictatorship there are undertones of things being perfect and righteous in the world. The session ended with Tracy creating a pedestal near the back wall to put a chest that would contain some narratives of their world. She along with the others created a teleport station to ZLO on the left hand side of the booth.

For each of the creations or modifications during this session, the students looked at the data/creations (e.g., tentacles on diagonally opposite quadrants, eye, glass floor of the world) that they had built earlier or creations that already existed (such as the floor which could be interpreted as geography). Based on these creations they engaged in critical thinking towards illustrating the theme of dictatorship through a three dimensional format. As they worked on the tentacles or floors, they came up with different connections that helped create representations in the interior of the booth. In other words, the initial data helped visualize the information that urged them to proceed beyond the narrative and test the situation by adding on more data to make sense of it. Hence Team Red exemplified how they engaged in critical thinking by perceiving the problem and then proceeding to find a solution collectively through their visualization of the aesthetics of the game from a data frame perspective.

It was obvious that the creations (tentacles, illuminati, eye, floor) with strong aesthetic capacity (as determined through their discussions and interviews) served as emotional anchors for learning, enriching the relational meanings and providing meaningful learning experiences for Team Red as suggested by Kim & Kim (2010). The facial recordings and field observations during the research also revealed that the students were immersed in their work. Using Lazzaro's (2004) notion of player experience we have characterized the emotion as hard fun. Hard fun creates emotion by structuring experience towards the pursuit of a goal while playing games (Lazzaro, 2004). In this specific case the challenge engaged the students at interpreting or re-interpreting the representation and interacting with the geography of the game towards establishing the theme of dictatorship. The recordings revealed how the students appreciated each other's work and provided feedback on their individual progress to keep the team informed of the progress. The sense of accomplishment was visible at the end because all three members congratulated each other by saying "Good job". The game offered a compelling challenge and the students had to strategize in order to illustrate their understanding of the type of government and economic system they wanted for their world. Thus by using hard fun as a resource for their learning the students were able to critically think and problem solve, which in turn, generated a sense of accomplishment.

Conclusion

In this paper, we demonstrated how interactions with and interpretations of aesthetic elements

(geography and representation) of *Minecraft* help develop critical and creative thinking skills in learners. We discussed how students in an arts immersion school had visualized the aesthetics in terms of the content or the theme of dictatorship and then recreated the geography and representation using their emotions to exemplify the context and the objects within a digital game-based learning environment. In the process we described how the students identified and evaluated the problem of representing dictatorship contextually within *Minecraft* and then, collectively assessed the options to find a solution through metaphorical representations that elaborated upon the type of government and economic system of the world. The research is being continued with various other groups and different projects within the Grade 8-9 Social studies curriculum and we hope to generate queries on other aspects of digital game-based learning, including learning of content, student participation, and group dynamics with various levels of *Minecraft* players.

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