Interpreting the Aesthetics of Games and Evaluating its Effect on Problem-Solving Using Visualization Theory

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Abstract

Digital game-based learning is often associated with problem based learning since games offer opportunities to take on new roles in the virtual worlds through problem solving. We believe that gaming environments can stimulate learners’ critical thinking and problem solving skills. We propose that aesthetics sparks learners’ interest in the content and draws them into an aesthetical experience of gameplay. An aesthetical experience emerges through the interaction of the players with all aspects of the games directly or indirectly which reflects upon the entire gaming experience. These interactions provide different meaning to learners and their sociocultural contexts and the associated emotions facilitate deeper engagement and meaningful learning. Utilizing the sociocultural paradigm that cultural understanding evolves through the identities and various modes of existence or practices of human beings, and using our own framework of visualization, we elaborate how learners interpret the aesthetics of games through a game, Global Conflicts. Our framework of visualization integrates the notion that in digital game-based environments, sense making and interactions within the environment, activate emotions that lead to cognitive processing of the information.

Introduction

“...I think the game [Global Conflicts] made me feel a lot more sympathetic towards the people who are going through that [Palestinian Israeli Conflict].”

“We think they are both right and both wrong [The Israel and Palestine issues over owning the Gaza strip and West Bank] but in the end the Palestinians have the right to not be barged in...”

The above excerpts are taken from interviews with students of Saltash.net Community school who as investigative journalists played the game Global Conflicts (Serious Games Interactive, 2008) depicting the Palestinian Israeli strife. The students were emotionally affected by the situations arising out of the Palestinian Israeli conflict and they tried to think of solutions. Such participatory experiences that involve unique encounters, and awaken interest in the unknown are often aesthetic in nature (Jardine, 2006). An aesthetic experience from this perspective can be understood as being pulled out of one’s subjectivity and into a web of relations that demand one’s attention (Gadamer, 2012). The aesthetic experience that also emerges out of a human computer interaction and interaction design, when conceptualized pragmatically, comes across as the interplay between the user, context, culture and history (Wright, Wallace & McCarthy, 2008). These aesthetic experiences bring about a lively integration of means and ends, meaning and movement, involving all the sensory and intellectual faculties and are thus emotionally satisfying, meaningful and fulfilling (Wright & McCarthy, 2004).

We propose that aesthetics of games as designed cultures establish and clarify the theme of learning which is essential for problem solving in games. Games are designed cultures because the social cultures and broader cultural notions of play mediate game play and hence learning (Squire, 2012). Aesthetics in game-based environments, is defined by the various facets of gaming experienced by the players (Egenfeldt-Nielsen, Tosca & Smith, 2013), and art or aspects of aesthetics can be utilized to communicate educational concepts (Squire, 2011). In fact, aesthetic qualities of a learning environment promote higher levels of comprehension when used to clarify the subject matter (Parrish, 2009). Based on the established body of research suggesting that game-based learning helps
learners develop problem solving skills (Barab, Gresalfi & Ingram-Noble, 2010; Barab, Gresalfi & Arici, 2009; Gee, 2008, 2003; McGonigal, 2011, 2008; Squire, 2005), we advocate for the deeper consideration of aesthetic qualities in designing games for learning.

In this paper we use the game *Global Conflicts* whose aesthetics represent the underlying themes of democracy, citizenship, human rights, terrorism and poverty, which are often difficult and abstract concepts to comprehend. We analyze the aesthetic qualities of the game, describe how learners interpret and interact with the aesthetics and explain how each interaction with the aesthetic qualities helps with critical thinking and problem solving using our own framework of visualization. Our framework of visualization is built upon the basic tenets of visualization in digital environments (Brodie, Brook, Chen, Chisnall, Fewings, Hughes, John, Jones, Riding & Roard, 2005) and embeds sense making (Klein, Moon & Hoffman, 2006) and cognitive processing through interactions within game-based environments (Kim & Kim, 2010). In the following section we begin by briefly discussing how games are designed cultures from a number of perspectives highlighting the role of aesthetics.

**Understanding the Cultural Framework of Games through the Aesthetics**

Games are often understood as designed cultures from an educational perspective on account of their unique design features, the underlying learning principles and the socially situated nature of game play (Squire, 2013). Games are designed to make the learners central and important participants in worlds where their knowledge is directly related to what they can do and ultimately who they turn into (Gee & Levine, 2009) thus establishing a culture of understanding reality through a virtual world. In fact purposefully designed games can be a form of dramatic agency positioning the player with intentionality, legitimizing the content and adding consequentiality to the context (Barab, Pettyjohn, Gresalfi & Solomou, 2012). This transactive potential of games transforms education by making it personally meaningful to the learners and situationally consequential (Barab, Pettyjohn, Gresalfi & Solomou, 2012). Such form of play integrating the person, the content and the context as part of a transactive system, has moved the focus towards more interactive experiences in games. As designed cultures digital games are also based on the principle of collective intelligence where the collective is a “complex, flexible and dynamic knowledge base” (McGonigal, 2008, p. 199). In an age of powerful and networked collaboration games enable players to exercise their power both individually and collectively. In the following, we discuss the role of aesthetics in understanding games as designed cultures, games’ underlying learning principles, and the visualization framework as a tool for understanding learners’ gaming experience.

Games as designed cultures with aesthetic qualities

The unique design features of a game are normally defined by the mechanics, the dynamics and the aesthetics: the mechanics are the basic components, the dynamics results from applying the game mechanics to players’ inputs, and the aesthetics is the subjective experience of the player from the game (Aleven, Myers, Easterday & Ogan, 2011). The aesthetical design of video games is often mentioned in connection with the aesthetics of human computer interaction and interaction design from a pragmatic account of human experience or culture (Wright, Wallace & McCarthy, 2008). In this pragmatist proposition, aesthetical experience emerges through the interplay of user, context, culture and history and the construction of relations between artifact and viewer, subject and object, user and tool. Such interactions mediated by personal or cultural reasons in game-based learning environments, is also an evidence of culture as learning through gaming is a form of participation in social practice (Squire, 2002). These aesthetic experiences are continuous integration of means and ends and meaning and movement involving the sensory and intellectual faculties establishing unity or wholeness that is fulfilling for the user (Wright & McCarthy, 2004).

From a cultural perspective aesthetics plays an important role in generating research discourses contributing to new ways of conceiving game design (Niendenthal, 2009). Aesthetics of games are conceived as (1) sensory knowledge, (2) art, and (3) play. From Niendenthal’s definition (2009), an aesthetic perspective on games comprises of the visual, aural, haptic or embodied sensory phenomena that players encounter in the game. It includes the commonalities that emerge or are shared with various art forms and is the experience of the game as in pleasure, emotion, form giving, sociability etc. Drawing from this notion, aesthetics as sensory knowledge functions as a cultural construction of various relationships through history, place and time and hence provides a geographical and cultural understanding of the game.

The notion of aesthetics as art in games revolves around the creation and display of art as in music or painting through the game to playfully engage the intellect as well as the senses of the players. This aesthetic approach adds to the immersion, and flow of the gamers and can be compared with Huizinga’s “magic circle”
because the players are able to focus on qualities of the fictional worlds, their roles, and the participation mechanisms (Niendenthal, 2009). In creating game art, a player is a co-creator of the piece not only by engaging intellectually but literally by making choices and modifications on such aesthetic design (Pearce, 2006). By allowing cultural construction of various relationships and participation in artistic endeavours, aesthetic experiences bring out the cultural aspect of the games.

The notion of aesthetics as play (Niendenthal, 2009) develops through the interaction of the players with the aesthetic qualities of the game such as rules, geography, representation, time and number of players (Eigenfeldt-Nielsen, Smith & Tosca, 2013; 2008). From a different standpoint, play is an inherent part of aesthetics and is incidentally present in digital games and works through the imaginative and cognitive faculties of players to create the aesthetic experiences (Kirkland, 2007). An aesthetic experience as play is derived through participation in the moments of opening and venture, which are crucial for individuals to comprehend the ways of the world (Jardine, 2006). Since aesthetic experiences are similar to being pulled out of one’s subjectivity and into a web of relations that demand his or her attention (Gadamer, 2012), they become meaningful (Dewey, 1980) through the act of playing and the aesthetic notion of play reflects the gaming culture.

Underlying principles of learning with games

One of the underlying principles of learning that establishes games as designed cultures is problem solving. It is a widely acknowledged fact that game-based learning goes beyond motivational factors since it advocates computer literacy, problem solving skills and real world scenarios. The specific mediated contexts of games are ideal for learning as they provide richly designed problem spaces with similar yet varying levels of challenges across the levels of the game (Gee, 2008). Games are thus “goal driven problem spaces” (Gee, 2008, p.26) and learning happens through the goal driven experience, which provides the purpose for learning and meaningful problem solving (Gee, 2008; Royle, 2008).

Contemporary games establish a functional or pragmatic model of knowing through the meaning making that occurs on account of the direct interactions and responses of the player(s) with the gaming world (Squire, 2011). These interactions are often motivated by the aesthetics of the games that enable players to see patterns in the gaming process or game states and thereby solve problems (Squire, 2011). Learning experiences involve transactions with the learning environment and these can be transformative with significant aesthetic qualities (Parrish, 2009). Such aesthetic experiences are crucial because they demonstrate the expressive power of life offering ways to discover and create meaning (Alexander, 1998). Since aesthetic experiences are efforts towards creating meaning aesthetic principles of learning have commonalities with information processing, constructivist and social learning theories (Parrish, 2009). The aesthetic principles incorporate learning experiences as narratives or plots within which the learner is a protagonist, the learning activity establishes the theme and the context contributes to the immersion (Parrish, 2009). The aesthetic of digital game play similarly includes learning through new ways of doing and being in a designed world and the aesthetic principles are entrenched in the deeply rhythmic experiences evident through authentic participation in complex activities that blurs the distinction between play and work (Squire, 2011).

Aesthetic qualities of a learning environment are also known to promote higher levels of comprehension by clarifying the problem. These clarifications are obtained through aesthetic qualities of the learning environments that incorporate patterns, routines and motifs as well as sources of aesthetic tension that enhance the complication and help sustain the engagement (Parrish, 2009). In digital game play, Squire (2012, 2011) defines this engagement as rhythmic immersion towards problem solving and attributes it to the design of the game.

As digital cultures games allow for social participation through various communities of practice and the social structures that govern game play (Squire, 2012, 2011). Games enable enculturation into communities of practice such as creating new game designs (Squire, 2011) and these communities are naturally occurring and self sustaining learning communities built on widely accepted sociocultural and cognitive theories of mind in psychology and education (Steinkuehler, 2013; 2006b). The social practices or interplay from the surrounding context, also known as metagame play a significant role in learning associated with games (Gee & Hayes, 2012). The metagame affords the interaction and the link between the organization of the space (the site or events including real world spaces and events) and the organization of the people. Gee & Hayes (2013) acknowledge these activities as nurturing affinity spaces in games that are supportive of learning. The interactional structures of social and material systems also afford cognition in game-based learning environments (Steinkuehler & Oh, 2012). From this perspective, it is through participation in a community of practice that an individual comes to understand the world and themselves from the perspective of that community and such activities have a direct import for the identity of the individual (Steinkuehler & Oh, 2012).
Culture is defined through the identities of individuals (Hollins, 2008), and communities of practices that afford learning (Packer & Goicoechea, 2000, Greeno, 1997) and can be understood through a system of learned behaviours, that individuals make use of to organize and make sense of the world (Wanda & Warms, 2011). The aesthetic mode of knowing also incorporates vicarious participation in situations that perform a referential function to some aspect of the world helping learners experience it (Eisner, 2005). The aesthetical principles of learning classify learning through a problem, tension or conflicting information (Parrish, 2009). The aesthetic is in fact secured within the process of coping with a problem, involving the exploration of the problem leading to the eventual resolution (Eisner, 2005). Hence we assume that the aesthetic interactions with the games allow the learners both individually and collectively, to engage in a cultural practice towards learning and problem solving. It is also pertinent to note in this context that the aesthetic components in games, such as rules, geography, representations and time, are all social constructs. The number of players in a game may depend on the design but collaboration or participation in a community of practice is a form of social activity that can occur depending on the intentions of the individuals playing the game.

Visualization framework for aesthetics and culture

Delving deeper into the process of learning, we propose that as the learners interact with the aesthetics of the digital games they visualize and start making sense of the information. This framework of visualization is based on three broad semantic contexts (Brodlie et al. 2005). The first semantic context deals with the data being displayed through a digital environment. We interpret this data as the aesthetical characteristics of the game, which the players interact with either directly or indirectly while playing. As previously discussed, the aesthetic interactions here refer to the learner interactions with the rules, the geography and representation, time and the number of players of the game.

The second semantic context includes the data specifying meaningful information to the viewers. We interpret this as meaning making that occurs through the interactions of the player with the aesthetics of the games as in the rules, geography and representation, time and number of players. We understand the meaning making through a data frame analysis (Klein, Moon & Hoffman, 2006), where an initial interaction helps the learners to create a frame for sense making and each interaction thereafter brings forth additional information or changes based on the initial context or frame of reference. Thus the player is able to build upon the frame by adding or removing information based on the continuous interactions with the aesthetical qualities of the game. For example, interactions with the aesthetical qualities of a game bring about a sensory understanding of the history, place and time thus providing a framework for a geographical and cultural construction. And this framework develops based on the more interactions of the players with the game aesthetics. To cite another example, player interactions with game art as in graphical style, content and music engages the player’s senses and intellect as it emerges as data. Subsequent developments of patterns or routines start making sense to the player based on his initial frame of reference leading to a rhythmic immersion or acculturation, which helps to clarify and solve the problem. Such participatory experiences that evolve out of interactions mediated by personal or cultural understandings in game-based environments are reflective of culture.

The third semantic context deals with the cognitive processing of the information. We relate sense making with cognition using the notion that growth of emotion and cognition are tightly linked (Zembylas, 2005). As the player interacts with the aesthetics of the gaming environment, each interaction provides different meanings to learners and their sociocultural contexts and the associated emotions affect their thinking, learning and performance as a system (Kim & Kim, 2010). Hence the players are able to visualize the problem using their interactions as emotional anchors to solve the problem. In the following, we discuss how learners might interact with the aesthetics of games through an example, Global Conflicts, using this framework of visualization.

Visualizing Problem Solving Through the Aesthetics of Global Conflicts

The game Global Conflicts (globalconflicts.eu) is based on issues pertaining to democracy, human rights, and social inequities around the world. The learners experience and comprehend these issues as newspaper journalists who are attempting to report on the situation. As they navigate the regions marked by turmoil, such as Israel or Palestine, the learners understand the problem from various perspectives and are able to report with their own thoughts on the story. As stated earlier the aesthetics of a game are the elements that make up a game, including the rules, geography and representation, time and number of players of a game (Egenfeldt-Nielsen, Smith & Tosca). Here we analyze each interaction with the aesthetic element of the game as evidence of culture using our framework of visualization for problem solving.
As the learners start playing the game by assuming the role of a journalist, they learn the rules of the game indirectly through their visualization of the context and interactions with the characters and objects. Such interactions in a learning environment as in Global Conflict – Military Operations, hold different meanings for the learners and their sociocultural contexts and the associated emotions impact their thinking, learning performances and development as a system (Kim & Kim, 2010). As the learner converses with the editor of the newspapers outside a café in Israel or travels across Abu Dis with the Israeli Defense Force, he or she gets a fair idea about the purpose, the limitations and the affordances of the game (Figure 1). These limitations and affordances within the game are the rules (Egenfeldt-Nielsen, Smith & Tosca, 2013). The conversation with the editor makes the learner realize that as a foreign journalist securing local sources for credible information is crucial. Witnessing the arrival of an army truck with a squad of soldiers beside the café in visualizing the same context through a change of situation clarifies the political situation of the country and the learner is able to comprehend why there is a need to wear a bullet-proof vest while on the job. As an American journalist the learner realizes that getting upset or showing arrogance while conversing is not going to garner the cooperation from the people.

![Figure 1. Screen shot of the journalist in conversation with the editor](image)

The learners are also able to see their own progress in the game through the emerging information as they start abiding by the rules for making the necessary moves. Thereby their actions become part of the narrative and this helps to sustain their engagement (Figure 2). Choices with responses and the options to work for different newspapers such as the Palestine Today, the Israeli Post or the Global News clarifies the rules even further and gives an insight into the theme of the game. When they are reporting for Global News for example they look at the conflicts up close by focusing on the events that take place, the military operations, the treatment of prisoners and the danger for the soldiers. For Palestine Today on the other hand the learners are focusing on the abuse of the Palestinian prisoners by the Israeli soldiers documenting the way the suspects are treated, the corruption and the brutal interrogation methods as well as the potential of innocent people being arrested. The learners are thus able to analyze the conflicts or problems through the interactions stemming from the rules of the games. These progressive interactions activate their emotions and hence their thinking and they are able to present their viewpoints from different perspectives. Therefore the rules as aesthetic characteristics define the game by elucidating the political and cultural aspects of the situation and the problem, which assists the learners to make sense of the Israel Palestinian issue.
The geography of the game represents the physical space that the learners encounter in the game (Egenfeldt-Nielsen, Smith & Tosca, 2013). The geography helps the learners to visualize not just the physical landscape as in Abu Dis or Jerusalem in Israel but various other landscapes binding with the geography such as the economic, social, cultural and political environment. The geography familiarizes the journalist(s) with Abu Dis and as the game progresses through various chapters the learners develop a deep awareness of the country from various perspectives and they are able to make meaning out of the physical, economic, social, cultural and political environments relating one to the other. This meaning making begins with the visualization of any landscape that the journalist chooses to use as the initial frame of reference (Figure 3). Based on the interactions with this initial frame of reference the journalist is able to figure out for example the areas frequently targeted for raids, the demographics involved and the reasons behind the frequent raids. The emotional experiences arising from such interactions activate and modify the cognitive processing of the learners. It also makes them aware of the economic situation within the country and familiarizes them with the social and cultural practices or norms by region providing an in-depth insight into the population of the country. The geography as represented in Figure 3 can also evoke emotions with the appearance of a sudden complication (Figure 4) that provides an aesthetically cultural understanding of the issue.

Representations as in the audiovisual characteristics (Egenfeldt-Nielsen, Smith & Tosca, 2013), also add towards creating the atmosphere that makes it meaningful for the learners to comprehend the theme of the game. *Global Conflicts (Military Operations)* is a photorealistic game, which makes it visually powerful for the learners. The accompanying realistic sounds and music add to the effect by evoking emotions and feelings that enable then to comprehend the game from various perspectives. When the journalist reaches the location (Figure 2) with the Israel Defense Force the visuals clarify that the area is quiet and deserted. As the prisoner is brought out into the open the mosque prayers are played in the background clarifying the neighbourhood as a Muslim area. The loud prayers also make the prisoner respond emotionally to the questions asked by the journalist elaborating on the religious issues in
the region. This in turn forces the journalist to deal with the issue delicately. Thus representations as aesthetic qualities present the theme and prepare the learner for a change in perspective. The problem as in the religious differences emerges through the representations of the game making it contextually meaningful and helping them with consequential decisions.

**Figure 4. Screen shot of IDF escorting prisoner out of the building**

**Global Conflicts (Military Operations)** is played in real time and the temporal characteristics unfold through the participation of the learners in the narrative. A change of the scenery (Figure 1 & 2) depicted by the quiet surroundings of the cafeteria as against the sudden arrival of the Israel Defense Force or the deserted street of Abu Dis becoming the center of activity all of a sudden due to discovery of explosives in a house (Figure 3 & 4) sustains the suspense and builds up the complication immersing the player in the game. Such immersion also helps with the real time strategizing skills of the learners such as wearing a bullet-proof vest for safety reasons. Time is also used aesthetically when the learner as a journalist interviews the characters in the narrative. These aesthetic moments clarify the problem from various angles such as the treatment of potential prisoners, dangers faced by the Israeli defense, the validity of the statements from the people interviewed and the reliability of the information in these situations. The learners are then able to weigh the information by developing the frame from one reliable source of information, which then serves as the initial framework. The learners may have positive or negative emotions towards the content but they respond to the relational meanings brought about by their personal interactions with the characters or objects (Kim & Kim, 2010). This in turn helps the learners to understand the issue and make their own judgments towards what needs to be done (as in publishing an editorial in the newspaper).

**Figure 5. Screen shot of IDF members surrounding the house of the potential terrorist in Abu Dis.**

Like most single player games, **Global Conflicts (Military Operations)** is procedural and based on artificial intelligence (AI) (Egenfeldt-Nielsen, Smith & Tosca, 2013). Progression in such games, are typically player centered but that does not limit the social dynamics of the game (Egenfeldt-Nielsen, Smith & Tosca, 2013). The narrative builds up through the AI or the characters, who as virtual entities are intelligent enough to respond to
various game conditions. The IDF members for example elaborated the narrative on the raid in Abu Dis by blowing up the door and surrounding the house before capturing the potential terrorist. They also discovered explosives hidden in the house (Figure 5). Thus these AI or characters establish the problem on the theme even if they are not communicating with the journalist. The social context of the game from another perspective comes into play in the learning environments of classrooms, which allow for collaboration both towards game playing and solution seeking discussions.

Conclusion

The purpose of this article was to emphasize the importance of aesthetics in game-based learning environments towards problem solving. We used a game, Global Conflicts, as an example to explain the visualization of aesthetics by learners for meaning making and hence problem solving. We also clarified how games are designed cultures and how the aesthetics of the games contribute to a cultural understanding of the content or theme presented in the game. Aesthetics in games is an emerging subject of interest and further research in this area will contribute to new perspectives on aesthetics of games and its' effects on knowledge creation. We believe learners at all levels stand to gain from a better understanding of aesthetics in games. A holistic understanding of aesthetics pertaining to digital games will contribute further to new areas of research in game-based learning.

Reference


