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Gamification of Education and Learning: Heuristic Elements, Player Types, and Learning Outcomes for Art History Games

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HEURISTIC ELEMENTS, PLAYER TYPES, AND LEARNING OUTCOMES FOR ART HISTORY GAMES

by

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Submitted in Partial Fulfillment of the Requirements
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ABSTRACT

Title of Thesis: GAMIFICATION OF EDUCATION AND LEARNING: HEURISTIC ELEMENTS, PLAYER TYPES, AND LEARNING OUTCOMES FOR ART HISTORY GAMES

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The technology of virtual reality (VR) and the gamification of education and learning has had proven educational benefits, especially in secondary education. However, there remains little to no research on the heuristic elements and mechanics that contribute to learning at the postsecondary level of education. Most research conducted has been refined to science programs, but even in these instances, a study of the effects and interests of different demographics has yet to be considered. Given the visual nature of how the discipline of art history has traditionally been taught, there are a number of virtual reality (VR) applications to assist instructors in the field better engage students in immersive environments to provide a more accurate understanding of subjects covered. In order to capitalize on the strengths of the new digital medium, including immersion, engagement, and presence, the end user needs to be considered. This heuristic study investigates the different experiences, preferences, learning styles, and expectations relating to educational gaming of art history students at a private, Midwestern college. Results demonstrate that effective game design and development need consider the target audience to optimize user experience and learning outcomes.

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The success of the current study is due to many talented individuals. First, the path that led me to gamification and education began with Dr. Jason Lively, who first suggested I begin investigating virtual reality (VR) in education. Research towards that goal led to a realization of how significant game engines were to the development of XR applications. Prof. Jay Ratican has provided consistent support as my chair and a critical voice in discussions of the scope and questions associated with the thesis. Prof. Ben Fulcher has introduced many new investigative directions that study can take with future articles on the structure and best suited genres for certain types of educational outcomes. Finally, Prof. Weber has been my advisor through the process and has been instrumental in overseeing the game design program here at Lindenwood University, ensuring students have the best experience with the latest technology and materials.

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Introduction

The gamification of everything is now. The cross-pollination of gaming and all areas of experience has been driven by gaming development technology in recent years and ease of access for users with a variety of backgrounds. The gamification of mobility, entertainment, business software, education, and everything else can be contributed to the demonstrably superior method for content delivery and engagement. Specific to education, learning is more engaging when entertaining, as well as having goals and targets to achieve. Examples of this may be seen in sites such as Khan Academy and applications like Duolingo. These gaming technologies and methodologies are now infiltrating the virtual classroom, though primarily at the secondary level (Exterman, 2021). However, despite recent technological advances and the new participatory, digital culture that pervades the lives of secondary and postsecondary students, traditional education has remained largely unchanged. Students remain segregated into levels, generally with one "expert" in a classroom at a time (i.e. the instructor/ teacher) and have little opportunity for authentic communities of practice and participatory learning (Squire, 2011). Participatory media culture now pervades every aspect of students' lives, except for education. With a plethora of options, one can create and disseminate content across multiple platforms with little training or background, such as with YouTube, Reddit, social media, Daily Kos, and more (Jenkins 2006; Black 2008). On the other hand, students largely are still taught by one expert and then are responsible for their own learning thereafter with little chance for immediate feedback or participation (Squire, 2011). Despite the model that still dominates academia, students are more likely to use their own sources of information instead of solely relying upon the instructor of a given course. In fact, in the study conducted by Levin and Sousan Arafeh (2002), the manner in which K-12 students now learn is online where they can look up what and when they want information, which makes it personal and meaningful to them. This new digital approach to online learning means that students have meaningful, tailored information provided for their specific interests and ability level and makes immediate feedback possible.

As the academy reconsiders the role of education in the new digital and participatory age, and with the ease of access to such a breadth of information available at any time, the learning outcomes of education need to be rethought. Recent studies have demonstrated that there is greater retention and engagement in the learning process if there is purposeful participation included in lesson plans. Dastyar (2019) confirms that the role of motivating factors that work in tandem with participatory learning increases both motivation and academic achievement in students. In the same way, games are also emblematic of a broad cultural shift toward said participatory culture and offer ways to model the same educational experiences. For instance, the act of gaming and gaming communities move players/students beyond passively consuming media/information to actively participating and producing an experience through their interaction with the game itself and other players. The same model may be adopted by educators (Squire, 2011).

While gamification has made education more engaging since antiquity, immersive realities, including virtual reality (VR), have been used to support educational materials since the 1990s (Biocca and Levy). Accelerated by the 2020 worldwide pandemic of COVID 19, online and distance education adopted new technologies at an unprecedented rate. The period of social and cultural evolution witnessed over the past few years has ended the monopoly of traditional academic methodologies and techniques for classroom instruction. The “sage on the stage,” or single subject-matter expert at the head of a lecture hall, is no longer the dominant form of informational delivery. At two-centuries old, the tradition must give way given the overabundance of information students have available to them. Today's students no longer need to be given access to information to memorize but need strategies for interpreting and analyzing data. In order to facilitate this shift in postsecondary education, from imparting information to facilitating active learning, new technological paradigms need to be established (Brownridge 2020). The realization comes as students in the pandemic cohort were digital natives, having grown up with new technologies, and never having known a time in their lives without computers, smartphones, and 3D-gaming consoles. The student experience moving through secondary education and high school is pervaded with technology- socializing, shopping, gaming, completing homework, and more. With this in mind, there is little surprise that there is a disjuncture between prior experiences and what students experience when entering college with how technology is most often used in classes (Flynn and Frost, 2021). Generation Z is already in college, and Generation Alpha will soon enter, and both generations expect more integration of technology in their education, while also demanding greater engagement and ways to learn. The challenges faced by current faculty are generational and technological since most are digital immigrants, and non-natives, who were not raised with computers and had to learn to adapt to new technologies later in life (Prensky, 2001). The adoption rate of new technologies that lead to new student-centered pedagogies has thus been slow. Moreover, educators are often blamed for the slow adoption (Ertmer and Ottenbreit-Leftwich, 2010; Howard and Mozejko, 2015). At the same time, there has been little in the way of training and adminstrative support for educators on how to use emerging technologies, including gamification and videogames, as well as Virtual Reality (VR) (Howard and Mozejko, 2015; Licastro, David Nieves, and Szabo, 2020).

Moreover, the notion of video games as art, and, conversely, the gamification of art history are both well-trodden concepts. In her article "Towards an Art History for Videogames," Lana Polansky noted that Deus Ex (Automata, 1984) was one of the first artgames, but went unnoticed due to the lack of commercial success (Champion and Foka, 2020). Such is the case for many so-called "artgames." Since then, there have been several attempts to reframe video games as art, such as *Art History of Games Symposium* (Georgie Tech, 2009, 2010). Regardless, the ability of video games to teach art has been well-studied, though little attempt has been made to tailor the heuristic elements of the game to player demographics.

This mixed-methods study seeks to provide practical examples for faculty teaching using digital humanities in visual culture areas using gamification theories and strategies combined with the immersive potential for experiential learning of virtual reality. Theories and practical applications of video game and immersive reality technology will be presented in order to ensure institutions of any size and resources are able to ensure their students benefit from the participatory nature of these experiences. Video game genres, game mechanics and player types will also be investigated in order to help frame the survey instrument. Art History students in a private Midwestern University were surveyed and demographic data collected. Students relayed their experiences with video games and gameplay in general; how gameplay was used for recreation or educational purposes; the game genres preferred; player types students identified with; and free responses collected. Demographic information was used to identify the preferred gaming experiences, mechanics, genres, and other heuristic elements by age, sex, gender identity, degree sought, and preferred reason for gaming. Results provide a reference for educational game designers, not just for art history and visual culture, but more broadly in the digital humanities and beyond.

Literature Review

The use of educational games and gamification instruction has received more attention as a means to engage learners across various demographics, backgrounds, and cultures (Kim, Song, Lockee, and Burton, 2018). While game-based instruction is not a newly developed concept, the adoption of recreational gaming for a broader demographic coupled with the ubiquitous availability of technologies has accelerated the exploration and application of such games for educational purposes (Wideman, Owston, Brown, Kushniruk, Ho, and Pitts, 2007). Coupled with the recent advancements in virtual reality technology, educational gaming is poised to engage students in the new participatory, digital age. In the field of education, gamification has great potential for learner engagement. Educators have struggled with engagement and interest in the classroom and have tried numerous approaches, such as the use of motivational strategies. These interventions last, unfortunately, only a short time, but gameplay has the ability to sustain attention and engagement for longer periods (Kim, Song, Lockee, and Burton, 2018).

Gamification is often described as modifying something that is not a game through game elements (van Grove, 2011; Werbach & Hunter, 2012). A more specific definition that will be used for the purposes of this study was proposed by Sangkyun, Song, Lockee, and Burton (2018, p.29), and assists in understanding the concept of educational gamification more clearly: "Gamification in learning and education is a set of activities and processes to solve problems related to learning and education by using or applying the characteristic, of game elements." The definition highlights many important aspects of gamification, including that the action is not one single activity, but is instead a series of activities and processes. Whereas the goal with many nondiegetic games is entertainment, gamification must have a goal that addresses specific educational problems. Moreover, the use of game mechanics in scenarios, such as points or badges, is insufficient. There must be additional game elements for proper gamification.

The relationship between serious games for learning and education and gamification should be identified as there are overlapping elements. For instance, serious games for learning are successful when achieving a learning objective grounded in reality. Serious games thus address real-world issues as part of the experience. Gamification in learning and education, on the other hand, supports learning and problem solving through the creation of believable, real-world environments within the real world. The relationship can be seen in **Figure 1** (Kim, Song, Lockee, and Burton, 2018).

Introduction to Virtual Reality

While the gamification of learning and education has a long history, there have been significant budgetary and technological constraints that have limited the use of virtual reality for either serious games for learning or education and gamification (Khaitova, 2021). Only recently has the technology become a viable option for teachers in secondary or postsecondary education. First, a working definition will be established to better understand how VR will be used in the study from this point forward. Pope's definition will be appropriate as "an experience that encompasses most of the senses, including sight, hearing, and touch, and represents an alternative to reality" (Pope, 2018). The first headset built in 1968 is credited to Sutherland and Sproull, but despite being around for over half a century, the technology was not broadly available or adopted until very recently. The first attempt at commercial promotion of VR can be attributed to second generation consoles beginning in 1993. Several video game studios developed software and applications for virtual reality head-mounted displays (HMD). However, both SEGA (1993) and Nintendo (1995) experienced commercial failure with the endeavor (Horowitz, 2004; Kushner, 2014). In fact, the first headset that could be considered commercially viable was not until 2013 with the Oculus Rift. While the HMD was originally designed for the video game market, the unit could also support educational applications (Moorefield-Lang, 2015). Since the release of the Oculus Rift, there have been many VR headsets released, including Google Cardboard, perhaps the most egalitarian version, which uses lenses and a smartphone, but the immersive experience being quite limited. At the other end of the spectrum, HTC Vive was released in 2016, and enjoyed popularity due to established distribution platforms like Steam. However, the unit required the use of a powerful computer with a GPU to improve latency, adding an additional expense for users. These past examples represent each end of the technological and budgetary spectrums. Arguably, Oculus, purchased by Facebook (now Meta) in 2014, represents a balance of the two, not needing the use of an external computer, and has achieved the greatest market saturation, starting with the Oculus Go and Quest. The success was built on with the release of the Oculus Quest 2 in 2020, the latest generation of headsets to overcome the limitations outlined by Kavanaugh et al (2017): user experience, accuracy, cost, and consumer availability. With consumer technology now available and affordable, VR headsets are likely to become as standard a piece of educational technology as the Personal Computer or word processor.

Education and Virtual Reality

With wider availability for adoption, the potential for educational impact need be considered and VR has proven to support learning with positive outcomes with different kinds of learning. In order to assist in describing how VR supports conceptual learning, Salzman, Dede, Loftin, and

Chen (1999) developed a model that describes how VR is able to support learning processes and outcomes. Research has confirmed that virtual learning environments (VLEs) are able to "stimulate learning and comprehension, because it provides a tight coupling between symbolic and experiential information" (Bowman, Hodges, Allison, and Wineman, 1998, p.121). Not only are immersive realities well-suited to experiential learning, studies have also found improved time-on-task (Huang, Rauch & Liaw, 2010; Johnson et al., 1998), increased enjoyment of learning (Apostolellis & Bowman, 2014; Ferracani, Pezzatini & Del Bimbo, 2014), motivation (Cheung et al., 2013; Jacobson et al., 2005; Sharma, Agada & Ruffin, 2013; Brownridge, 2020), deeper learning and long-term retention (Huang et al., 2010; Rizzo et al., 2006; Hussein and Nätterdal, 2015). These positive pedagogical correlations can be applied to all areas of study, however, Dalgarno, Hedberg, and Harper (2002) have also studied the capacity of VR to assist in a deeper understanding of three-dimensional objects and environments through 3D learning environments (3DLEs). Selvarian (2004) continued research into the potential of spatial and social technologies in VR and also found a positive correlation. Finally, Lee and Wong (2008) concluded the use of VR to improve educational performance and conceptual understanding in various fields.

The key areas of consideration for a successfully immersive and engaging educational experience are *immersion*, *engagement*, and *presence*, especially with 3D and VR video games. Immersion relates to how a player is caught up in the world of the games story, or the diegetic level, and the strategy that has gone into the game, or the nondiegetic level. Important for educational gaming, complete photo- and audio-realism is not necessary to produce a sense of immersion in a viewer, though most developers do aim for this effect. In order to effectively achieve a sense of immersion, the designer and developer need to ensure that: 1) the user's expectations of the game environment align with the conventions of said environment, 2) the user's actions have a significant impact on the environment, and 3) conventions in the game world must be consistent, though not necessarily reflect the physics of the real world. At the same time, most video games do not rely heavily upon narrative and so there is the nondiegetic level of consideration that players enjoy. Therefore, engagement is often a combination of both diegetic and nondiegetic with the ability to gain points, devise winning strategies, and/or confirming prowess in or outside of the game with other players/students. The term used to explain this state of deep engagement is known as *deep play*. Finally, the adoption of more 3D and first-person design in games and virtual reality environments (VREs) has led to the use of the term *presence.* The level of presence can be determined by the level of perceived immersion in a game (Wolf & Perron, eds., 2003).

The studies cited thus far note a positive relationship between the use of VR for teaching and learning and subsequent learning outcomes, but do not present a coherent model. Not surprisingly, the first models for understanding the benefits of VR in teaching complex conceptual topics came by way of the sciences. *Project ScienceSpace* (1999) was developed by Salzman, Dede, Loftin and Chen and used VLEs for the instruction of the physical sciences. The project included three "worlds": Newton World, Maxwell World and Pauling World. The model developed for the project first considered the interactions between the user and the equipment (HMD) and learning applications. Next, the research team focused on how other variables affected learning as they worked in tandem, such as the task to be completed, individual learning styles of students, and virtual learning experience that influences learning outcomes (Salzman et al, 1999). In order to ensure appropriate alignment of learning outcomes and the appropriate features to support them, researchers argue for a preliminary step in pre-production phase of development be set aside. The features to consider in this phase that VR is best suited to offer in designing an experience are multiple frames of reference, multisensory cues and immersive three-dimensional representations, multiple frames of references and multisensory cues. These features need to be aligned with the learning style and characteristics of the intended student user, including spatial reasoning, gender, experience with technology, inclination toward motion sickness (VR sickness), and more. Since each learning is unique, the learning experience and environment designed for them should be, as well (insofar as possible). As such, researchers and developers of VR applications should balance the immersive and engaging abilities of this new technology with an understanding of what learning outcomes students are intended to get out of said experience. In order to facilitate this, educators and designers should begin with the end in mind with a backwards design process and consider how the proposed simulation, game, or experience enhances, reinforces, or supports the learning objectives for a particular course learning objective. However, educators should begin to familiarize themselves with existing VR applications prior to working with a designer and developer to create their own, and there the same considerations apply in making selections.

The use of pre-developed applications to present or reinforce subjects taught in class is the most accessible starting point for adopting VR in the field. Other examples would include VLEs built by students themselves, often to test hypothesis in the sciences. In the same fashion, already existing applications often rely on virtual environments for students to complete a specific task or activity as in serious games. Examples of this would include the aforementioned *ScienceSpace* or *Maxwell World*. Representing the broadest integration of VR in postsecondary education, these applications are designed for teaching and learning in the physical sciences (Christou, 2010). There have been, however, forays into other fields, such as cultural heritage and archeology (Pujol, 2004). Examples include developers like Learning Sites that produced desktop applications that allow students to explore archeological reconstructions of sites and structures. REVEAL is another software that allows the 3D re-creations of ancient sites, buildings, and artifacts (Sanders, 2014). While these are not VR, the applications represent a necessary step in the development and interest in immersive learning environments for teaching arts and culture.

Interest in studying arts and culture through the lens of technology has increased as of late due to the emergence of digital humanities. Direct application to the fields in the humanities, including art history, is demonstrable through the ability to reconstruct lost or destroyed cities and civilizations and immerse students in cultures foreign to their own. Regardless, questions still remain surrounding when and how these applications should be integrated into teaching and learning. As a subset of digital humanities scholarship, the studies that do exist relevant to the integration of VR into art history programs can be broken down into five distinct phases. Starting with the turn of the millennium, phases of integration parallel the adoption of other emerging technologies like smartphones and video games that also use motion sensor technology and touchscreens. The digitizing of cultural heritage sites (such as UNESCO) began in 2001. The following decade saw many museums integrating VR experiences for educational or edutainment purposes. Important for the democratization of art and technology, 2011 witnessed the launch of full virtual museums and Google's *Arts and Culture*   Fulfilling the work began in 2001, the past few years have witnessed the mapping of additional UNESCO UNESCO World Heritage Sites and the digitization of large museum collections, such as the Louvre in Paris.

Virtual Reality and the Art World

Before discussing the development of the virtual museum (VM), the potential and lessons learned with such models learned for edutainment to augment exhibition experiences in physical museums should be considered. The affordances to reach a younger audience and increase their cultural awareness through emerging technologies like VR was considered early on by museum curators. The scarce adoption seen in such venues in the first decade of the twenty-first century, according to Carrozzino and Bergamasco (2010), was due to a lack of training with the technology and cost prohibitions of earlier HMDs. Despite a lack of widespread adoption, scholars continued to argue for the potential benefits for the field. Roussou (2001) related how the technology would be ideal for museums to adopt from the virtual environments created by the Foundation of the Hellenic World (FHW), a cultural heritage institution in Athens. Using the CAVE technology used by FHW, a digital reconstruction of ancient cities began with Miletus, an Athenian and later a Roman colony on the coast of Asia Minor (Tzortzaki, 2001). Other examples can be found in Austria (Ars Electronica, http:www.aec.at) and Japan (Intercommunication Centre, http:// www.ntticc.or.jp/).

With the work of earlier pioneering intuitions, including the founding of virtual museums like The Museum of Pure Forms (2002) and The Virtual Museum of Sculpture (2011), the groundwork was laid for broader adoption. Carrozzino and Bergamasco (2010) pointed out that the increased adoption corresponded with wide avaialbility and acceptance of related technologies for the general public, including Nintendo's Wii (released 2006) with motion sensors, and the iPhone (released 2007) with touch screens and camera-based applications. The first edutainment installations that used VR were not well-engaged with museum and gallery attendees, but increased familiarity of similar technology led to a more open-minded public. The test cases of these early virtual museum exhibitions paved the way for the ever-expanded list of applications available today. Arguably, these examples moved VR into the public sphere of education as they were designed for the general public with no experience of the complex hardware, whereas most applications at that point were designed for the medical field and physical sciences where users had specific expertise. Another outcome of designing experiences for public spaces like museums was that the duration of the experience decreased. Earlier examples cited above from Salzman, Dede, Loftin and Chen were in-depth learning environments that took thirty minutes or longer to navigate. Those developed for museums, on the other hand, required short durations to keep visitors moving through exhibition spaces and allowing more individuals to use the HMD. Once the potential of moving through a virtual museum space was realized, short experiences in physical spaces gave way to fully virtual spaces, such as The Exploratorium, a public science museum, and The CREATE project, an EU funded project that allows users to reconstruct archeological sites (Christou, 2010). The need for a user-friendly interface and immersive design, coupled with shorter durations of the experience, has led to the design of virtual learning environments (VLE) that are popular today.

With the ready availability of VLEs and virtual museums, the field of art history is poised to broadly adopt VR for classroom instruction. Instructors can bring students into digitized collections and museums across the globe or create their own computer-generated versions, bringing together works that would never been seen in the same location to compare and contrast. Since 2011 and the release of Google’s *Arts & Culture* application, visits to virtual galleries and museums using immersive realities became mainstream and accessible by anyone with a smartphone. Combining the application with Google Cardboard and a smartphone further democratized the technology. Other VLEs have since been developed to transport viewers to virtual museums and historical sites around the globe, including the National Archeological Museum of Marche, Ancona, 3D reconstruction of the Roman Forum, the city of Gyeongju, South Korea, and the Rijksmuseum, Amsterdam. (Favro, 2006; Clini, Ruggieri, Angeloni, Sassob, 2018). While photogrammetry and digitization of spaces and collections continues, the use of game engines, such as Unity and Unreal Engine, have provided the tools to import these scans and even to create computer-generated versions of virtual museums for students. Brennan and Christiansen (2018), for instance, outlined the process for digitizing cultural objects using 3D scanners and high-quality photography imported into Unity to create an immersive experience for ancient sculpture collections. Another example comes from The Universidad Nacional de San Agustin de Arequipa, Peru that also developed an experience for art history students in Unity (Huaman, Aceituno and Sharhorodska, 2019). However, unlike earlier simulations where viewers merely walk through and experience a virtual set of works or monuments, the virtual museum created by UNSAA gamified the experience where students gained points for moving through different rooms and engaging with different works of art. The survey data collected from students demonstrated that the experience improved student outcomes, but also revealed that greater interactivity and engagement would result from allowing students to create their own exhibitions. Developers like VIVE have since capitalized on the results and released VIVE Arts, which enables users to both create and exhibit works of art within a virtual space. Since 2016, the Venice Biennale and International Film Festival holds the Venice VR, the official VR competition associated with the annual event, which showcases work in this new medium.

With the growing library of VR applications, institutions of higher education are now able to begin designing infrastructure and processes to support their distribution in support of various subjects. The most common functional area to house XR equipment has been library servicces. With the budget and systems management processes in place, library staff are ideally positioned to support faculty and students with training in and selection of appropriate educational applications. In fact, libraries such as that at the University of Calgary and the University of Oklahoma have begun expanding into services that include VR as early as 2016. Instead of housing headsets in an XR lab, many libraries have designated VR carts to transport headsets to classrooms and other shared learning spaces for use. Others, as discussed by Hurrell and Baker (2020), direct undergraduate students to sign up for lab visits to supplement in-class lectures. Experiences include virtual field trips using Google Earth VR to expose students to far-flung destinations without the expense of travel. Modern languages are also supported through VR. For instance, German language classes tour historic locations in Germany and Austria. Women's studies classes experience the Stonewall Riots by touring Greenwich Village, while Classics courses can tour the Parthenon and Pantheon. The downside to the examples provided here is that the headset carts provided and in labs are not numerous enough to accommodate a large undergraduate class of twenty to thirty students, restricting use of only a few at a time or scheduled outside of class time.

Virtual Reality and Gaming in Art History Education

Art history games afford a broader engagement for the public. Champion and Foka, for instance, (2020, p.239) outlined four areas that such games could achieve, including 1) encouraging an understanding of the classification of art, 2) identification of art and matching those to their respective artists, 3) provide an understanding of how artworks are constructed and conserved, and/or 4) communicate the "spatial, chronological, personal and social context in which art is created and experienced." With the ability to effectively transport students to any site in the world, including world culture heritage locations and museums, immersive realities are ideally suited to understand the context of a work. Through conveying critical changes in time, space or behavior through interaction and sensory immersion, these games can create thematic conceptual experiences that are themselves framed by contextual meaning. The field has already adopted emerging technologies to investigate cultural artifacts. Taking cues from the artworld itself, art historians disseminate reproductions of works first through printmaking and then through projections with magic lanterns. The modern age saw the rise of the slide carousel projector and now the ubiquitous ceiling-mounted LCD projector in classrooms across the world today. Art history has always sought out the most immersive methods to bring works to students. Furthermore, the ability of these emerging technologies to preserve, represent, and disseminate cultural heritage has received much attention in digital humanities scholarship (Addison and Gaiani, 2000; Papagiannakis et al., 2008; Adhani and Rambli, 2012; Anthes et al., 2016; Bekele et al, 2018). But unlike the earlier technologies listed above, VR is not primarily a passive information delivery system. VR and gaming have the unprecedented educational ability to dynamically engage students and educators in a simulacrum. The three characteristics that act in concert to provide such an experience are outlined by Bekele and Champion (2019, p.31) as the ability to: "(1) establish a contextual relationship between users, virtual content, and cultural context, (2) allow collaboration between users, and (3) enable engagement with the cultural context in the virtual environments and the virtual environment itself." The features afford users the ability to engage with the experience, other users, and a deeper understanding of the context of the relationship between the three in a virtual environment.

A point should be made here between games proper and simulations. Many of the examples cited above are, in fact, simulations in that they differ from games which have roles, goals and agencies. In fact, many of the art games studied are simulations, such as *The Forbidden Palace: Beyond Space and Time*, *Rome Reborn*, *Digital Pompeii Unity*, and *Virtual Rome* (Champion and Foka, 2020). On the other hand, in *Civilization* (1991-), for instance, players have the role, such as that of a leader, and a goal, which could be to advance your people, and agency in that decisions affect the outcomes of the game at large made by the player. On the other hand, simulations generally have a preordained series of experiences meant to effectively replicate or inform of a given experience, such as how to drive a tank or a cinematic of the Pyramids of Giza (Squire, 2011). Both are valuable learning experiences depending upon the outcome desired.

While 2-D level design and side-scrolling platformers dominated when *Civilization* and other educational games first emerged, a shift towards greater and greater immersion has unfolded. After the parallax effects of 2-D games, such as *Prince of Persia* (1992), isometric design was developed for Massive Multiplayer Online Games (MMOGs) like the *World of Warcraft* series (1994-), which found the player hovering above a surface on which characters engage with the environment. The manner in which the player engaged with characters in the game gave way to first-person point of view popularized in First Person Shooters (FPS) like *Doom* (1996-) and spread to nearly all video game genres. The shift in perspective and design is indicative of the overall trend to make PC video games mimic the immersive qualities of virtual reality (Wolf & Perron, eds., 2003).

Such immersiveness is increasingly being applied to arts education. For instance, the virtual museum Huaman, Aceituno and Sharhorodska developed further demonstrates the benefits of gamification in the field. Similar arguments are made by Froschauer, Arends, Goldfarb, and Merkl (2011) with their online multiplayer Serious Game *ThIATRO*. The project grew out of a need to address the tedious manner in which students perceive the learning of art history. The sheer amount of rote memorization in each class, along with the context of cultures over time, represents a steep learning curve for many students. At the same time, the very element that thwarts engagement can be made into an asset as the cultural-historical background of art history can play an important role in raising a student's interest in contemporary culture and cultural heritage. *ThIATRO* is a multiplayer game and engages digital natives in a gamified manner to increase motivation and learning outcomes. Like other games, such as *ARTé: Mecenas*, *ThIATRO* compels the player to think about, organize and use information in ways that encourage active construction of knowledge, as well as to collaborate with others. Another project by Casu, Spano, Sorrentino and Scateni (2015) sought to leverage the lower cost of consumer hardware in developing an application for the teaching of Art History. Art Thief is another example of a game created at the California Institute of the Arts (2017) for CalArts Game Makers Club. In this scenario-RPG, a young security guard named Olive must fend off an art thief in a museum, while simultaneously interacting with the museum staff and visitors to solve puzzles, etc. Unfortunately, the 2D game is limited in its interactions and is not as engaging as immersive content to be discussed (Champion and Foka, 2020).

Other examples allow for ease of use in configuring museums as desired. For example, *ArtRift*, a VR tool designed for art history students and teachers, allows for the configuration of virtual rooms in a museum with pre-selected artworks and is enhanced by multimodal annotation. Improving upon a traditional art history lecture where two works are compared and contrasted, the application allows for works to be juxtaposed with each other in each room and instructors add additional multimedia content, such as audio or textual descriptions. Among the immediate benefits of such virtual spaces, outlined by Casu, Spano, Sorrentino, and Scateni (2015), is that comparisons can be made in a physical space that would never be possible in reality. Large sculptures, such as Michelangelo's *David* and *Moses* cannot ever be seen together as one is in Florence while the other Rome. In these simluated, virtual museum spaces, students can now compare the physical and stylistic elements of art as they were unable to do previously. In order to study the effectiveness of the application, students at Filippo Figari High School, Sassari were broken into two groups. The first was given access to works through a LCD projector on a wall, while the second through VR. At the close of the class, students were given the Instructional Material Motivation Survey instrument (IMMS) to assess their experiences. Students were queried on three areas: Attention Factor, Satisfaction, Relevance. All areas had qualitatively significant reporting and motivation was improved through the use of VR as opposed to traditional instructional methods.

As the previous example illustrates, previous research in the use of VR has primarily focused on secondary education (Merchant, Goetz, Cifuentes, Keeney-Kennicutt, and Davis, 2014). As an example, Brownridge (2020) outlined a curriculum to integrate VR into history and social studies classes in K-12 education. In the examples provided, students would take virtual field trips using Google Expedition (GE). A series of studies confirmed improved engagement and motivation once VR was integrated into coursework. The few studies that have been carried out in postsecondary education, however, have found the same positive correlations. For instance, Ghida (2020) discusses how immersive reality has been used in his History of Western

Architecture class, leveraging the ability to study a three-dimensional monument fully in three dimensions instead of an image or digital projection on a two-dimensional surface. Ghida provided students with specific monuments to view in Google Earth VR (released 2017) in order to experience monuments virtually in human scale. Given the advantages for architecture students, there is little surprise that the approach has since been adopted in architecture departments around the world, including Utah State University, MIT, Queensland University of Technology, Georgia State University, University of South California, The Chinese University of Hong Kong, Mount Saint Mary College, NY, and Florida State University.

In addition to providing the ability to tour monuments in three dimensions, research has also demonstrated that, as in the sciences, VR can be used to understand abstract concepts such as chronology in the field of art history, as well. Through a study of UK and Ukranian students at three levels from secondary to college, Korallo (2010) sought to determine the effectiveness of using VLEs to assist in the teaching and learning of historical chronology in different fields. The study confirmed the difficulty in teaching the abstract nature of time for different learning levels. In order to learn the sequences of events and address this pedagogical issue, the groups were taught the sequences of events in a virtual environment. At the same time, control groups were shown the same events with texts and pictures, as well as with PowerPoint slides. Sets of parallel timelines were shown simultaneously, including music and art history, and the history of psychology, art and general history, respectively. The most beneficial experience was when undergraduate students were able to view three parallel timelines simultaneously within a continuous virtual environment. More specifically, using virtual environments assists in understanding historical events on a timeline and is a superior learning strategy than traditional techniques.

Another immersive experience was developed for a Renaissance art history class at the University of Indiana, Bloomington. Brennan (2018a) supported by the subject-matter expert, Dr. Giles Knox, developed four fresco cycles in the Unity game engine. With limitations of the HTV Vive headsets needing to be connected to a desktop computer, there were not enough units nor space to set up in the actual classroom, and thus the Virtual Reality Lab on campus hosted small groups of students outside of class time. After covering the material in class, students would then set up a time to explore the fresco that had just been covered, starting with the Scrovegni Chapel in Padua, Italy. 360-degree photographs of the cycles were imported as skyboxes into the game engine to support the build out. As prolonged movements often lead to VR sickness, students moved through the experience via teleportation between skyboxes/nodes. Smarthistory lectures were triggered when approaching the respective scenes. The production phase was followed by playtesting and several iterations of the application to ensure the best user experience.

Game Design Studio

The lone efforts of individuals working in collaboration with art history and computer science departments mentioned above have yet to be scaled, and are currently very time intensive, often taking several years to complete. In order to address the operational and workflow issues inherent in developing educational video games, MIT began with a Comparative Media Studies (CMS) project that supplemented academic theories of games to consider real-world challenges facing practitioners. The project was further expanded with the 2006 establishment of the Singapore-MIT GAMBIT (Gamers, Aesthetics, Mechanics, Business, Innovation, and Technology) Game Lab. Through “applied humanism,” games are created within an academic context. The goal of the project was to bring academics and researchers "down from the ivory tower" to demonstrate the values of their theories through building games (Perron and Wolf, eds. 2009, p.256). In the summer of 2007, 30 students from Singapore were brought for a nine-week internship to work with MIT graduate and undergraduate students to create six games. Each team had seven members: two programmers, two artists, a game designer, a test lead, and a project manager. In addition, a two-person audio team provided sound and music support for all development teams. Given the constraints of time, top-down oversight was not possible, and so the "Scrum" project management model was adopted from industry. This model requires agility in project management and acts on new findings, unexpected outcomes, and user feedback quickly and efficiently. Teams would iterate and develop a playable build of their games every two weeks and receive feedback. The goal in this instance was for each team to demonstrate a single research idea in their game project (Perron and Wolf, eds. 2009).

Conclusion

Though uptake in adoption of virtual reality (VR) for the use in education, specifically art history, has been slow, the major barriers have now been removed. Research has concluded that the use of VR in education leads to greater student motivation, better engagement and learning outcomes. The difficulty educators have faced include the cost-prohibitive nature of the technology until now and the necessary expertise to be trained. However, the latest generations of headsets are inexpensive and have built in training. Now, educators need to understand how to leverage existing applications for their coursework, and then how to identify gaps and work with developers to create new experiences. There are still considerations for online and distance education, however. Kavanaugh et al (2017) noted the drawbacks and pointed out that if specialized hardware is adopted, there will automatically be difficulties in troubleshooting, ensuring students have access, and support services associated with the launch. Up until recently, this has been accurate given the cost-prohibitive nature of HMDs. Yet, in spite of these previous limitations, research has demonstrated the educational benefits of immersive realities in teaching and especially in art history. For instance, paintings can be compared and contrasted in virtual museums, famous monuments can be visited and interacted with, class lectures can be held in virtual museums and virtual classrooms, and historical context and chronology can be more readily learned through visual orientation and understanding events as physical spaces.

Methodology

Designing Educational Games

In considering the design of an educational game, certain principles need to be considered. What is often misunderstood is that many academics believe that authenticity and accuracy are the most significant criteria for a successful game. However, with newly available digital media, the learning outcomes must be carefully considered first and then the following considerations used during the design and implementation process. First, we would help define the components of a game in general, which include four essential characteristics that include 1) goals, 2) constrains, rules, and incentives, 3) competition, and 4) set within a specific context (Wideman, Owston, Brown, Kushniruk, Ho, and Pitts, 2007). Without these characteristics, the experience designed is likely to be a simulation (which may be a more desirable approach for certain outcomes). With regards to educational games, effective and entertaining examples (according to Squire (2011)) should consider eight features:

- Utilize academic subject matter as a tool for achieving learning outcomes

- Provide opportunities for systematic understanding
- Employ advanced game design mechanics
- Ensure there are different strategies embedded in the game to allow for different ways to play the game
- Ensure players interests are piqued to raise interest in academic subjects
- Clearly communicate ways of viewing and valuing the world being inhabited
- Encourage social interaction of different kinds that lead to productive outcomes
- Inspire creativity and smooth ramps to usher players from users to producers

Designing a game with the preceding considerations in mind would then naturally lead to a consideration of types/genres of games that would best align with the specified outcomes and experiences to reinforce them.

Typology of Games

There are various ways in which scholars have approached the classification and typology of games. Some focus on game types while others on games in general (Eilon, 1963; Juul, 2005; Murray, 1952). The primary categories of video games today can be grouped broadly within the categories of Action, Action-Adventure, Adventure, Role-playing, Simulation, Strategy, and Sports. Though each category has specific characteristics that distinguish them from one another from goals, engagement, reward systems, social interaction, etc., there are further multi-dimensional factors that can be used in each. Elverdam and Aarseth (2007) further expanded the typologies with a total of eight "meta-categories" and seventeen additional dimensions. The typologies listed in the eight "meta-categories" include: virtual space, physical space, external time, internal time, player composition, player relation, struggle, and game state. With regards to the additional seventeen dimensions, these include: virtual perspective, virtual positioning, environment dynamics, physical perspective, physical positioning, representation, teleology, haste, synchronicity, interval control, composition, stability, evaluation, challenge, goals, mutability, and solvability **(Figure 2)**. Where as the categories may be understood as genres, such as Action Adventure, these other characteristics and dimensions relate the specific mechanics, design, interactions, immersion, and other elements that often support the user experience and lead to the interactive nature of gaming.

Important for this study, previous scholarship has identified the educational game genre as separate from the other types discussed above. Of course, educational games can be cast in genres such as action adventure, but the design, mechanics, and goals are quite distinct. Dell'Aquila et al. (2017), for instance, defines the educational gaming genre as one designed to support a student or learner toward the goal of gaining knowledge, skills, or other kinds of attitudes about a particular academic area or subject matter. Traditionally, this genre would focus more on education than entertainment, though the genre transcends all others, and the primary goal is what differentiates them. Examples of this genre would include *Crazy Machines: The Wacky Contraptions Game, Math Doodles, Monster Physics, Montessori Crosswords, Rocket Math, Stack the Countries*, and *Stack the States.* The list may be expanded upon to focus more on areas that are prime for gamification. Sangkyun, Song, Lockee, and Burton (2018), for instance, note that there are many video game genres, but four are especially appropriate and support gamification- war games, simulation games, serious and/or applied games, and alternate reality games.

The types of gamified genres align better with some disciplines as opposed to others. War games are used primarily for the military, business and education. The exercise of carrying out a planned strategy will reveal the effectiveness and value of the plan without the expenditure of resources. In the field of education, business administration, industrial engineering, and economics are best suited to benefit from the war games genre. Simulation games are also useful for similar disciplines. These simulate real-world situations or virtual situations and have been used for business education in order to teach strategy, accounting, sales, marketing, and financial management. The recent advances and proliferation of technology have seen these expand to all areas of education where appropriate. Serious or applied games, on the other hand, are produced for a reason other than simple entertainment and enjoyment of playing (Ulrich and Helms, 2017). *The Oregon Trail* (1971-74) may be considered an ancestor to serious games in the field today, which was designed to teach students about nineteenth-century American history. Finally, alternate reality games require involvement with the real world, which can include real-world media like text messaging, email and websites to deliver content (McGonicgal, 2011; Sangkyun, et al., 2018).

Theories for Gamification in Learning and Education

There are four major theories of learning associated with gamification of education. Depending upon the desired outcome, activity, or lesson, various concepts and principles may be applied to improve student motivation and engagement with *Motivation Theory, Self-Determination Theory, Achievement Goal Theory,* and *Social Learning Theory and Situated Learning Theory.* For instance, educators looking to motivate students in learning may consider Motivation Theory. As studies have demonstrated, motivation remains the single most significant variable with regards to successful learning in a gamified environment (Sailer, Hense, Mandl, and Klevers, 2017). Whether extrinsic or intrinsic, "motivation" can be described as the emotional and/or mental state of a student or learner that has a positive correlation to behavioral or psychological change. Intrinsic motivation relates to a learner's own innate interests, curiosity or enjoyment (Ryan and Deci, 2000). Whereas researchers have found that intrinsic motivation is a better indicator of successful academic achievement, extrinsic motivation should be used by educators since most students lack self-actualizing motivation (Taylor et al., 2014). Extrinsic motivation influences learners by way of external factors, such as the real or perceived threat of punishment, promise of rewards, or other compelling pressure systems. However, educators should use caution when adopting extrinsic motivation since: 1) the student may not perform in the same manner once the external factors are removed and 2) extrinsic motivation has been found to decrease intrinsic motivation in certain situations, replacing the need for internal stimuli (Deci, Koestner, & Ryan, 1999; Deci Koestner, Ryan & Cameron, 2001; Kohn, 1993; Warneken, & Tomasello, 2008).

The second theory associated with gamification is Self-Determination Theory, which builds on the dual system mentioned as a macrotheory of motivation (Adams, Little, and Ryan, 2017; Deci and Ryan, 2008). Building on the extrinsic motivational theory, Self-Determination Theory assumes that an individual's volition and motivation are directly influenced by their immediate environment, which include social and cultural factors. In this macrotheory, individuals grow due to inborn psychological desires that include relatedness, competence, and autonomy. In order to capitalize on learning with the theory, educators should offer as many choices as possible during instruction to ensure: 1) students feel they have control over their behaviors and consequences, 2) perceive the ability to complete missions and 3) enjoy a sense of community through interacting with others.

Related to the macrotheory of gamification, Achievement Goal Theory assumes individuals may be motivated by desire to complete a specific task or goal (Dweck & Leggett, 1988; Elliott & Dweck, 1988). The theory has two specific types of goals: performance and mastery goals (Hamstra, Yperen, Wisse, and Sassenberg, 2014; Nicholls, 1984; Pekrun, Cusack, Murayama, Elliot, and Thomas, 2014). Mastery goals relate to an innate desire to understand a concept, finish a task or acquire abilities. Learners with mastery goals, otherwise known as task-involved goals, are inherently more self-motivated, and focused on competence development, and self-improvement. Performance goals, or “ego-involved” goals, are instead ones that look to outperform others who pursue the same task. These types of learners are more interested in social comparison than learning outcomes (Seifert, 2004). As with intrinsic and extrinsic motivation, educators should carefully use performance goals as they may negatively impact motivation as well as self-efficacy (Schunk and Mullen, 2012). Student types should also be considered when gamifying learning. For instance, competitive learning environments are ideally suited to performance goals, however, these are more effective for older male students rather than younger female students (Midgley and Kaplan, 2001).

Building on the importance of the learning environment and social motivations, Social Learning Theory and Situated Learning Theory are also important to consider as these relate that students actually learn best while observing others, including their behaviors and outcomes of those behaviors. The approach to learning incorporates cognitive processing and social interaction in four principles: attention, retention, reproduction, and motivation (Bandura, 1977). In the social approach outlined here, educators should identify a model student for others to observe and model their own behavior on after seeing the outcomes of their actions.

Considerations of the preceding theories include the type of achievement goal, learning environments, possible side-effects, and characteristics of the student population.

Students Perceptions of Gamification and Player Types

The perceptions of students to gamification of learning and games in general has been extensively studied. In one such attempt to identify the elements involved in intrinsic motivation in instruction, Malone (1981) organized those that actively contributed to ensuring a game was enjoyable and fun into three groups- Challenge, Fantasy, and curiosity. Subsequently, Lepper (1988) continued the investigation by focusing more on the instructional design and the influence it has on intrinsic motivation and broke the design principles down to four elements: control, challenge, curiosity, and contextualization. Expanding on these earlier studies, Korhonen, Montola, and Arrasvunori (2009) further categorized Playful Experience (PLEX) in gameplay into twenty types: captivation, challenge, competition, completion, control, discovery, eroticism, exploration, expression, fantasy, fellowship, nurture, relaxation, sadism, sensation, simulation, subversion, suffering, sympathy, and thrill.

With such a range of playful experiences, the engagement of various gamers and what is considered fun and enjoyable will also be determined by learner type and demographics. Kim (2013) studied engineering student preferences for certain types of play from the PLEX categories above and determined that gender played an important factor in which activities were ranked as most enjoyable. For instance, male students in rank order preferred challenge, completion, exploration, and simulation most **(Figure 3),** while female students exploration, relaxation, discovery, completion, and fantasy**.** Therefore, the difference in gender relating to preference on play and fun should be taken into consideration when gamifying learning to ensure the audience needs and expectations are met. In this model, a game that is built around mechanics of nurture or fantasy would be effective for female students, but not male.

From these different preferences also arises gamer types. Once determining the type of gamer in a class, the designer/instructor can assign appropriate roles to them. Bartle (2005) classified gamer types into eight variations: griefers, opportunists, politicians, planners, friends, hackers, networkers, and scientists. Before describing the characteristics of each, it should be noted that these were taken from a study of MMOGs that are inherently social by nature. As such, the abilities of the players are more expansive than other game types. For instance, griefer gamer types often tease or harass other players, preferring to get a reputation even if bad. Opportunist type gamers are explorers and take chance when presented. However, opportunists prefer to explore rather than confront obstacles or challenges. Politician type gamers play strategically to achieve long-term goals. These gamers act on foresight and enjoy good reputations to exploit other players. Planner types are also strategic, however, they set a goal before acting in a game. Friend type gamers nurture friendships within other players. Hacker type gamers are more intuitive and are interested in new objects, events or places. Networker type gamers like making new friends, however, unlike friend type gamers, networkers evaluate whether a friendship is beneficial and discard friends if necessary. Finally, the scientist type gamers are interested in cause and effect with regards to phenomena in games. Play is systematic and experiments may be a part of game play. Understanding player types will assist in designing appropriate games and will lead to greater success in learning outcomes. Assessing player types at the outset of a class is highly recommended.

Mixed-Methods Survey Instrument

The previous considerations, which include game genres, player types, preferences for mechanics and demographics, informed the design of the survey instrument used for this study. The mixed-methods study included data from surveys collected from undergraduate and graduate students. The sample was collected from Lindenwood University, a private, four-year, liberal arts institution in the suburban ring of St. Louis, Missouri. Participants included 38 graduate students and 24 undergraduate students enrolled in art history courses from the Colleges of Education and Human Services, Arts and Humanities, Science, Technology and Health, and the Business and Entrepreneurship. The purpose of the project was to assess types, familiarity, and preferences for games and gamification. Results gathered were compared between demographics of major, age, and race/ethnicity. This project utilized a mixed-methods study design which included qualitative (open-ended comments) and thematic (quantitative) results from an online survey. The survey was administered in Fall of 2021 and collected data on student demographics, academic level, frequency of game play, preferred game platforms and gamification, passed experience of playing educational games, preferences for social and cooperative game play, preferred gaming elements, preferred game settings, preferred character elements, motivations for gaming, gamer type. The categories and elements that predict success in educational gaming and the associated demographics were drawn from previous literature (Eilon, 1963; Malone, 1981; Dweck & Leggett, 1988; Elliott & Dweck, 1988; Lepper, 1988; Juul, 2005; Murray, 1952; Wideman, Owston, Brown, Kushniruk, Ho, and Pitts, 2007; Deci, Koestner, & Ryan, 1999; Deci Koestner, Ryan & Cameron, 2001; Seifert, 2004; Bartle, 2005; Kohn, 1993; Warneken, & Tomasello, 2008; Adams, Little, and Ryan, 2017; Deci and Ryan, 2008; Elverdam and Aarseth, 2007; Montola, and Arrasvunori, 2009; Squire, 2011; Midgley and Kaplan, 2001; Schunk and Mullen, 2012; Kim, 2013; Taylor et al., 2014; Hamstra, Yperen, Wisse, and Sassenberg, 2014; Nicholls, 1984; Pekrun, Cusack, Murayama, Elliot, and Thomas, 2014; Dell'Aquila et al. 2017; Ulrich and Helms, 2017; McGonicgal, 2011; Sangkyun, et al., 2018; Sailer, Hense, Mandl, and Klevers, 2017 Ryan and Deci, 2000)

Participants were asked to indicate via a Likert scale their preferences for games and gamification and to self-identify as specific gamer types. Students were asked an open-ended question relating to what kind of art history game they would most prefer to see created that currently does not exist, reflecting upon their answers in the survey. Students were contacted either through the University course management system or were emailed with links to online surveys. The survey was available for approximately two-weeks at the end of the term and all data was collected using Qualtrics to ensure privacy and anonymity of responses. These results were sorted based on demographics (major, age, and race/ethnicity) and data were exported for the survey system. Descriptive statistics were calculated and used for comparisons between groups.

Analysis

Students across all colleges enrolled in art history courses Fall 2021 were surveyed and demographic data collected from them. 64 students responded to the survey- 38 graduate students and 24 undergraduate students. Of those, 32.81% were 18-24 years of old, 37.5% 25-34 years of age, 15.63% 35-44 years of age, 9.38% 45-54 years of age, and 4.69% 55-64 years of age; 68.25% identified as female, 26.98% male, 3.17% non-binary, and 1.59% transgender male; 3.13% Asian, 75% white, 10.94% Hispanic or Latino, 1.56% American Indian or Alaskan Native and 9.38% Black or African American. 38.71% identified as undergraduate students, 54.84% as graduate students, and 6.45% (graduate) certificate students. 58.73% were art history majors and

41.27% were non-art history majors, including: Fashion Business and Entrepreneurship, Psychology, English, Finance, Graphic Design, Game Design, Interdisciplinary Studies, Pre-Art Therapy, Digital Art, Web Design, Art and Design, Elementary Education, Biology, Mass Communications, Digital Marketing, and Fashion Design and Technology.

Students were then surveyed on the types of games and on what platforms they most often play. First, students were asked whether they played games and what kinds, including video games, board games, card games, party games or others. 88.89% responded in the affirmative and 6.35% answered “maybe,” and 4.76% responded in the negative. There was no statistically relevant difference between male and female populations, nor art history majors and non-majors, with regards to how many played games regularly. Separated by level, however, there were differences in how undergraduate and graduate art history majors responded in that 100% of undergraduates claimed to play games, while only 87.10% of graduate students responded the same. The ages of those that claimed to play games was also of interest to the study for only 88% of the youngest (18–24-year-old students) generation responded in the affirmative, 25–34-year-old category 91.30%, 35–44-year-old category 90%, 45–54-year-old category 100%, and 55–64-year-old category 66.67%. There is, therefore, a bell curve mapping gameplay that starts high with First Year college students, then increases from 25 years old and peaks at 45-54 years of age, then begins declining at age 55.

Regarding gaming platforms, 31.15% of students responded mobile (phone/tablet), 24.59% computer (PC/Mac), 13.11% boardgames, 11.48% PlayStation, 6.56% X-Box, 4.92% Nintendo Switch, 3.28% VR Device, 3.28% party games, 1.64% augmented reality. Majors and non-majors had little variance and reported similar results. However, when separated by gender a noticeable difference in preference emerges. Male participants overwhelmingly preferred the computer as a platform, whereas females preferred mobile gaming on phones and tablets. The same breakdown may be reflected in age and gender for undergraduate and graduate art history students as undergraduates responded Nintendo Switch as their preferred platform and graduates mobile gaming. Broken down by age, the types of devices preferred, and platforms also change. The first group (18-24) preferred mobile gaming, second (25-34) gaming on Computer, third (35-44) ranked mobile gaming and VR device as equally used, fourth (45-54) mobile gaming, and, lastly, (55-64) board games and party games.

Experience with and preferences for or against gamification of learning were then surveyed. Students were first queried on whether they believed material presented as a game would be easier to learn. 53.97% agreed, but many were unsure with 38.1% responding "maybe" and 7.94% definitively stating that they would not. There was not a significant difference between male and female responses. Major versus non-major yielded different results, with art history majors preferring gamified learning with 59.46% responding in the affirmative versus just 44.83% from non-majors. The preferences became even more stratified when differentiating undergraduate and graduate majors. 100% of undergraduate art history students agreed that learning through gamification would be beneficial, but only 51.61% of graduate students said the same. Broken down by age, the preference for gamification also changes. Of the first group, 50% (18-24) preferred gamification, second (25-34) 65.22%, third (35-44) 60%, fourth (45-54) 0% (though the group answered 83% "maybe"), and, lastly, (55-64) 66.67%.

The same preferences were also reflected in responses to the question as to whether respondents had played an educational video game or application. Examples such as *Oregon Trail* and *Big Brain Academy* were given. 80.95% of respondents stated that they had, in fact, played such games, while 14.29% stated they did not with only 4.76% relaying uncertainty. At the same time, more female than male respondents had exposure to educational gaming. Moreover, a greater percentage of majors had experienced educational gaming (84.21%) versus non-majors (75.86%). In general, the results point to a greater preference for exposure to gamified learning among art history majors. Interestingly, even though both graduate and undergraduate populations had the same response when asked if they had played games (83%), significantly more undergraduates found gamification of learning beneficial and preferential. Broken down by age, there was also a difference of how many in a group had played educational games. Of the first group, 76% (18-24) answered in the affirmative, second (25-34) 91.3%, third (35-44) 80%, fourth (45-54) 66.67%, and, lastly, (55-64) 66.67%.

Students were surveyed next on their preferences and experience with game types, genres, and mechanics. First, preference for or against cooperative gameplay was surveyed. 46.03% of respondents preferred to play alone, 19.05% cooperatively, and 34.92% had no preference. When differentiated by gender, the preferences for platforms are carried through into preferences here. Female respondents significantly preferred to play alone (46.51%) versus cooperatively (11.63%), whereas males claimed to prefer playing alone and cooperatively equally (37.5% each, respectively). Given the proportion of female majors, there is little surprise that art history majors preferred playing alone (57.89% aggregate, and 66.67% undergraduate and 54.84% graduate) versus non-majors playing cooperatively (37.93%), though it should be noted that there was a more even distribution in preferences among non-majors. Broken down by age, one is able to see preferences shift. Of the first group, 36% (18-24) answered they had no preference with Alone and Cooperative gameplay ranked the same at 32% each; second (25-34) 47.3% preferred Alone, third (35-44) 70% preferred alone, fourth (45-54) 66.67% preferred Alone, and, lastly, (55-64) 66.67% had no preference.

The elements that were preferred in such games were surveyed next and 47.06% selected Curiosity, 33.33% Challenge, and 19.61% Fantasy. Results were fairly similar across gender lines with both males and females ranking Curiosity first and Challenge second. However, males preferred Challenge more than females (35.71% versus 28.57%) and females preferred Fantasy (22.86% to males 14.29%). Majors also preferred Curiosity at 56.67% while non-majors Challenge (41.67%). Again, it should be noted that there was a more even distribution among preferences here for non-majors. At the same time, both graduate and undergraduate students preferred Curiosity first, but that tied with Fantasy for undergraduates with no interest in Challenge whatsoever, and graduates had the following ranking of Curiosity, Challenge, and then Fantasy. Broken down by age, preferences for game play elements are as follows. Of the first group, Curiosity was preferred (18-24), second (25-34) Curiosity preferred, third (35-44) Challenge and Curiosity were equally preferred, (45-54) Curiosity vastly preferred, and, lastly, (55-64) Challenge was preferred.

Game genres followed the question of preferences for game elements. Results differed between genders and level of college enrollment. The aggregate response by students was ranked as follows:

1. Casual Games: Puzzle, Visual Novels, Point-and-click Adventure, Hidden Object, Match Three, Interactive Fiction, Idle, Trivia, Logic
2. Action-adventure: Adventure, survival horror, stealth
3. Action: Arcade, 3rd/1st person shooter, platformer, racing, sports, fighting, Battle Royale, survival, rhythm games
4. Role-playing Games: Real-time, turn-based, tactical, roguelike/lite
5. Simulation Games: Life, sports, flying, racing, etc.
6. Party Games
7. Digitized Board/Card Games

8. Strategy Games: Real-time, turn-based, 4x, artillery, tower defense, MOBA

When considering differences by gender identification, more traditional categorizations emerge. Males ranked Action as their top choice, whereas females Casual Games. Both genders had the same second and third favorite rankings, however, with Action-Adventure, and Role-Playing Games. Majors preferred Casual games whereas non-majors Action-Adventure. Undergraduate majors ranked Simulation and Action-Adventure as tied for the top spot followed by Casual Games and Role-Playing Games. Graduate students had a similar ranking with Casual Games, Action-Advanture and Role-Playing Games. Broken down by age, preferences for game genres are as follows. Of the first group, (18-24) Action-Adventure and Casual tied for first spot followed by Action and Simulation, second (25-34) Action-Adventure, Casual, and Role-Playing, third (35-44) Casual, Action-Adventure, and Simulation, (45-54) Casual, Action, and Simulation, and, lastly, (55-64) Party Games, Digitized Board Games, and Casual.

Following up on the preferred genres, students were asked what types of settings they most preferred for their games and ranked the following in order of preference:

1. Mystery Stories
2. Fantasy Stories
3. Set in the Past
4. Science Fiction Stories
5. Suspense Stories
6. Romance
7. Make you nostalgic for your youth
8. Set in the modern day
9. Post-apocalyptic Stories
10. Set in the Far Future
11. Family
12. Set in the Near future

13. Horror Stories

Reviewing the results and comparing them by gender, found similar interests. Both genders, as well as majors and non-majors, all preferred Mystery Stories as their favorite genre. Females then equally ranked Suspense and Fantasy and males Fantasy and Science Fiction. The responses seem to indicate that females prefer both fantasy settings and elements, whereas males prefer only the elements. Undergraduate majors preferred Mystery followed by Suspense and Fantasy, while graduate majors Mystery followed by stories set in the past, and, finally, Science Fiction Stories. Broken down by age, preferences for game setting are as follows. Of the first group, (18-24) Mystery, Fantasy, and Suspense, second (25-34) Mystery, Fantasy, and Science Fiction, third (35-44) Mystery, set in the past, and Science Fiction, (45-54) set in the past, Mystery, and Modern Day, and, lastly, (55-64) Modern Day, Mystery, and Romance.

Following up on the preferred characters, students were asked what types and characteristics they most preferred for their games and ranked the following in order of preference for:

1. Customized player characters
2. Visually realistic characters
3. Visually stylized characters
4. Characters played in the first-person point of view (no visible character)
5. Characters that reflect the player’s gender
6. Characters that reflect the player’s age
7. Non-human player characters
8. Characters that reflect the player’s race/ethnicity
9. Character that is younger than the player

Differences by gender include a preference for games played in the first-person in males and the ability to customize the player character for females and art history majors. At the same time, the second and third preferences for both genders were visually realistic and stylized characters. Non-majors preferred visually stylized characters. Undergraduate majors preferred playing as their own race/ethnicity, which tied with ability to customize characters. Graduate majors also ranked customizing characters as their first choice followed by visually realistic characters. Broken down by age, preferences for characters are as follows. Of the first group, (18-24) prefer customizable characters, second (25-34) prefer visually realistic characters (followed by customizable), third (35-44) characters played in first person and visually realistic characters were equally preferred, (45-54) and (55-64) preferred first person characters followed by those that are customizable.

Next, students were surveyed on their motivations relating to game play and association with their gamer type. When asked about motivations, students responded and ranked their experiences in order of preference as follows:

1. Captivation
2. Discovery
3. Exploration
4. Challenge
5. Completion
6. Fantasy
7. Competition
8. Expression
9. Relaxation
10. Control
11. Fellowship
12. Simulation
13. Thrill
14. Sensation

15. Nurture
16. Sympathy
17. Eroticism
18. Subversion
19. Sadism
20. Suffering

In considering gender, both ranked their top three as Captivation, Discovery, and Challenge. Majors preferred Discovery, Captivation and Exploration, ranking them as such, while non-majors ranked Captivation, Challenge, Discovery. Undergraduate majors ranked Discovery, Exploration and Fantasy as their top three, while graduate majors Discovery, Captivation, and Exploration. Broken down by age, motivations for gameplay are as follows. Of the first group, (18-24) Captivation, Discovery and Challenge were ranked in order, second (25-34) Captivation, Discovery and Exploration were ranked, third (35-44) Exploration, Discovery and Captivation were ranked, (45-54) Challenge, Captivation, and Discovery were ranked, and, lastly, (55-64) Challenge, Discovery and Fellowship.

Finally, with regards to gamer types, students were asked to self-select their own and the preferences were ranked as follows:

1. Opportunist type gamers are explorers and take chances when presented
2. Friend type gamers nurture friendships within other players
3. Hacker type gamers are more intuitive and are interested in new objects, events or places
4. Politician type gamers play strategically to achieve long-term goals
5. Planner types are also strategic, however, they set a goal before acting in a game
6. scientist type gamers are interested in cause and effect with regards to phenomena in games
7. Networker type gamers like making new friends, however, unlike friend type gamers, networkers evaluate whether a friendship is beneficial and discard friends if necessary

8. Griefer type gamers harass and tease other gamers, preferring to get a reputation even if bad

Both genders ranked Opportunist as their most self-identified gamer type with nearly identical scores. But that is where the similarities end. Reflecting earlier research, males then ranked the following: Politician with Planner, Networker, Griefer, and Scientist all tied for third. Females ranked the following after Opportunist: Friend, Hacker, followed by Planner and Scientist tied for fourth and Politician and Networker tied for fifth. Notably, males were the only demographic to select Griefer and females were the only to choose Friend and Hacker. Also, interesting was the both major and non-major selected Opportunist as their first gamer-type, but that is where the similarities ended. Majors had the following ranking: Opportunist, Hacker, Politician and Planner were tied, Scientist and Friend tied, and, lastly, Networker. For non-majors, the following were ranked: Opportunist, Friend, Networker, and Griefer, Planner and Scientist all tied for last. Undergraduate majors identified a range of types equally, including Opportunist, Friend, Hacker, and Planner. Graduate majors ranked Opportunist as the most common gamer type with Politician and Hacker tied for second, followed by a tie for third of Planner and Scientist, then Friend and Networker. Broken down by age, self-identified gamer types are as follows. Of the first group, (18-24) Friendship type was ranked first, followed by Opportunist and Networker, second (25-34) Opportunist followed by Politician, Hacker, and Scientist that all scored the same, third (35-44) Opportunist, Planner and Hacker ranked first equally followed by Politician and Scientist, which also tied in ranking for second, (45-54) Opportunist followed by a tie for Planner and Hacker and, lastly, (55-64) Politician, Friend, and Scientist all ranked equally.

The survey concluded with two open-ended questions for students. The first asked what kind of art history game students would most like to see made, including period, setting, genre, and the like. The most popular response was antiquity, including Greece and Rome, and Classical gods, then Egypt, Tang China, Sengoku Japan, followed by Medieval and Renaissance, and, finally, modern settings like 19^{th}- and 20^{th}-century styles. There were a few responses that indicated a desire to move between periods, such as "Some sort of interactive platform where you can choose different artist styles and mediums to create a new piece to truly understand what different eras of time along with." As noted in the preferences in setting and period, the free responses confirm overwhelmingly that students prefer the distant past over the recent past. The final open-response question asked if there were other considerations those developing educational, art history games should consider with regards to content.

Responses were wide ranging, but there was a theme that reiterated a desire for engaging, immersive and sensorial experiences that were historically accurate. One response read: "Making sure information presented in the game is factual and easily accessed (ie, presented in story narrative or through collectibles such as notes found in the world)." Another reiterated the sentiment with "Close proximity to historical accuracy." Acceptance of the experience as educational was also a point of contention, as one student noted: "People play games to have fun, learning is a side-effect; presenting a game as 'educational' is judged immediately as 'not a game' but interactive learning tool."

Further demographic considerations would be to filter survey responses by major, gender, and age groups to better align gaming elements and genres with different populations. Broken down by age, the free responses shed additional light on the preceding results of the survey. Of the first group, (18-24) a preference for games set in antiquity and elements being realistic was cited, second (25-34) settings were preferred in the 19^{th}- and 20^{th}-Centuries with a great deal of skepticism expressed regarding the ranking structure of the survey instrument and questions, but did confirm a preference for puzzles or playing as a famous artist, third (35-44) ancient and non-western settings were preferred with sensory immersion and historical accuracy as game elements, (45-54) preferred medieval and Renaissance settings for games that are set in VR and also incorporate job skills, and, lastly, (55-64) 20th-century American as the setting, but adamant that a gaming element should not be mandatory for a course requirement in the art history program.

Learning Outcomes and Game Genres

The difference in preferences by student population of major and non-major, and undergraduate versus graduate art history majors can be attributed to age, gender, and academic interest, but we should also consider the types of learning that different game genres are best able to support for learning outcomes. Qian and Clark (2016), for instance, studied Game Based Learning (GBL) across a range of fields and concluded that there were positive correlations and potential for skills development. However, successful GBL was not merely playing entertaining games or generic educational games, but instead required a concerted effort on the part of educators and designers to align mechanics and design elements with pedagogy and skills assessment.

Several studies have been conducted on learning styles, learning outcomes and game genres. Focus on the use of computer games to develop skills in children, Rapeepisarn, Wong, Fung, and Khine (2008) studied the alignment of learning techniques and different game genres. Drawing on earlier studies relating to learning style, educational content, and possible games **(Figure 4)**, researchers aligned the facts, skills, and behaviors to be learned with various games, such as role-playing, puzzles, etc. The results of their study confirm that students preference for game genres reflects their learning styles. Breaking learning styles into Activists, Reflectors, Theories, and Pragmatists, the group created the following chart to align the best game genres for them **(Figure 5).** The study concludes with a new conceptual model for understanding the alignment of game genres with learning outcomes and learning styles **(Figure 6).** Likewise, Doherty, Keebler, Davidson, Palmer, and Frederick (2018) argued for a realignment of game genres to reflect what skills they develop, respectively. While the group focused on emotions elicited and skills required to play, the relevance to educational gaming is in alignment with the other studies mentioned above. In considering mechanics such as frequency of interaction, one must consider how often a player must interact with the game to avoid failure. The second control related comparison is based on the degree of error tolerance in a game. This would equate to how many errors a player can make (if any) and still be successful in a game. Such considerations led to a new chart outlining the psychological construct and the gaming attributes that they align to (Figure 10). These are broken into motivation, skills, and cognitive processes.

In their study De Byl and Brand (2011) noted the importance in game genre and alignment with learning outcomes to ensure success in an academic cohort. While intended for the medical community, De Byl and Brand provide some guidance when trying to align a game genre with a skill to be learned. With serious games designed for play on computers/desktops, De Byl and Brand reviewed learning styles by discipline to align gamification principles for certain learning outcomes **(Figure 7)**. Research since 2000 has demonstrated that previous teaching strategies that relied on analog materials are no longer a motivating factor in teaching and learning, therefore, the latest technology need be leveraged in classrooms. To support that, the pair developed pedagogical approaches that align with different learning styles **(Figure 8**). After identifying different learning styles and how to best motivate each, a review of the elements in game genres is laid out with Action, Action-Adventure, Strategy, and Process-oriented **(Figure 9)**. For instance, Action games are tied to quick reflexes and fine motor skills and, therefore, are ideal for surgeons to reduce time in surgery; Adventure games require deep-thinking and critical-thinking skills ideal for medical practitioners to continue seeing the connections in their fields as new research emerges; Strategy games are using for physicians that juggle large caseloads to fine tune the skills necessary to keep those in alignment; and process-oriented games align with medical students that must go through phases of learning information progressively.

Recommendations for Gamification

In order to support learning across a heterogenous population, understanding the relationship between demographic and game genre is paramount. Sherry (2010) developed a useful chart and alignment of Bloom's educational objectives and game genres **(Figure 10).** Seen in the chart, most genres have the ability to address the six educational objectives from Bloom, except for Quizzes and Puzzles. In his study, Silvia (2019) further builds on this alignment with an alignment of Learning Techniques, Activities and Game Genres **(Figure 11)**. As can be seen in the chart, if the Learning Technique involved Learning by Doing, the Learning Activities would include interaction, practice, drill, imitation, and would align best with the game genres of Shooters, Action/Action-Adventure, Fantasy/Role-Playing. Such considerations should be taken by future developers in the area of cultural heritage and art history when considering the specific technique, activity and in what game genre. In order to assist future designers and developers, a summary of considerations from this study will now be presented **(Figure 12).**

a. *Designing for Non-Art History Majors*

The population that identified as non-majors were taking classes for a variety of reasons, but primarily as a General Education requirement. As such, the motivation and perceived relevance of the material presented need be considered in order engage the population. Non-majors were less likely to prefer gamified learning experiences and be less likely to have played an educational game; they prefer to play alone or cooperatively equally; there is less homogeneity with preference for game elements with wider interests; Action-Adventure is their preferred genre; Mystery Stories are their preferred settings; preference is given for visually stylized characters; their motivations are Captivation, Challenge, Discovery; and Opportunist is the preferred gamer type.

b. Designing for Art History Majors

The population is already inherently motivated by the content and subject matter of the gamified experience. Other considerations here would relate to the type of activities, outcomes, and experiences that relate to each demographic best. This population primarily games on mobile devices; they prefer gamified learning and were more likely to have experienced an educational game in the past; they prefer playing alone; they are most motivated by Curiosity; they prefer Casual games and Mystery Stories; they prefer to play as customizable characters; they prefer Discovery, Captivation and Exploration; Opportunist is their most common gamer type.

c. Designing for Undergraduate Art History Majors

The population is often younger, has slightly less experience with gaming overall, but all have played at some point. The considerations for this population include: All claim to have played games and believe gamification to be beneficial; they play more console games than graduate students; more undergraduates found gamification of learning beneficial and preferential; prefer playing alone; motivated by Curiosity but also prefers Fantasy; Simulation and Action-

Adventure are the preferred genres; preferred Mystery followed by Suspense and Fantasy; preferred playing as their own race/ethnicity, but also like the ability to customize characters; they are motivated by Discovery, Exploration and Fantasy; identified their gamer types as Opportunist, Friend, Hacker, and Planner.

d. Designing for Graduate Art History Majors

Graduate students are usually older and have more life experience than undergraduates. Considerations for this population include: less likely to have played a game or want gamified learning as compared to undergraduates; prefer mobile gaming; prefer playing alone; motivated by Curiosity in gameplay; prefer Casual Games, Action-Advanture and Role-Playing Games; prefer Mystery and stories set in the past; prefer to play customizable characters and visually realistic characters; prefer Discovery, Captivation, and Exploration; ranked Opportunist as the most common gamer type with Politician and Hacker tied for second, followed by a tie for third of Planner and Scientist, then Friend and Networker.

e. Other Considerations

As breaking down the respondents by age demonstrated, there are longitudinal differences. First, there is a bell curve mapping gameplay that starts high with First Year college students, then increases from 25 years old and peaks at 45-54 years of age, then begins declining at age 55. Combining this with the preferences of each generation for platform, game genre and their changing player type will yield more successful outcomes.

Conclusions

The examples cited above, however, are either generic in their alignment of learning styles and personality types, or relevant only to one field (e.g. medicine). In order to create a reliable measure for game genres and learning for assessment, Natucci and Borges (2021, p.np) outlined the following phases of research that need to be conducted. First, integrating various sources of research needs to occur to the end of alignment game elements with pedagogical theories; "Understand the connection between affect, cognition, motivation and social/cultural foundations in games, and how they influence both player's experience and learning;" and "Create an intuitive and effective framework for designing and assessing SG/GBL, based on both empirical practices/industry standards in game design and academic re-search, that can be used by educators and game designers with various backgrounds." At the same time what needs to happen to accomplish this is to 1) create a unified taxonomy of game genres and elements that can be used by both educators and game developers and designers, and 2) creation of a unified open repository of empirical studies relating to specific game elements (such as that provided in this study).

Studies of heuristic elements and game genres are sporadic and do not use a systematic pedagogical theory to ensure validity. This study provides a model for other game developers to use in how developing a Game Design Document, Level Design Document, and other industry-standard practices need be preceded, even before the pre-production process, with a clear understanding of the learning outcomes, skills, and knowledge that players are to have after playing the game successfully. Additionally, understanding the player, their preferences and motivation, and how those are affected by demographic considerations like gender, age, background, and education. Recommendations from the study include future considerations of the role of specific gameplay heuristics and mechanics in learning taxonomy and outcomes. In order to effectively assess the applicability of different game genres and learning activities to specific outcomes, further investigation is required into actual game play that introduces, reinforces, or provides an opportunity for mastery of said outcomes. One approach would be to start with simpler games in learning taxonomy that assist in remembering key concepts and advance from there to more abstract ones and synthesizing information before analyzing and creating. Furthermore, a scaffolded approach should be considered that combines high-impact pedagogy with gamification. Several touch stones can be presented that build on one another to inform the scholarship of teaching and learning aligned with gamification.

Illustrations

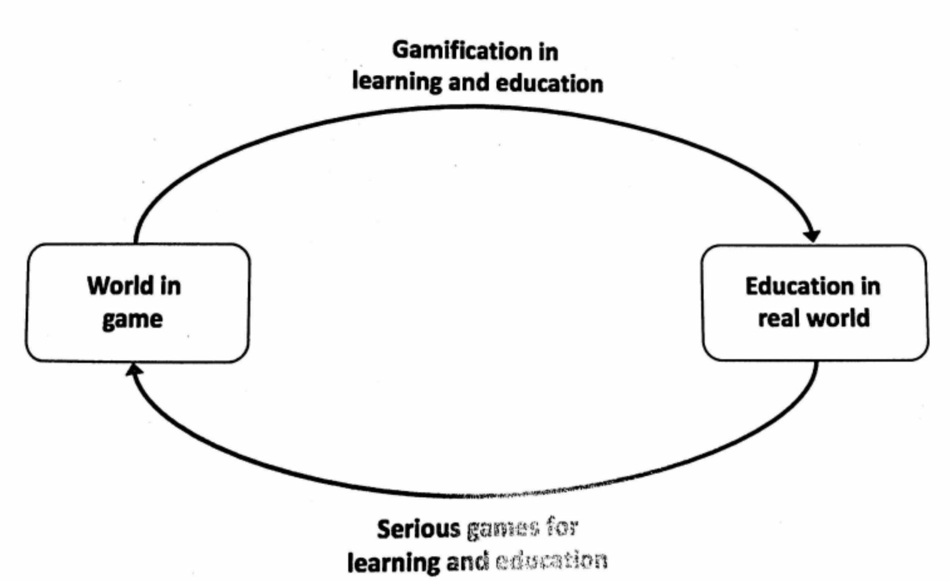

Figure 1. Relationship between serious games for learning and education and gamification in learning and education

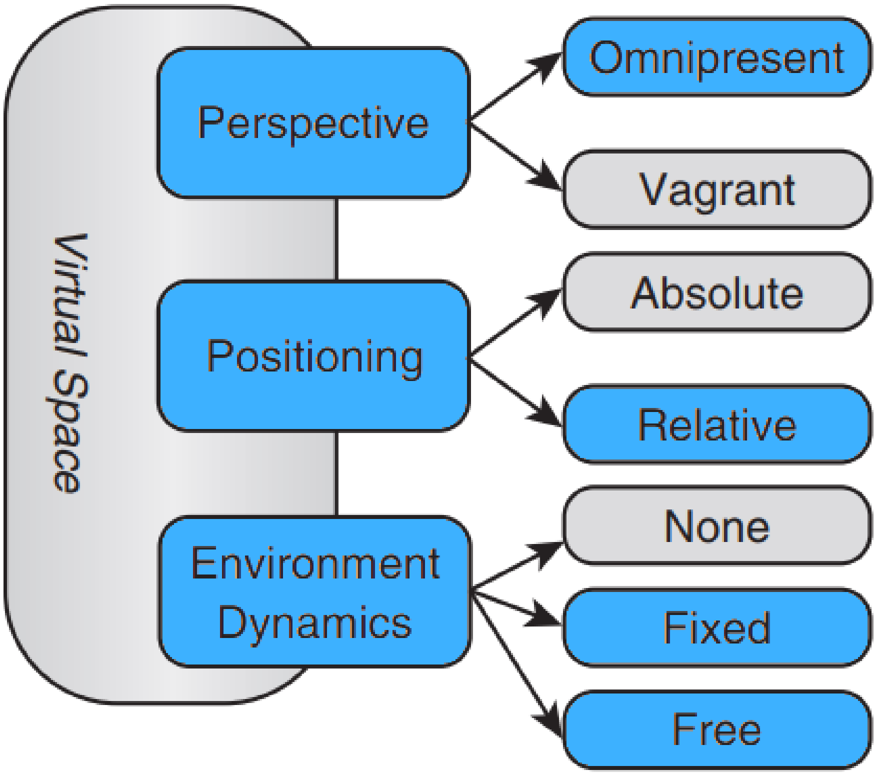

Figure 2. Elverdam and Aarseth's (2007) typology

Experience	Description
Captivation	Forgetting one's surroundings
Challenge	Testing abilities in a demanding task
Competition	Contest with oneself or an opponent
Completion	Finishing a major task, closure
Control	Dominating, commanding, regulating
Cruelty	Causing mental or physical pain
Discovery	Finding something new or unknown
Eroticism	A sexually arousing experience
Exploration	Investigating an object or situation
Expression	Manifesting oneself creatively
Fantasy	An imagined experience
Fellowship	Friendship, communality or intimacy
Humor	Fun, joy, amusement, jokes, gags
Nurture	Taking care of oneself or others
Relaxation	Relief from bodily or mental work
Sensation	Excitement by stimulating senses
Simulation	An imitation of everyday life
Submission	Being part of a larger structure
Subversion	Breaking social rules and norms
Suffering	Experience of loss, frustration, anger
Sympathy	Sharing emotional feelings
Thrill	Excitement derived from risk, danger

Figure 3. 20 playful experiences in the PLEX framework

Learning Content	Learning Activities	Possible Game Styles
Facts : laws, policies, product	Questions, memorization, drill, association	Game show competitions, flashcard types game, mnemonics
Skills: interviewing, teaching, management	Imitation, feedback, coaching, continuous practice	Persistent state games, role-play game, detective games
Judgment: management, decisions, timing, ethics	Reviewing cases, asking questions, feedback, coaching	Role-play games, multiplayer interaction, adventure game, strategy game, detective game
Behaviors: supervision, self- control, setting example	Imitation, feedback, coaching, practice	Role-play game
Theories: marketing rationales, how people learn	Logic, experimentation, questioning	Open ended simulation games, building game, construction games
Reasoning: strategic & tactical thinking, quality analysis	Problems, examples	Puzzles
Process: Auditing, strategy creation	System analysis & deconstruction, practice	Strategy games, adventure games
Procedure: assembly, bank teller, legal	Imitation, practice, play	Timed games, reflex games
Creativity: invention, product design	play	Puzzles, invention games
Language: acronyms, foreign language	Imitation, continuous practice, immersion	Role-play games, reflex games, flashcard games
Systems: health care, markets, refineries	Understanding principles, graduated tasks	Simulation games
Observation: moods, morale, inefficiencies, problems	Observing, feedback	Concentration games, adventure games
Communication: appropriate language, involvement	Imitation, practice	Role-play games, reflex games

Figure 4.
Finding Summary of Prensky's Learning Content, Leaning Activities and possible GameStyles

	Role-playing games (Counter Strike)	Strategy games (Championship Manager)	Puzzles (Bookworm)
Activists	Enjoy playing this game	Discard the instructions given before the start of the game	Use their brainstorming to solve the problem
Reflectors	Prefer not to lead the game	Observed to follow the instructions given to them earlier	Not able to draw strong conclusion
Theories	Not able to draw strong conclusion	Reacted very similar to the reflectors	Did not learn and play well
Pragmatists	Dislike this game	Copied the strategy given during the briefing	Great interest in this game

Figure 5. Experimental finding summary based on Chong et al.

Learning techniques	Leaning activities	Possible game genres
Practice & feedback	Questions, memorization, association, drill, imitation	Game show competition, flashcard type game, mnemonics, action, sports game
Learning by doing	Interact, practice, drill, imitation	Strategy game, action game, role playing game
Learning from mistake	Feedback, problem	Role-play game, puzzle game
Discovery learning & guided discovery	Feedback, problem, creativity play	Adventure game, puzzle game
Task-based learning	Understand principle, graduated tasks	Simulation game, puzzle game
Question-led learning	Question/ questioning, problem	Quiz or trivia game, game show competition, construction game
Situated learning	Immersion	Immersive style game such as role-playing game, flashcard game
Role playing	Imitation, practice, coaching	Role-playing game, strategy game , reflex game, adventure game
Constructivist learning	Experimentation, questioning	Building game, constructing game
Multisensory learning	Imitation, continuous practice, immersion	Game in which introduce new technologies such as locatable sound or force feedback, reflex game
Learning object	Logic, questioning	Games which are becoming object-oriented
Coaching	Coaching, feedback, questioning	Strategy game, adventure game, reality testing game
Intelligent tutors	Feedback, problem, continuous practice	Strategy game, adventure game, puzzle game, reflex game

Figure 6.
The relationship between learning techniques, learning activities and possible gamestyles

Psychological Construct	**Game Attribute**
Motivation	Fantasy Representation Mystery Feedback Rules/Goals
Skill-based Learning	Amount of control Learning through game interaction Fantasy Representation
Cognitive Processes & Knowledge	Challenge Adaptation features Conflict

Figure 7. Summary Table of Elicited Attributes in Gamers

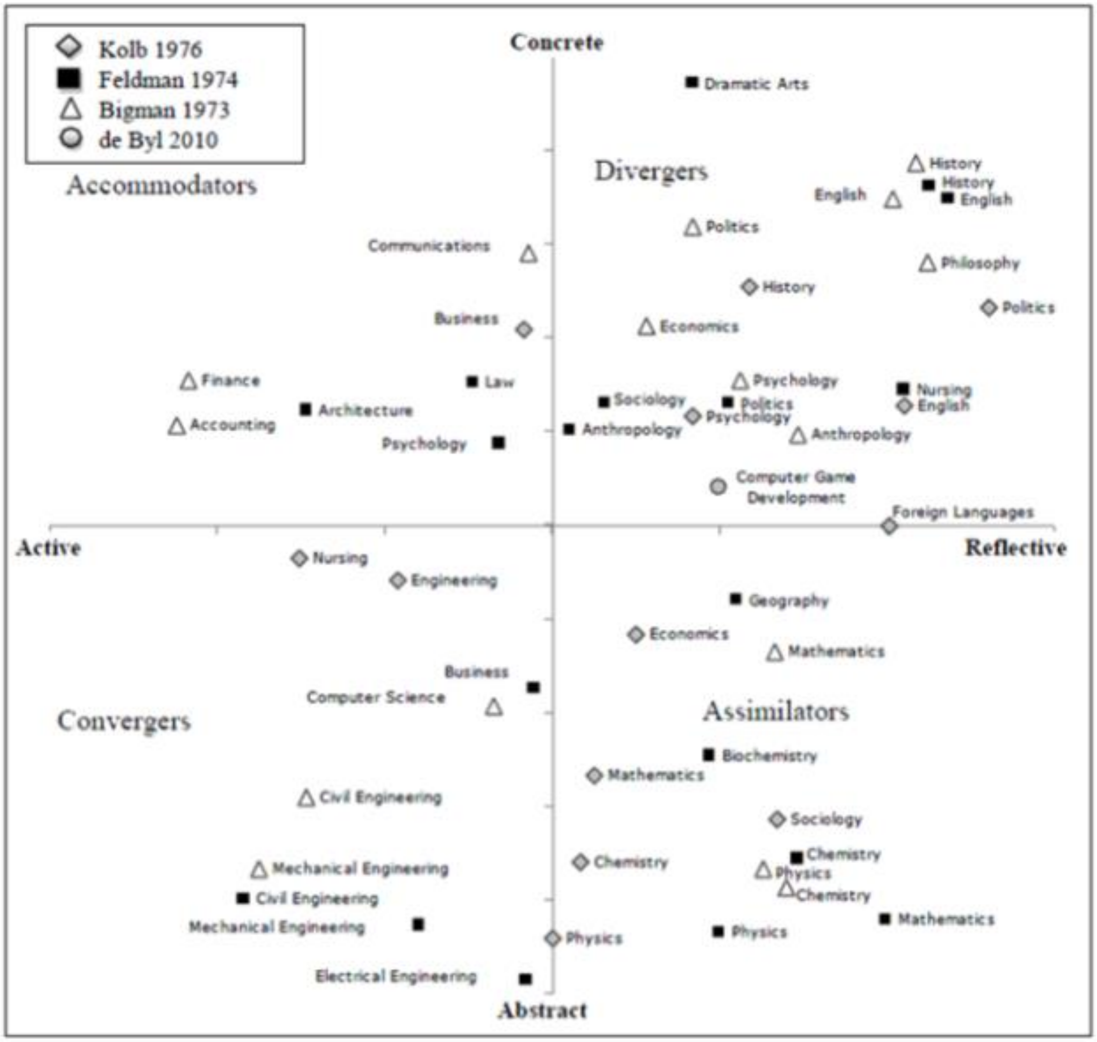

Figure 8. Learning style differences among academic disciplines adapted from Biglan 1973, Feldman 1974, Kolb 1981 and de Byl 2010

	Divergers	Assimilators	Convergers	Accommodators
Control	High level of control over environment to personalise and innovate.	Highly pre-defined and structured lessons.	High control over manipulation of environment in order to test hypotheses	Require an environment where they can trial ideas and learn from mistakes
Context	Observation and Reviewing of Others	Require holistic view of learning situation (e.g. all the facts). Abstract problems	Relevant real world problems	New opportunities, highly challenging tasks
Competency	Approaching problem-solving from multiple perspectives.	Solving problems requiring sequential thinking.	Mimicking	Risk-taking, Flexible
Engagement	Team environments.	Rational situations, working alone	Role-playing with others.	Engaging with and leading others

Figure 9. Suggested pedagogical approaches for motivating students based on learning style

	Action games	Adventure games	Strategy games	Process-oriented games
Typical action (interactivity)	Battle	Solving mystery	Build nation in competition with others	Exploration and/or mastery
Criterion of success	Fast reflexes	Logic ability	Analysing interdependent variables	Varies widely, often non-existent
Sub-genres	FPS, Combat, Race, Rhythm	Platformer, Flyers, Puzzle, Quiz	RTS, Gambling, Board, Card,	Sims, RPG, MMORPG
Archetypal titles	*Counter-Srike*	*Myst*	*Civilization*	*Sim-City*

Figure 10. Game genres, actions and success. Adapted from Egenfeldt-Nielsen et al. (2008)

	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
1 - Shooters	X	X	X	X	X	X
2 - Action/ Adventure	X	X	X	X	X	X
3 - Fantasy/ Role-Playing	X	X	X	X	X	X
4 - Sports	X	X	X	X	X	X
5 - Simulation	X	X	X	X	X	X
6 - Puzzle	X	X	X	X		
7 - Quiz/Trivia	X					

Figure 11. Game genres based on Bloom's educational objectives

Learning Techniques	Leaning Activities	Game Genres
Practice & feedback	Questions, memorization, association, imitation	2, 4
Learning by doing	Interaction, practice, drill, imitation	1, 2, 3
Learning from mistake	Feedback, problem	3, 6
Discovery learning	Feedback, problem, creative play	1, 2, 6
Task-based learning	Understand principle, graduated tasks	5, 6
Question-led learning	Question, problem	7
Situated learning	Immersion	1, 2, 3, 4, 5
Role playing	Imitation, practice, coaching	1, 2, 3
Constructivist learning	Experimentation, questioning	5
Learning object	Logic, questioning	5
Coaching	Coaching, feedback, questioning	2, 5
Intelligent tutors	Feedback, problem, continuous practice	2, 6

Figure 12. Relationship between learning techniques, learning activities, and game genres

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Appendices

[If applicable]