Video Gaming and Growth Mindset

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1. Introduction:

The self-esteem movement of the 1990s pushed everyone to believe that it was important to tell people how smart they are in order to motivate them and increase their achievement. This theory, however, backfired as people who were told they were “fabulous, brilliant, talented, and special” actually ended up “accepting mediocrity, not challenging themselves to fulfill their potential, being afraid of challenges and folding in the face of obstacles” (Talks at Google, 2015). The discredited theory of self-esteem sparked world-renowned psychologist, Dr. Carol Dweck’s research about mindsets. Dweck’s research about mindsets was influenced by “The Power of Yet” and a high school she learned of in Chicago where students had to pass 84 units in order to graduate and if they did not pass, they got the grade “not yet”—this supported her interest in learning how children coped with challenge (Stanford Alumni, 2014).

In 2006, Dr. Carol Dweck, released a book titled *Mindset: The New Psychology of Success* in which she discussed how learning is attained through understanding the fixed mindset and growth mindset dichotomy. Having a fixed mindset means a person believes that their intelligence is fixed. Alternatively, having a growth mindset means a person believes that their intelligence can be developed. The tendency to call on one’s fixed mindset personality when presented with a new challenge is common amongst people of all demographics. Proponents of early childhood education would argue that it is wise to foster a growth mindset from a young age as it is likely that this will encourage children to tap into the right personality when dealing with struggle as they grow older. An increasing prevalence of education technology in the lives of today’s children provides the opportunity to nurture a growth mindset. Video gaming, as an emerging technology, presents myriad possibilities with which to support a growth mindset for players as research has supported its ability to be an effective teaching and training device and promote motivation to learn (Mayer, 2014, pp. 12-17). A video game, for the purposes of this paper, is defined as: “a simulation that is intended to promote academic learning (i.e., intended to improve performance on measures of learning outcomes)” (Mayer, 2014, p. 4). After Dweck discovered the importance of encouraging young people to have a growth mindset and especially after the idea of ‘rewarding yet’, she decided to team up with game scientists at the University of Washington to create a math game that would go about reward in a different way—through *Brain Points*. “Math games typically reward right answers whereas in *Brain Points*, users are rewarded by their use of effort, strategy, and progress” (Stanford Alumni, 2014). Considering video games’ link to learning, it is no surprise that Dweck invested her time in the creation of a math game for the purposes of further researching praise, reward, and its connection to growth mindset.

According to Eichenbaum et al. (2014) “over the last half-century, video games have evolved from crude contests played by a few enthusiasts to richly immersive worlds enjoyed by billions of people around the world…they also fight against declining mental capacities in old age, promote job-related skills, and offer models of how to teach children complex tasks and abilities” (p. 50). With video games increase in popularity and evolved research supporting its ability to enhance learning abilities, it is also interesting to note that among the 53% of tweens that have their own tablet and 67% of teens that have their own smartphone, 27% of teens and
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tweens are engaged in playing mobile games everyday” (Common Sense Media, 2015). Additionally, “access to mobile media devices and applications amongst poor and minority children is much higher than it was two years ago” (Common Sense Media, 2013). Video games are now created to fit screens smaller than a laptop or desktop to cater to this increase in access to mobile and tablet devices. With their rise in popularity amongst children and young people, carefully designed “educational video game play serves to captivate and challenge its players as they use the type of reasoning skills that they may be expected to show in more formal learning settings” (Blumberg, 2014, p. 5). Further, “8-18 year olds have been found to spend as much as 90 minutes per day involved in video game play (Rideout, Foehr, & Roberts, 2010). Through understanding the impact that video gaming has in the lives of adolescents, it is clear that intentional design of educational video games can lend themselves to positively influencing learning. A vast amount of research conducted shows how powerful well-designed games can be for cognitive skills such as: “interactivity, agency or control, identity, feedback, and immersion”, which also have the ability to foster a growth mindset (Blumberg, 2014, p.5).

Video game mechanics and key learning theories of growth mindset together prove to be truly transformative for players. Key pieces of games cater to cognitive processes that map to evoking a growth mindset and as a result, can act as a technology that supports both teachers and learning in the classroom. The remainder of this paper will take a closer look at game mechanics and characteristics and how each of them contribute to a significant aspect of growth mindset. A theoretical and empirical analysis will work to provide a holistic view of video gaming and growth mindset. Additionally, examples of two video games whose design elements encourage a growth mindset will also be presented as case studies. An overall assessment of the technology is included to further discuss its evolutionary path and ability to be transformative.

2. Theoretical and Empirical Framework:

Growth mindset can be fostered through theories of teaching and learning like motivation, autonomy, self-efficacy, and the zone of proximal development. “Motivation is anything that serves to activate or energize behavior and give it direction” (Huitt, 2011). “Autonomy is independence or freedom, as of the will or one’s actions” (Christman, 2015). Albert Bandura’s theory of self-efficacy is “one’s belief in one’s ability to succeed in specific situations or accomplish a task… one’s sense of self- efficacy can play a major role in how one approaches goals, tasks, and challenges” (Bandura, 1993, p. 117). The zone of proximal development is “the distance between the actual development level as determined by independent problem solving and the level of potential development” (Vygotsky, 1978, p. 84). “The zone of proximal development permits us to delineate the child’s immediate future and his dynamic developmental state, allowing not only for what already has been achieved developmentally but also for what is in the course of maturing” (Vygotsky, 1978, p. 84). Motivation can encourage a positive change in behavior among students who might be struggling or facing challenges with academic goals. Apart from being motivated by parents, teachers, friends, and others major figures in a child’s life, activities that a child is involved in can also prove to be motivating. After the child is motivated for a positive change in behavior, it is also more likely for him or her to then build an understanding of self-efficacy. Through a child’s ability to see him or herself as successful, the child is more likely to be comfortable with autonomy. A related concept, the zone of proximal development, stimulates motivation, autonomy, and self-efficacy through its intentional
adjustment of an experience that strikes a balance between giving a child the right level of difficulty while still ensuring a child’s ability to solve parts of the task though prior experience. These learning theories are present in aspects of game design, thus supporting video games’ ability to evoke a growth mindset in players.

In his book *Computer Games for Learning*, Mayer explains that there are five characteristics of games that make them a learning environment. These are shown in Figure 1 below. The defining characteristics are divided into sections that provide connections between their descriptions and elements of growth mindset. In each of the sections, comparisons are drawn to two educational video games that I have deeply interacted with. Here, images taken from the games, which are included throughout the paper, will also be referenced. The intent is to provide specific examples of key game and growth mindset features that are infused in these educational games to support the thesis. The games referenced as case studies are *Quandary* and *Xenos*. Both these games have been built by Learning Games Network—an award-winning non-profit learning game studio spun out of Massachusetts Institute of Technology’s Education Arcade. *Quandary* is an online video game that encourages players to think ethnically as they lead a colony struggling for survival on planet Braxos. *Xenos* is an English-language learning game for Spanish speakers and is set in a virtual world on the *Isle of Xenos*.

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<th>Table 1.1</th>
<th>Five defining characteristics of games</th>
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<td>Characteristic</td>
<td>Description</td>
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<tr>
<td>Rule based</td>
<td>Events occur within a causal system, based on a knowable set of rules</td>
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<td>Responsive</td>
<td>Environment allows for player to act, and responds promptly and saliently</td>
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<tr>
<td>Challenging</td>
<td>Environment provides opportunities for success on tasks that are difficult for the player</td>
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<td>Cumulative</td>
<td>Current state of the environment reflects player’s previous actions and allows for assessment of progress toward goals</td>
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<td>Inviting</td>
<td>Environment is interesting, appealing, and fun for the player</td>
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*Figure 1. Five defining characteristics of games*

2.1 Rule based:

“The single most important feature of a game is that it represents a simulated system or model based on causal rules that a player can master (in addition to the operational rules of game play,
which also must be learned)” (Mayer, 2014, p. 5). This mastery of rules links directly to aspects of the zone of proximal development, in which learners learn best if mastery is attainable yet appropriately challenging. The rules structure in Xenos prompts the player to complete a tutorial in order to understand the object of each mini-game within the virtual world. The tutorials for the games try to balance a player’s feeling of frustration versus playfulness. The goal is not to take away the inherent playful nature of the games but to provide the player with enough information with which to begin navigating and understanding the game without frustrating the player. Game designers of Xenos, believe that it is fine for players to be confused for the first twenty seconds of the game since they do not want to lose the game’s aspect of exploration and discovery. This idea also relates to the zone of proximal development as the game designers of Xenos feel that a little bit of challenge for players is acceptable. In the zone of proximal development, tasks are slightly ahead of where the player is in order to motivate them to confront and tackle challenges. If learning comes too easily, players are likely to become disinterested. This also connects to Carol Dweck’s theories of growth mindset as students who are constantly told or shown how “smart” they are can have a hard time building skills to accept failure and challenge. Games, then, because of their rule-based nature provide a low-stakes environment for the player to experience both success and failure.

2.2 Responsive:

A game’s nature to be responsive lends itself to evoking growth mindset as it provides players with feedback and the ability to replay the game. Feedback encourages players to move forward by giving them ideas of what they could do differently while playing the game again. It sometimes shows players the moves that he or she has made and can alter in order to reach a desired or all together unique outcome. This freedom allows players to stay motivated in continuing to play the game even if they have made mistakes while playing. A second key feature of a responsive game provides players with the ability to replay the game. This substantiates the idea that there are always ways to improve and learn from the mistakes that are made—another central outlook of growth mindset. Support for the responsive nature of games is provided in the article titled “The Benefits of Playing Video Games” featured in the January 2014 issue of the American Psychologist where the authors state: “We propose that video games are an ideal training ground for acquiring an incremental theory of intelligence because they provide players concrete, immediate feedback regarding specific efforts players have made” (Granic et al., 2014, pp.70-71). Furthermore, an interview with Kristin Villanueva, game designer at Mindset Works, reflected the same importance of the replay ability in a game, especially with regard to growth mindset. Villanueva and her co-workers at Mindset Works are currently designing a game called SciScaleQuest whose intent is to marry growth mindset and gaming with a missions-based video game targeted towards middle school aged students and mapping to Next Generation Science Standards. As a design feature of the game, Villanueva shared that “players will get mindset points for challenging themselves or going back and practicing or perfecting a skill they have already learned” (K. Villanueva, personal communication, September 30, 2015). The purposeful inclusion of this feature was something Villanueva and her co-workers decided on as it is a key piece of growth mindset formation. Furthermore, the language used in the game is another important part of helping students learn about growth mindset. An example of the language used in SciScaleQuest is show below in
figure 2. The words and phrases may look similar to that of Carol Dweck, as the game designers have done extensive research of her work in order to design the game.

Similarly, both *Quandary* and *Xenos* are responsive in nature as they provide players with feedback and give players the opportunity to replay episodes and games. Figures 3 and 4 are examples of the feedback and replay features included in *Quandary*. After hitting the “OK” button as shown in figure 4, the player is automatically directed back to the home screen where he or she can choose to replay the episode or to play another episode. He or she can return back to any episode and play it again at any time.
Figure 3. Quandary feedback and replay feature

Figure 4. Quandary feedback and replay feature
2.3 Challenging:

Making a game challenging according to Mayer and Johnson (2010), means creating an “environment that provides opportunities for success on tasks that are difficult for the player” (p. 7). This essentially maps to tailoring the level of challenge in a game to a player’s zone of proximal development. The theory of the zone of proximal development supports the idea that learning happens best when the learning demands are a little ahead of where the learner is—where a learner can get a little help to support him or her through the learning process and move ahead. Thus, the zone of proximal development, a key aspect of growth mindset, is also prevalent in game design. “In a recent review, Dweck and Master (2009) summarized research evidence that supports each of these points:

> Self-theories are relevant to the design of educational games for two reasons. First players’ beliefs about intelligence can influence how they play the game, so that players with a belief in fixed intelligence may be less likely to respond productively to challenges and hence learn less from the game. Second, conversely, experience in game playing can affect players’ beliefs about intelligence, so that success in figuring out how to overcome challenges in a game can help players develop the belief that intelligence is changeable” (Mayer, 2014, p. 74).

Furthermore, Mayer (2014) states: “Concerning challenge, the game should require performance at a level that is slightly higher than the player’s current level of competence, which can be achieved by building progressively more difficult levels into a game” (p. 76). In the game Xenos, for example, players are instructed to play the mini-game, Wordscape in order to complete their mission. Phase I of the game requires the player to listen to audio in English and drag and drop one word they heard into an audio box in order to prepare for the next phase of Wordscape. This is particularly challenging for native Spanish speakers learning how to speak English but is a less challenging task than phase II. In phase II, the player uses the words he or she dragged in the audio boxes and other existing words to create simple sentences. Even if the player does not drag and drop the correct words in the audio boxes or the time has run out in Phase I, he or she will still be able to continue on to phase II of the game, though it is likely he or she may experience more difficulty in this level. Although the player is not restricted to move forward, this scaffolding technique in difficulty among levels of the game helps to challenge players by taking into account the zone of proximal development.

Quandary and Xenos also include examples of conflict, cooperation, and competition, which are elements of challenging games. Conflict is a key theme of Quandary as the game’s focus is on the player as the captain of the colony investigating viewpoints in order to help solve problems in the colony. Cooperation is key in Xenos as some mini-games have both a single-player and multi-player feature. Two of the seven mini-games encourage cooperation—Too Many Cooks and In Other Words. In Too Many Cooks, players work together to deliver correct orders and chat with each other when portions of the order are missing. While playing In Other Words, players either provide written or verbal clues to help another player guess the correct word. Empty Handed and Mail Drop, two mini-games in Xenos, encourage competition. In Empty Handed players compete with each other to try to correctly match all of the rhyming and syllable word cards in their hand. In Mail Drop players compete with each other to sort messages into the
correct inbox by emptying their inbox first. Examples of these game mechanics are shown below in figures 5, 6, and 7.

Figure 5. In Other Words-mini-game showing cooperation

Figure 6. Empty Handed- mini-game showing competition
2.4 Cumulative:

A game’s ability to be cumulative includes the game element of a reward structure. Giving players rewards for their performance on a game task or phase of a game is a central theme of growth mindset and specifically motivation. Motivation is an essential emotional process as it directly fuels a growth mindset as well as a fixed mindset. With the right kind of motivation, a player can be encouraged to call on his or her growth mindset. There are two types of motivation—intrinsic and extrinsic motivation. Mayer (2014) discusses the difference between these types of motivation when he explains: “People try harder to learn when they are intrinsically motivated (i.e. driven by an internal desire to learn and the satisfaction that comes with mastery) rather than extrinsically motivated (i.e., controlled by external rewards and punishments)” (p. 76). Taking a more psychological perspective on motivation, Howard-Jones et al. (2011) states:

…uncertain reward appears to increase the type of dopaminergic response that has been linked to motivation. This effect of reward uncertainty has been suggested as an explanation of why humans are so attracted to games involving chance. Uncertain reward is a defining characteristic of computer games and has been identified by some as an important and pleasurable aspect of their challenge.
Video games provide a platform on which players can experience struggle as well as reward. Both *Xenos* and *Quandary* do not show players what they get points for before playing the games—this is something that players experience as they are playing the games. *Quandary* does not show its players a summary of the points accumulated throughout the game after each play session, since the focus is more on building thinking and reasoning skills; however, players can track their progress and scores after registering for a free account. Each episode or scenario presented in the game has multiple outcomes and it is rare for a player to encounter the same outcome more than once. As shown in Figure 6, the captain is in charge of investigating the viewpoints of all of the colony members in order to make the most ethical decision and the Colonial Council is there to guide the captain through any decision he or she has made for the colony. Players get points for correctly sorting information as facts, solutions and other opinions. Players also get points for sorting opinions that are in support of or against the proposed solution. Thus, *Quandary* intrinsically motivates players to keep playing. Intrinsic motivation is also something players of *Xenos* feel as they are driven first by their desire to learn English as native Spanish speakers and second by seeing their performance cumulatively through the stages they have completed in their missions. Mastery in *Xenos* is attained through a player’s performance and interactions in the mini-games which is shown at the end of each game on the summary screen. It is also seen through a player’s transfer of learning, which is something a teacher, caregiver, or the player themselves can track in their data dashboard. The dashboard displays the learning data as the players are interacting with the games. Intrinsic motivation then also leads to a player’s development of autonomy. Once the player is internally motivated he or she is also more likely to have the motivation to be autonomous.

“…behavioral research shows that games are capable of providing a variety of basic psychological needs. These include autonomy (the belief that one has control over his or her own actions and decisions), competence (the belief that one has the level of skill necessary to achieve goals), and relatedness (the feeling that one is socially connected with other human beings)” (Przybylski, Rigby, & Ryan, 2010)

### 2.5 Inviting:

Games are inviting when they are created as fun and engaging environments for the player. A game’s nature to be inviting also motivates the player to not only continue playing the game but also encourages the player to take part in the learning that is occurring throughout the game. Mayer (2014) further illustrates this point by stating that:

Concerning fantasy, the game should allow the player to experience a sense of presence in an enticing environment that goes beyond the player’s normal experience. Concerning curiosity, the game should reveal holes in the player’s knowledge in a way that primes the player to want to make sense of the game” (p. 76).

Similarly, the aesthetics of a game also contribute to a player’s formation of self-efficacy. Hense and Mandl (2012) explain this as:
Competence relates to the construct of self-efficacy and describes the experience when an individual is in a position to be in control and master a situation. There is no doubt that this is one of the most important and most attractive characteristics of well designed computer games (cf. Salen & Zimmerman, 2004) since they continuously enable players to experience self-efficacy. It is also interesting to note that this often occurs through contexts that users often do not have access to in real life, such as driving race cars in a racing game, governing a city in a design simulation or fighting dragons in a 3-D role-play, a fact which refers to the role of interest in this context.

A major characteristic of inviting games is storytelling and this is a key design feature in Quandary. Before the captain investigates the problem, a narrative is shown in a comic strip style which informs the player of the scenario and their role in helping to solve the quandary. The use of a narrative in this case also supports the zone of proximal development, as it presents the right level of challenge to the player. It discusses the situation without giving away too much information as it is up to the captain to further investigate the viewpoints of all of the colonists. An example of this narrative is shown in Figure 8. This is the screen that the player sees once they have clicked on the fourth episode of the game titled “Mixed Messages”, a scenario involving cyberbullying.

![Figure 8. Quandary’s comic strip narrative](image-url)
Personalization in game design also makes a game inviting for the player. Especially considering younger players, it is fun and encouraged that they explore different identities to better understand their own. Being able to personalize aspects of a game also leads to a players’ autonomy and self-efficacy, which ultimately links back to growth mindset. Blumberg (2014) argues that “identity contributes to the appeal of video game play, which refers to players’ opportunity to form relationships and linkages with game characters or to become game characters via avatar construction (p. 4). Xenos is a good example of personalization as players are able to design their own avatar. Players are able to change their avatar at any time and are able to play with their avatar’s clothing and hairstyle. A game’s ability to incorporate a players’ interests through this design feature makes a game more engaging, interesting, and motivating for a player. People learn best through experiences that relate to them and are meaningful to them and being able to personalize an aspect of a game supports learning through gaming. Dan Roy, the game designer of Xenos, explains that “the avatar creation process should begin after players have been immersed in the world and are more invested in it” (D. Roy, personal communication, November 20, 2015). Roy and his colleagues aim to design the game such that players have an avatar with hidden features at first so that the player, once they are comfortable with the world, can change their avatar to however they would like (D. Roy, personal communication, November 20, 2015). With consideration of identity formation, players of Xenos can alter the gender, skin color, and clothing of their avatar which, is something that most people do not expect (D. Roy, personal communication, November 20, 2015). An example of the avatar changing booth is shown in Figure 9.

![Figure 9. Xenos avatar changing booth](image)

Another aspect that caters to the inviting nature of Xenos is the virtual world that the player is immersed in. Careful consideration went into the creation of the marketplace where the player is initially placed upon arrival into the game. Xenos is a ‘choose your own adventure’ type of game where players have personalized avatars and can explore the island by walking around and by chatting with others in the world. Figure 10 is an example of this interaction.
2.6 Advocates:

In this section, I will discuss the perspective of the advocates of video gaming while comparing the findings presented above.

One major advocate of educational video games is the Creative Director of Learning Games Network, Scot Osterweil. Osterweil shares this advocacy for gaming through an understanding of the importance and need of play in the lives of both children and adults. In 2009, Osterweil co-authored a paper titled “Moving Learning Games Forward: Obstacles, Opportunities, & Openness”, in which the authors discuss two major ideas: “games can engage players in learning that is specifically applicable to “schooling”; and there are means by which teachers can leverage the learning in such games without disrupting the worlds of either play or school” (Klopfer, Osterweil, and Salen, 2009, p. 3). In their discussion, they explain the link between gaming and play through what they call the “Five Freedoms”:

1. freedom to fail
2. freedom to experiment
3. freedom to fashion identities
4. freedom of effort; and
5. freedom of interpretation

As previously discussed, games have five distinct characteristics (i.e. rule based, responsive, challenging, cumulative, and inviting) and one can draw many parallels to the “five freedoms.” One can also see the link between the “five freedoms” and growth mindset when Klopfer et al.
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(2009) explain: “within the proscribed space of a game, players regularly exhibit all of the freedoms of unstructured play…most players undertake games in the knowledge that failure is a possibility” (p. 5). Embracing failure and experiencing these five freedoms connects back to the theory of growth mindset. By being given these freedoms, especially through gaming, students are then able to build self-efficacy and autonomy.

Similarly, another advocate of gaming, Jane McGonigal, shares her outlook on gaming in an interview conducted by Publishers Weekly:

- “Games are hands-on and can produce a sense that we’ve worked at something and made progress” (p. 38).
- “This sense of resilience-leading-to-triumph (that you get from games) is a core part of what it takes to be satisfied in life” (p. 38).
- “A lot of people think that we play games because they’re easy, but in fact we play them because they are difficult” (p. 38).
- “All these emotions, relationships, and experiences we get from games can fill our lives with positivity, and that is unique to games—games do this naturally and inherently” (p. 38).

McGonigal also discussed the Foldit game that was created by researchers at University of Washington. It is a 3D game that teaches you how to fold proteins and it has been discovered that folding proteins is a way to investigate the causes of diseases like cancer or Alzheimer’s. Players of the game are essentially taking part in producing ideas for eradicating diseases and it is empowering to be part of this as a young player. McGonigal’s views on gaming discussed above draw many comparisons to features of growth mindset like the zone of proximal development or the defining characteristic of games being challenging. Her ideas also connect back to motivation or the defining characteristic of games being cumulative and a player’s sense of accomplishment through making progress.

3. Overall Assessment of the Technology:

Video gaming as an emerging technology for learning also has the potential to encourage a growth mindset according to the research supporting this idea above. There is, however, limits to each and every emerging technology. In the sections below, I will highlight the strengths and limits of video gaming as well as the likely barriers to adoption and the evolutionary path of video gaming with respect to its current trends.

3.1 Strengths and Limits

Through my personal experience with two educational video games and the research conducted on video gaming and growth mindset, I contend that this emerging technology has many strengths. I believe that the strengths of this technology lie in its ability to foster a growth mindset through its characteristics and mechanics. If educational video games are rule-based, responsive, challenging, cumulative, and inviting, then they are likely to motivate players and lead to building a player’s sense of autonomy and self-efficacy. Examples of these game characteristics that were shown in the case studies work to further support the combination of
gaming and growth mindset. *Xenos* puts players in real-world scenarios through game experiences, gives players a range of games to play and the ability to replay them, encourages collaboration and a social community, and helps to build the identity of the player. *Quandary*, although an entirely different game, motivates players to make ethical decisions by problem-solving and investigation of real-world scenarios, and gives players the ability to replay episodes. Both games promote a healthy level of competition while *Xenos* also focuses on cooperation. Both games also give players feedback and have inviting features. By playing and interacting with *Xenos* and *Quandary* myself, I can support their suitability for learning. I have enjoyed conducting user experience testing for both of these games throughout my time at Learning Games Network. I have seen the iterations the games have gone through, and the improvements made are commendable. I have also spoken with teachers who use both *Xenos* and *Quandary* in their classrooms and see the vast impact the games are having on their students. Educators and caregivers alike can also attest to their suitability for learning.

The strengths of video games with respect to growth mindset are that the game mechanics lead to “cognitive processes and facilitate neural plasticity that prepare people for ‘learning to learn’” (Blumberg, 2014, p.6). An understanding of how to brain changes when someone is engaging in learning is a key element of the growth mindset movement. The aim is for students to learn how their brains physically grow and change when they encounter challenges and that straying away from difficulties does not affect your brain in the same manner. Game characteristics that foster autonomy, self-efficacy, and motivation help to build cognitive skills that can promote this understanding of the brain’s development. “On the positive side, game features can promote player’s motivation leading to deeper learning outcomes and on the negative side, game features can distract the learner causing poor learning outcomes” (Mayer, 2014, p. 12). As discussed in an article titled “Critic-proofing” of the Cognitive Aspects of Simple Games” presented in the *Computers & Education* journal, Martinovic et al. (2014) explain the limits of video games as:

“…computer games can be addictive and may overload the limited capacity of working memory in children and increase the risk of poor school performance Today's children are believed to have a shorter attention span than earlier generations and to need immediate answers which may be a consequence of the extensive propagation of video games. Since the main features of many video games are quick reaction time and immediate feedback these games may reinforce the inclination towards fast, focused, and repetitive actions that result in direct and limited learning in a short time” (para. 7).

I was also given some insight into the potential limits of video games by interviewing teachers that use educational video games in the classroom while attending the Massachusetts Computer Using Educator Conference (MassCUE). I asked the question: “what concerns or doubts do you have about using digital learning games in your classroom or school”? and educators said things like, “kids getting addicted to games”, “kids getting obsessed with games”, “kids not focusing on completing their classwork and racing through to get to games.” These are concerns that teachers as well as researchers share in regards to using video games in the classroom.

Blumberg (2014) suggests that “many of the design principles associated with video games (As cited in Gee, 2003) allude to motivational elements which are generally supported by theory and
research on achievement motivation, specifically linking certain instructional practices to enhanced perceptions of competence and value (as cited in Perry et. al., 2006) (pg. 81); however, more research on video games’ ability to increase motivation and transfer of academic skills in players remains to be conducted and discovered as there is very little evidence to support these claims (Blumberg, 2014, p. 81). As more and more research is uncovered, there is much hope for video gaming and its ability to positively influence players learning abilities and attitude through growth mindset.

On the other hand, according to Mayer (2014), proponents of video gaming argue that:

“Kids learn more positive, useful things for their future from their video games than they learn in school”, “good games are problem-solving spaces that create deep-learning—learning that is better than what we often see today in our schools”, “the key to solving the current crisis in education will be to use the power of computer and video games to give all children access to experiences, and build interest and understanding”, and “good games lend themselves to systematic understandings” (p. 14).

In the article titled “The Benefits of Playing Video Games” the authors explain that: “games have mastered the art of pulling people of all ages into virtual environments, having them work toward meaningful goals, persevere in the face of multiple failures, and celebrate the rare moments of triumph after successfully completing challenging tasks” (Granic, Lobel, & Rutger, 2014). These ideas are what link gaming to growth mindset. In order to call on a growth mindset personality, people must realize how to embrace failure, what Carol Dweck calls “the art of failing successfully” and see it as a learning opportunity—an opportunity to physically change their brain and connect neurons.

3.2 Barriers to Widespread Adoption

In “Moving Learning Games Forward: Obstacles, Opportunities, & Openness”, Klopfer et al. (2009) discuss the barriers to widespread adoption of educational video games.

- Curriculum Requirements: Historically, schools have been reluctant to give up textbooks or purchase educational technologies that are either not clearly linked to state standards, or that have not proven their efficacy. As a result, K-12 curriculum standards “lock down” the curriculum leaving no space for adoption.
- Attitudes: Some parents and educators have negative attitudes about video games, which are reinforced by a limited dialogue in the media around the relative merits of video games broadly. These attitudes take on a different flavor in the “chocolate broccoli” problem: Kids, particularly pre-teens, tweens, and teens shy away from games they are told are good for them, or labeled as educational.
- Logistics: Educators often find it difficult to integrate the play of game into the time structure of school day, which is often ruled by 45-minute classes. In some schools, access to computers is too limited for games to play a mainstream role in learning. For mobile games, the ban on mobile phones and other portable devices in schools is a large barrier to entry,
• Support for Teachers: Most teachers have little experience in integrating games into the classroom, and professional development programs most often do not include support in this area. Teachers lack the time, incentives, and support for this work.

• Assessment: While games may be especially good at teaching higher order skills, these skills are not typically assessed in standardized exams. New frameworks for assessment of these skills must be developed if games are to be leveraged within the performance-driven culture of most schools.

• Evidence: While this is changing, not enough studies have been done to date showing that learning games are effective. Without this evidence, the attitudes and barriers discussed above will be slow to change.

• Uses of Games: Examples of how games can be integrated into a range of curricular experiences is crucial; a limited set of these models exist currently.

• Limited View: People often have a limited view of the variety of games available, which narrows expectations around the viability of games to engage students.

• Social and Cultural structures: Existing social and cultural structures around education, school, learning, and play make the uptake of educational games challenging. These structures are incredibly difficult and slow to change, and pose perhaps the greatest challenge to the educational games space.

3.3 Likely Impact and Evolutionary Path

Jane McGonigal, a proponent of video gaming, once stated: “I foresee games that fix our educational systems” (Mayer, 2014, p. 14). Although many advocates of gaming support their ability to change educational systems and classroom communities, the real challenge occurs in game design because without proper game design, students are unable to learn from mistakes and capitalize on their failures. Educational video games are only useful if created with the five abovementioned defining characteristics. Mayer (2014) further discusses this idea when he claims: “the challenge of game design is to balance the positive and negative aspects of game features and instructional features to suit the needs of each learner” (p. 13). This is often when designers run into the “chocolate covered broccoli” idea that Klopfer et al. (2009), discuss as harnessing the great “soft skill” that one learns from games but connect it with content (pp. 31-33). The goal is to find the game in the content rather than the other way around because one cannot trick people into learning. This is often the outlook on games—that they do a good job of “masking” learning so students feel like they are not learning while actually playing a game. The goal of games, with respect to growth mindset, is the opposite, with a focus on actually understanding the learning that is taking place in the game.

With games like SciScaleQuest, which is currently being developed by Mindset Works, we can hope to see a fusion of gaming and growth mindset in the near future. Gaming in general, is something of attention and support even through the United States government. “In 2011, U.S Secretary of Education, Anne Duncan announced the establishment of the Digital Promise, a nonprofit initiative created to promote digital technologies with the potential to transform teaching and learning” (Blumberg, 2014, p. 339). Blumberg (2014) continues to explain the Nation’s literacy crisis as “foundational literacy skills are completely stagnant among low-income and minority students; despite billions of dollars spend on early intervention in literacy” (pp.399-340). This concern of literacy is shared with Learning Games Network, which is why
Xenos was initially created as a language learning game. As a result, Xenos is currently being used in schools as well as by organizations like the Florida Immigrant Coalition whose mission is the “fair treatment of all people, including immigrants” and among other ways, they work towards this mission “through coordination of immigrant organizations and community education.” (Design Action Collective, 2015).

Similarly, the push toward science, technology, engineering, and mathematics (STEM) has emerged due to the “the challenges our young people now face in an interconnected, digitally driven global landscape require a new set of competitive and cooperative skills” (Blumberg, 2014, p. 340). This is yet another aspect of learning that gaming can positively influence as carefully designed games with the five key characteristics, present opportunities to learn from competitiveness and cooperation. Through learning about growth mindset through gaming, students are likely to embrace and tackle challenges. Overall, video gaming has the potential to be a transformative emerging technology, by creating a low-stakes environment for players to experience learning through failure, which also promotes an understanding of the idea that intelligence can be developed—a growth mindset.
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