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# **Growth mindset in video games**

by

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## Abstract

Video games have great potential to encourage students in learning environments, whereas growth mindset impacts students' academic performance in positive way. This work explores the growth mindset in video games in order to potentially optimise and improve its presence. The growth-oriented frame of mind possesses distinctive traits that prevail in interactive games. These features are assessed to see to what extent they match. This evaluation set the stage for distinguishing the four central elements of the game design, that is, challenge, reward system, feedback, and language. I have examined two case studies, *Eco* and *Cuphead*, based on those results. Both cases were dealt with in terms of their usage and application of challenge, reward, feedback, and language and to assess in what ways these games have corresponded with growth or fixed mindset, or perhaps not at all. Further research would be required as it has been observed through this work that video games have great potential to help build a growth mindset if designed in accordance with growth-oriented features. More research needs to be done with users to look how effective they could be.

**Key words:** growth mindset and agency in video games, feedback in video games, challenges, reward system, feedback, language in video games, zone of proximal development

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## List of Abbreviations

<b>ZPD</b>	Zone of Proximal Development
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# Introduction

Digital media has become an indispensable medium through which a culture is formed and expressed. Alongside the traditional means of expression, such as literature, cinema, art, theatre, music the emergence of the videogame has brought about a new construct that stands apart from the traditional artistic domains due to its interactive and real-time nature. Video games incorporate visual rhetoric, artistic imagery, visual representation, and music. Also, like all media forms, it influences culture and society which inevitably impacts the lives of students. Because of its persuasive power, video games have been recognised in education as a means that can support traditional teaching. Since the educational environment embraces the growth mindset approach to learning, and video games attempt to foster this frame of mind, this paper explores to what extent this theory is reflected in practical terms. This exploration could potentially optimise and improve the presence of the growth mindset in video games.

The first chapter will revolve around a mindset theory developed by Carol Dweck. Her research took place over the course of decades and led to the development of the theory of the fixed mindset and the growth mindset. The growth-oriented frame of mind possesses distinctive traits that set it apart from fixed mindset. Those central characteristics will be discussed as well as the methods to induce this way of thinking.

The second chapter deals with videogames and the assessment of the characteristics of the growth mindset theory that prevail in interactive games. This focuses on distinctive features taken from the previous chapter to assess to what extend they match.

The third chapter outlines the theoretical framework for game design. This section investigates the structure of rules in line with critical thinking; Lev Vygotsky's concepts related to cognitive theory; and growth theory. Following this, the emphasis switches to the utilisation of the growth mindset by encouraging the use of feedback, appropriate language, substantial rewards and setting challenges that must be overcome.

In my fourth chapter I will analyse two case studies, namely *Eco* and *Cuphead*, through the lens of the growth mindset theory and the previously introduced framework to understand how the growth mindset materializes in practise.

The sum of these chapters will enable me to draw together the findings and determine to what extent the growth mindset is inculcated in videogames. The paper will conclude by considering how these results can further optimize the presence of the growth-oriented features in videogames and recommendations for future research will be highlighted. The overall goal of this evaluation is to emphasize how the theory of the growth mindset can keep the educational value of videogames at its highest possible standard.

# Chapter 1

## The meaning of mindset

The formation of the mindset is shaped and formed by external factors, including culture, socialisation, “spirituality, religion, and media exposure” that impacts the way individuals feel and act.<sup>1</sup> The foregoing explanations indicate that the belief system guides individuals and determines their behaviour as well as their decision-making. Thus, it depends on the mindset whether one can spot opportunities or be trapped in a self-defeating cycle. By distinguishing different sets of mindsets it is possible to understand patterns that are responsible for selecting cues in a particular situation, and recognise how they affect human behaviour. This work will not concentrate on listing various mindsets but rather it will focus on what Carol Susan Dweck, psychologists who researches the beliefs and motivations people have about learning and intelligence, defines as growth and fixed mindsets. Mindset impacts people’s perception of intelligence and learning, it stands behind human decision making and how they face challenges, deal with failure and success.

Forward-looking behaviour and the belief that one can change the outcomes impacts that person’s perseverance and is what Dweck defines as a growth mindset theory.

This chapter will provide an overview of mindset theory coined by Carol Dweck. The definition of the fixed mindset will be explained in the first section (1.1), together with the explanation of the growth mindset theory (1.2). Next section explores the components of the growth mindset (1.3) and ways to develop those characteristics (1.4).

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<sup>1</sup> Maxie Blasini, Nathalie Peiris, Thelma Wright, and Luna Colloca, “The Role of Patient-Practitioner Relationships in Placebo and Nocebo Phenomena.” *International Review of Neurobiology* (2018.) 139: 211-231.

## 1.1 Fixed mindset

A fixed mindset relates to the assumption that intelligence and creative abilities cannot be developed and assumes that human traits are based on one's inherent nature. This entails the belief that human qualities are static and prompt individual to seek validation from the external environment that maintains the sense of being intelligent. Any indication of hard work or struggle is an evidence of weakness and lesser intelligence that leads to performance avoidance in unfamiliar fields. For example, in educational settings students with fixed mindset accept perfection over failure, circumvent struggle and are "concerned with others seeing them struggle or fail."<sup>2</sup> This belief emerges from the idea that abilities are innate and have already been developed in earlier life stages. Thus, it disregards the fact that person can change their abilities over time. Therefore, to appear competent individuals gravitate towards familiar challenges and refrain from showing effort. In addition, the belief that success is based on intelligence emphasises that smart individuals succeed without much effort. This type of mindset regards failure as evidence for incompetence and is not receptive to feedback. Reinforcement of repetitive patterns encourages learners to grow stronger in the knowledge that fixed characteristics cannot change.

## 1.2 Growth mindset

Growth mindset is defined as a belief system that praises effort and learning from mistakes. Dweck states that people who "believe that their most basic abilities can be developed through dedication and hard work" exhibit a growth mindset. The attitude one has about oneself, the external reality, and interaction between the lifeworld and its internal interpretation is treated as a filter to process everyday experiences. When growth mindset serves as the starting point, it allows learners to overcome struggle, learn from failure, and to "face challenges while working toward a long-term goal more successfully."<sup>3</sup>

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<sup>2</sup>Debbie Silver and Dedra Stafford, *Teaching kids to thrive: essential skills for success*. (Corwin Press, 2017), 77-78.

<sup>3</sup>Ibid., 77-78.

### 1.2.1 Traits of growth mindset

In a growth mindset, individuals persist when struggling to solve a problem or complete a difficult task. Somehow they know they are in control of their own ability and this allows them to stretch their capabilities in order to acquire new knowledge or develop a skill. For instance, Dweck takes as an example Albert Einstein's process of developing a theory of relativity or Michael Jordan's path to become the best basketball player. She shows that persistence, motivation and innate belief that it is possible, contributed towards their achievements.<sup>4</sup> This risk taking attitude helped them to seek creative solutions and navigate through obstacles, making resilience and perseverance "the number one ingredient in creative achievement."<sup>5</sup>

Students who believe that their goals can be accomplished through effort and hard work are not concerned with their inadequacies, but rather are devoted to improve their basic qualities.<sup>6</sup> This is due to the fact that they understand that their cognitive capabilities are not predetermined by birth and can be improved with training.<sup>7</sup> Whether in education, workplace, sports, or relationships, this knowledge helps individuals to pursue their current tasks regardless of the difficulty. Therefore, effort and hard work are viewed as a strategy that can be changed over time. This indicates that hard work, effort and perseverance instils the belief that achievement is just a matter of finding the right tools.

Meanwhile, perceiving challenges as opportunities, and failure as a lack of significant effort or information about specific subject, reinforces new patterns of thinking and perception of difficulty. For example, setbacks delay the process of progress but also provide valuable information about the steps that need to be taken in order to achieve particular results.<sup>8</sup> Resilience towards mistakes provides students with the fail-forward attitude that ignites the idea that learning from mistakes provides valuable insights.

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<sup>4</sup> Carol S. Dweck, "Even Geniuses Work Hard." *Educational leadership* (ASCD) 1, no. 68, (2010.): 16.

<sup>5</sup> Carol S. Dweck, *Mindset. Changing the way you think to fulfil your potential*. (Great Britain: Robinson, 2017), 12.

<sup>6</sup> Robin Cheska, "Growth mindset in the classroom," *Science Scope* 41, no.2 (2017): 18-21, <http://elib.tcd.ie/login?url=https://www.proquest.com/scholarly-journals/growth-mindset-classroom/docview/1942178538/se-2?accountid=14404> accessed March 22, 2021.

<sup>7</sup> Jeni L Burnette, Jeffrey M. Pollack, Rachel B. Forsyth, Crystal L. Hoyt, Alexandra D. Babij, Fanice N. Thomas, and Anthony E. Coy, "A Growth Mindset Intervention: Enhancing Students' Entrepreneurial Self-Efficacy and Career Development." *Entrepreneurship Theory and Practice* (SAGE) 5, no. 44 (2020): 879.

<sup>8</sup> Hans S. Schroder, Megan E. Fisher, Yanli Lin, Sharon L. Lo, Judith H. Danovitch, and Jason S. Moser, "Neural evidence for enhanced attention to mistakes among school-aged children with a growth mindset," *Developmental Cognitive Neuroscience* (ELSEVIER) 24, (2017.): 42-50.

Neuroscientist Dante Chialvo states that “mistakes-driven neuronal learning” approach can surpass the other models of learning that are more “sophisticated” and advanced in nature.<sup>9</sup> Knowing that “all learning occurs by mistakes” allows students to change their mindset and perceive mistakes as learning opportunities.<sup>10</sup>

The idea that stretching the brain through effort is what makes people smarter and more talented provides more control over their intelligence and changes their attitude towards learning. Inducing the concept of growth mindset in educational settings by introducing neuroscientific explanations in school facilities, impacts students’ motivation, academic achievement as well as the brain activity. Neuroplasticity and neuroscientific studies show that intelligence is mutable and can be developed by repetition and learning.<sup>11</sup> Thus, teaching children about neuroplasticity has positive influence on their learning.<sup>12</sup> In addition, these findings suggest that students are highly motivated and find joy when understand that their talents and skills can be developed.<sup>13</sup>

Another trait of growth mindset is feedback. Feedback that fosters growth mindset does not praise the outcome, but rather outlines which current capabilities should be strengthened or developed to enhance future success. A feedback is a helpful way to improve performance because it delivers supportive and accurate information about the performance. Moreover, research shows that feedback is associated with “emotional pain” when the emphasis is put on results, talents and abilities.<sup>14</sup> However, when feedback rewards improvement it becomes a valuable and appreciative source of information.<sup>15</sup> Critical feedback becomes an “effective feedback” when tailored in accordance with growth mindset for it points out the process of developing skills that include effort and persistence. This motivates students to seek creative solutions instead of being tied to repetitive behaviour that limits their capabilities.<sup>16</sup>

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<sup>9</sup> D. R. Chialvo and P. Bak, “Learning from mistakes,” *Neuroscience* (Elsevier Science) 4, no. 90 (1990): 1137-1148.

<sup>10</sup> Ibid.

<sup>11</sup> Fiona Murphy and H I Gash, “Can’t Yet and Growth Mindset,” *Constr. Found* 15 (2020): 84.

<sup>12</sup> Jérémie Blanchette Sarasin, Lucian Nenciovici, Lorie-Marlène Brault Foisy, Geneviève Allaire-Duquette, Martin Riopel, and Steve Masson, “Effects of teaching the concept of neuroplasticity to induce a growth mindset on motivation, achievement, and brain activity: A meta-analysis,” *Trends in neuroscience and education* 12 (2018): 22.

<sup>13</sup> Cheryl Jeffs, Nancy Nelson, Kimberley A. Grant, Lorelli Nowell, Brit Paris, and Nazia Viceer, “Feedback for teaching development: moving from a fixed to growth mindset,” *Professional Development in Education* (2021): 1-15.

<sup>14</sup> Ibid.

<sup>15</sup> Ibid.

<sup>16</sup> Cheryl Jeffs, Nancy Nelson, Kimberley A. Grant, Lorelli Nowell, Brit Paris, and Nazia Viceer, “Feedback for teaching development: moving from a fixed to growth mindset,” *Professional Development in Education* (2021): 1-15.

The ability to reflect allows to take the time to think deliberately about “the meaning of an experience.” Philosopher John Dewey states that reflection means “active, persistent, and careful consideration of any belief or supposed form of knowledge.”<sup>17</sup> Growth mindset enhances self-reflection because the mind is focused on moving forward and if this progression is blocked or discouraged, assistance is provided to help address the issues. This form of self-assessment helps students retention and to direct their progress.

Linguistic expression that focuses on progress and process fosters growth mindset. Language that “conveys the idea that ability and motivation are fluid” and is not limited by time makes students feel that they are on a learning curve.<sup>18</sup> This acknowledges the effort that was put into the process.<sup>19</sup>

Creating safe environment where mistakes are acceptable, gives participants the freedom to explore the unknown territories. “Mistakes friendly” surroundings allow to allocate errors and look at them as learning opportunities.<sup>20</sup> For example, research shows that a math friendly classroom encouraged making mistakes. This increased students “effort in the work” largely due to the fact that “the fear of being wrong” was eliminated from the classroom environment.<sup>21</sup> Mistakes friendly environments expose its participants to explore new ideas without the fear of being judged for their inaccurate calculations or argumentations. Hence, it makes room for recognising one’s strengths and limitations. This is crucial in growth-oriented settings.

Even talented people have to work hard to achieve their goals and learning about how successful people handle setbacks helps them to accept the slow process of learning. In fact, studies show that the so called “fast learning is not always the deepest and best learning.”<sup>22</sup> Studies show that in many instances those who take longer to grasp particular concepts are learning it at a “deeper level.”<sup>23</sup> Albert Einstein, for example, performed poorly in school because he was pondering the “same questions year after

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<sup>17</sup> , Korstange Ryan, “Developing Growth Mindset Through Reflective Writing,” *Journal of Student Success and Retention* (Research gate) 3, no.1 (2016.): 3.

<sup>18</sup> Carol S. Dweck, “Even Geniuses Work Hard,” *Educational leadership* (ASCD) 1, no. 68 (2010): 19.

<sup>19</sup> Ibid., 3.

<sup>20</sup> Jo Boaler, “Mistakes “Grow” Your Brain,” Stanford University Graduate School of Education (2016).

<sup>21</sup> Ibid.

<sup>22</sup> Carol S. Dweck, “Even Geniuses Work Hard,” *Educational leadership* (ASCD) 1, no. 68 (2010): 19-20.

<sup>23</sup> Ibid., 16.

year”, eventually with “excellent results.”<sup>24</sup> As can be seen, it is fundamental for growth-oriented classrooms to discuss other people’s path to accomplishment, not only in education but also in business ventures. This would allow students to implement a healthier attitude towards painful struggle, mistakes, and hard work.

### **1.2.2 Ways to foster the growth mindset in teaching institutions**

Studies show that the difference between praising for effort and the process of working on a solution to complete a task is a tremendous step towards improvement. This approach contributes towards developing a growth mindset. This suggests that when external praise emphasis the performance it produces fruitful results.<sup>25</sup> However, praising for the process even though it does not bring any fruits over time, causes students to feel incompetent. This ineffective approach may contribute towards “blame” if the student is unsuccessful in their attempts to solve a problem.<sup>26</sup> Therefore, teachers are obliged to properly assess the tactics implemented by a student. Highlighting good strategies the student has applied, instead of praising for effort, lies at the core of growth mindset. If tactics and strategies are correctly assessed student is in a position to connect the missing components accomplish certain tasks independently.

Not only information about the implemented tactics fosters growth-oriented mindset, but also how to use “this information to understand the challenges and setbacks” teaches students to incorporate this frame of mind.<sup>27</sup> Teaching the idea the brain as a “muscle” that gets stronger with exercise” helps people with perseverance in the face of setbacks. For example, students who were considered to have poor academic performance achieved better results when reminded that “the brain forms new or

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<sup>24</sup> Ibid., 17.

<sup>25</sup> Carol S.Dweck, and David S. Yeager. “Mindsets: A View From Two Eras” *Perspectives on Psychological Science* (SAGE) 14, no. 3 (1019): 484.

<sup>26</sup> Ibid., 490.

<sup>27</sup> Ibid., 489.



stronger connections with rigorous learning,” especially when they learned new, challenging material.<sup>28</sup>

Teaching about neuroplasticity and the formation of new neuronal connectivity provides people with facts about what happens in the brain during learning. The knowledge that neurons strengthen the brain and form new paths supports students’ understanding and willingness to sustain healthy approach when faced with setbacks.<sup>29</sup> Students are motivated to persist through obstacles and learn more, when they understand what behaviour makes their brain stronger and better.

Fostering growth mindset puts an emphasis on direct-to-student method. It strengthens the role of teachers as mentors who personally monitor students’ progress and provide instructions based on the growth mindset. In-class discussion are also encouraged because it contributes towards cultivating a collaborate and effective learning environment, where “everyone’s talents are deeply respected and vigorously developed.”<sup>30</sup> Building on the idea that individuals have the potential to change over time serve as a tangible evidence that errors are welcome and do not define how intelligent one is.

Characteristics of the growth mindset	How to build a growth mindset
1.View challenges as opportunities to learn and persevere through stumbling blocks. <sup>31</sup>	When difficult task is seen as an opportunity to learn something new or acquire a new skill, a new perspective on risk taking and stretching oneself is taken. This can be achieved in a culture that encourages risk taking attitude and perseverance in the face of adversity. <sup>32</sup>

<sup>28</sup> Carol S.Dweck, and David S. Yeager. “Mindsets: A View From Two Eras” *Perspectives on Psychological Science* (SAGE) 14, no. 3 (1019): 487.

<sup>29</sup> Robinson Cheska, “Growth mindset in the classroom,” *Science Scope* 2 (41): 18.

<sup>30</sup> Carol S.Dweck, and David S. Yeager. “Mindsets: A View From Two Eras” *Perspectives on Psychological Science* (SAGE) 14, no. 3 (1019): 491.

<sup>31</sup> Fiona Murphy and H I Gash, “Can’t Yet and Growth Mindset.” *Constr. Found* 15 (2020): 84.

<sup>32</sup> Carol S. Dweck, “Even Geniuses Work Hard,” *Educational leadership* (ASCD) 1, no. 68 (2010): 16.

2. Recognition that effort and hard work are necessary for achievement.	Rewards for effort and the process. When teachers and coaches reward their students for their tremendous efforts, applying new methods, displaying persistence and overall process, they encourage them to pay more attention on a here and now that contributes to lasting effects. <sup>33</sup>
3.Fail-forward, mistakes are a part of the learning process. <sup>34</sup>	In an environment that values learning as a never-ending journey students embrace their mistakes when teachers increment the challenges and allow them to make mistakes. <sup>35</sup> This can be achieved by teaching learners to test different methods to solve particular problems and trace those that did not contribute to the solution. <sup>36</sup>
4.Being open to feedback as a source of information and a guide to further improvement.	Research shows that business managers with fixed mindset that participated and learned about growth mindset were “more receptive to feedback” and accustomed to learn. <sup>37</sup>
5.The belief that intelligence and talents can be developed. <sup>38</sup>	Intelligence is malleable and can be improved by expanding the experience and knowledge “through application and experience;” <sup>39</sup> similarly, talent can be developed through practice and rehearsal. <sup>40</sup>
6.Being a reflective learner.	To take a step back and to analyse one’s own performance is a powerful tool for self-improvement; it provides an opportunity to confront deficiencies as well as strengths. <sup>4142</sup>
7.Linguistic communication. <sup>43</sup>	When developing a mindset it is crucial to use a vocabulary that complements the concept of continuous growth, not only in theory but also in practice and speech. The word “yet” shows that the ability is in motion, not a final destination but a continuous process. This habit can be instilled by teachers and/or coaches, simply by reminding students to use “yet” in the end of each sentence. <sup>44</sup>

*Table 1. Growth mindset characteristics and how to develop them*

<sup>33</sup> Carol. Dweck, “Mindsets: Developing Talent Through A Growth Mindset,” *Olympic Coach* 21, no. 1 (2009.): 5.

<sup>34</sup> Fiona Murphy and H I Gash, “Can’t Yet and Growth Mindset.” *Constr. Found* 15 (2020): 86.

<sup>35</sup> Fiona Murphy and H I Gash, “Can’t Yet and Growth Mindset.” *Constr. Found* 15 (2020): 88.

<sup>36</sup> Carol S. Dweck, “Even Geniuses Work Hard,” *Educational leadership* (ASCD) 1, no. 68 (2010): 18.

<sup>37</sup> Carol. Dweck, “Mindsets: Developing Talent Through A Growth Mindset,” *Olympic Coach* 21, no. 1 (2009.): 6.

<sup>38</sup> Fiona Murphy and H I Gash, “Can’t Yet and Growth Mindset.” *Constr. Found* 15 (2020): 84.

<sup>39</sup> Fiona Murphy and H I Gash, “Can’t Yet and Growth Mindset.” *Constr. Found* 15 (2020): 84.

<sup>40</sup> Carol. Dweck, “Mindsets: Developing Talent Through A Growth Mindset,” *Olympic Coach* 21, no. 1 (2009.): 4.

<sup>41</sup>Ibid., 7.

<sup>42</sup> Fiona Murphy and H I Gash, “Can’t Yet and Growth Mindset.” *Constr. Found* 15 (2020): 84.

<sup>43</sup> Carol S. Dweck, “Even Geniuses Work Hard,” *Educational leadership* (ASCD) 1, no. 68 (2010): 3.

<sup>44</sup> Ibid., 3.

Creating a growth-mindset environment
1. Modelling growth mindset by a coach or educator who exhibits the characteristics of the growth mindset. Teachers with growth mindset approach teach growth mindset, whereas those with fixed mindset spread similar habits and beliefs onto their students. <sup>45</sup> It is fundamental for educators to develop a proper growth mindset.
2. Following the research of brain plasticity. The idea that the brain is a muscle allows students to understand that the brain expands when enters new fields of endeavour, and just like a muscle it gets better over time through practice. <sup>46</sup>
3. In-class discussions about characters, who have developed a growth mindset and have faced obstacles to achieve their goals, familiarises students to identify their path through hardship, instruction, effort and practice. <sup>47</sup> This in-class recognition leads to clear understanding that exceptionally high achievers do not “display” their talents into the world, but earn it through their work. <sup>48</sup>

*Table 2. Growth mindset environment*

This chapter has analysed characteristics of growth mindset as well as its implementation in educational settings that contribute to fostering this set of behaviours and mind frames. It has become apparent that in such environments students broaden their skills and knowledge and strengthens their confidence in learning. I will take these findings to my next chapter to examine how those characteristics correspond to video games.

<sup>45</sup> Carol. Dweck, “Mindsets: Developing Talent Through A Growth Mindset,” *Olympic Coach* 21, no. 1 (2009.): 4-7.

<sup>46</sup> Fiona Murphy and H I Gash, “Can’t Yet and Growth Mindset.” *Constr. Found* 15 (2020): 86.

<sup>47</sup> Carol. Dweck, “Mindsets: Developing Talent Through A Growth Mindset,” *Olympic Coach* 21, no. 1 (2009.): 4.

<sup>48</sup> O'Rourke, Eleanor, Kyla Haimovitz, Zoran Popović, Christy Ballweber, and Carol Dweck. 2014. “Brain points: a growth mindset incentive structure boosts persistence in an educational game.” *CHI '14: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 3343.

## **Chapter 2**

### **The presence of growth mindset in video games**

In most cases, learning new skills requires a modification of those we already possess and with continuous practice leads to proficiency. Video games provide many opportunities to automatize player's skills and competence on a range of different levels. Simulated realities present the player with situations that require a "good deal of thought and effort" as well as the opportunity to learn the basic tools and skills required to play the game.<sup>49</sup> After combining and repeatedly employing the basic skills, the time comes when the player realises that in order to progress through the game it is fundamental to learn new skills. This is the point, Gee states, where the player has become competent in the skill. The competence comes from playing the game, exploring and discovering new features, and encountering new places, situations and activities that teach the players new skills. Certain actions are expected of the player and each stage requires a different skills set.

This section will follow the characteristic of growth mindset listed in the previous chapter and will look at where they appear in video games. Since the simulated reality functions as an environmental settings for growth-oriented behaviour, this section will not discuss to what extent those features match the growth mindset environment.

Viewing challenges as opportunities to learn and persevere is the first characteristic of the growth mindset. Challenging environments in video games are an inseparable part of virtual reality through which players' abilities are tested. Gradual and persistent progression in the game world allows the player to develop skills and acquire knowledge. Game developers create demanding environments by tailoring the game

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<sup>49</sup> James Paul Gee, *What video games have to teach us about learning and literacy* (New York: PALGRAVE MACMILLIAN, 2007), 139.

to operate from a point that keeps a balance between difficult and easy tasks.<sup>50</sup> Optimal challenge determines whether the player will play the game and take on new challenge despite unsuccessful attempts. This persistence in the game world turns into perseverance.

Next characteristic relates to the idea of failing forward. Game mechanics are designed in ways that show defeat or lack of success in a positive light, reversing the psychology of how we look at the failed attempt.<sup>3</sup> According to Postdoctoral Scholar Craig Anderson, who specialises in cognitive influences of failure in video games, the “dynamic difficulty adjustment, difficulty settings, and other mechanics” that encourage players to continue playing the game are the aspects of game design that “adapt their difficulty” to the players current skillset.<sup>4</sup> As can be seen, video games create a setting that forces the player to move through a challenge in order to progress in the game world. This means that players are pushed to the edge of their current ability and every setback sets them forward to develop the most effective and sufficient strategies.<sup>51</sup>

Virtual environments of video games familiarise the player with the idea of painful struggle that is eventually rewarded. Professor of literary studies and gaming expert, James Paul Gee, discusses learning principles where achievement is associated with reward.<sup>6</sup> Reward systems adapt to the variations of applied skills on different levels throughout the game. When the player becomes well versed in a new skill, she is rewarded for progressing through the game. This recognition relates to the “feeling of winning, and relaxation.”<sup>52</sup>

Moreover, struggle is part of the learning process where hard work and effort are recognised. The process of recalibrating the tactics and strategies depends on the goal. The re-evaluation of previously employed paths of thinking prior to the action

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<sup>50</sup> Craig G. Anderson, Kathryn Campbell, and Constance Steinkuehler. “Building persistence through failure. The role of challenge in video games.” (2019): 1.

<sup>51</sup> Ibid., 5.

<sup>52</sup> Cheng Chen and Louis Leung, “Are you addicted to Candy Crush Saga? An exploratory study linking psychological factors to mobile social game addiction,” *Telematics and Informatics*, (2015): 10.

enables the player to “see the strategic depth in a game.”<sup>8</sup> Exposure to this kind of behaviour creates a strong will and perseverance.

Furthermore, feedback provides information that allows the player identify what needs to be improved in order to achieve particular results. Video games offer clearly defined goals with transparent feedback. Through clear feedback players learn more about the task at hand and reach their goal by optimising their strategies. The evaluation process shakes the concept of failure and “*teach[es]*” *players how to* eliminate the feeling of “helplessness” that accompanies demanding settings.<sup>53</sup>

Reflection is a space that measures abilities after careful thought. It helps recognise failure in a productive way. According to Gee, video games are a “mirror” in which the player perceives her or his “everyday behaviour reflected, amplified, distorted and revealed” and that discloses “how to rise to a challenge.”<sup>10</sup> Games that follow the model of self-improvement portray failure as a temporary state pointing out that the previous record needs to be improved. Arcade games for instance follow this exact model. This form of environment calls for re-evaluation of previous achievements that almost forces the player to dissect the failure in order to identify what can be done and “how it reflects on” the player “personally.”<sup>11</sup> Gee states that good video games instruct the player to engage in the reflective process. He calls the first step “probation” of the virtual world that requires making thoughtful notes to form a hypothesis “in a usefully situated way,” and investigating the game world with a previously formed hypothesis by exploring the causes and effects of her or his actions. The results of these actions allow the player to perceive the effects of the actions taken and reconstruct the hypothesis if necessary.<sup>12</sup> For example, to make progress in shooter games, the player cannot shoot randomly throughout the whole process because she will soon run out of ammunition, reduce the health bar and die. To prevent this from happening, video games allow the player to explore many different aspects within the game world where the player is obliged to think about the results of the actions taken and how that would lead to progression through the game.

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<sup>53</sup> Jasper Juul, *The Art of Failure: An Essay on the Pain of playing Video Games* (Massachusetts: The MIT Press, 2013), 51.

Linguistic communication in video games is built on abstractions that are based on concrete visual representations “from embodied experience of a material world,” dialogue, statements, and/or feedback.<sup>13</sup> The use of language supports the game narrative and is easily processed by the player because it applies to current experiences and this form of communication corresponds and enhances the game experience.<sup>54</sup>

In this chapter, I have outlined the presence of some of the components of growth mindset shown in the previous chapter. It has become apparent that video games integrate all of the listed characteristics. The aim of the next chapter is to set a theoretical framework for further investigation.

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<sup>54</sup> "The power of yet," YouTube video, 7:32, TEDx Talks, September 12, 2014, <https://www.youtube.com/watch?v=J-swZaKN2Ic>.

## **Chapter 3**

### **Theoretical background in game design**

The objective of game design is to emphasise the “playful mindset” and insist on tools that highlight exploration, imagination, and dialog.<sup>55</sup> The process of developing video games focuses on the design aspects that follow a structure and implement a variety of tools players incorporate into the gameplay. This means that the game encourages a type of thinking that is required in order to play the game.

In the previous chapter I concluded that video games support growth mindset in many different ways. Its optimisation in accordance with growth mindset theory would allow players to form cognitive patterns that contribute to their flourishing, without formulating competitive cognition for example.<sup>56</sup>

In the following section, using Lev Vygotsky’s concepts of Scaffolding and Zone of Proximal Development, I will look at structuring game rules based on growth mindset theory and how it could contribute to building a framework that promotes critical thinking. This would demonstrate that working from the ZPD can be learned and encouraged by the implementation of growth mindset through constructive feedback, appropriate language, adequate rewards and ideas of how to deal with challenges. All of these elements will be discussed in this section.

#### **3.1 Rules**

Establishing clear and concrete rules based on growth mindset would help the player to understand logic of the game and formulate patterns of thinking grounded in growth mindset principles. This would enable the player to “be the sort of problem solver who”

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<sup>55</sup> Kirsikka Vaajakallio, and Tuuli Mattelmäki, “Design games in codesign: as a tool, a mindset and a structure,” *CoDesign* 10, no. 1 (2014): 217.



is open to finding “new ways to solve new problems in new situations” that can be taken to the next game.<sup>5758</sup> Thus, forming a new mind frame.

The concept of the game is rooted in the ideological construction of the game designer that establishes the in-game reality as well as, what professor of Media Studies Ted Friedman defines as, the consciousness of the simulated realm. This means that game environment is built on “founding principles” determined by the game designer and fixed on the computer simulation the player engages with.<sup>59</sup> The game reacts to the player’s actions and provides an immediate response, “which in turn provokes a new reaction from the player.”<sup>60</sup> These responses are offered to players by game designers and give boundaries to game world. For example, SimCity’s economic model is based on the idea that low taxes contribute towards economic growth while high taxes are responsible for recessions. This shows that rules in video games are concrete and to some extent resemble real reality. Most importantly however, they establish a framework that allows very engrossing play. The player is bound to this reality and makes decisions based on this logic. This internalisation allows the player to “map-in-time” everything that holds together the entire game world along with the interconnected constructs that need to be taken care of.<sup>61</sup>

In good, entertaining video games like SimCity, players are exposed to complex problems for which they are encouraged to find solutions. If the game is devoid of reflection, it imprints a particular model of consciousness that is internalised by player who must optimise their set of skills when navigating through its complexities. These fixed rules develop a particular game consciousness that does not familiarise the player with conflicting ideas present in the real world. In contrast, game designer and academic researcher Gonzalo Frasca proposes to extend the game rules by adding a variety of behaviours. In *The Sims*, rules adopts social components to provide actions that reflect a “biased vision of the world.”<sup>62</sup> Grounding video games on a variety of behaviours, ideologies, realistic science and economic theories, not only from a capitalistic point

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<sup>57</sup> James Paul Gee, “What video games have to teach us about learning and literacy,” *Computers in Entertainment (CIE)* 1, no. 1 (2003): 36.

<sup>58</sup> Debbie Silver and Dedra Stafford, *Teaching kids to thrive: essential skills for success*. (Corwin Press, 2017), 75.

<sup>59</sup> Ted Friedman, “The Semiotics of SimCity,” *First Monday*, First Monday, June 3, 2021, <https://firstmonday.org/ojs/index.php/fm/article/download/660/575?inline=1>.

<sup>60</sup> Ibid.

<sup>61</sup> Ibid.

<sup>62</sup> Gonzalo Frasca, “Rethinking agency and immersion: video games as a means of consciousness-raising.” *Digital Creativity* 12, no. 3 (2001.): 172.

of view, but also for instance from Amartya Sen's definition of economic development, will expand the game's consciousness and the player's behaviour and actions. Such immersive game worlds allow the player to thrive in situations that reinforce internalisation of its logic. In addition, researcher specialised in video games Ryan Rogers argues that a "wide range of behaviours will positively predict feeling of autonomy."<sup>63</sup> Because rules shape the game, they also broaden the pallet of available actions contributing towards the feeling of autonomy in the player. Since autonomous action is directly connected to growth mindset, this finding suggest that flexible rules, apart from shifting the "behavioural rules" also contributes to the optimisation of malleable mindsets and transfers it to other video games.

When player enters the creative vision of game designer, she enters a realm from which she first explores the environment in order to navigate and proceed in the game. The player does not immediately navigate the rough waters embodied in the game-play experience, but rather she relies on assistance to build up confidence and interest. This process is defined as "scaffolding" by psychologist Lev Vygotsky and implies that game world is communicating knowledge in a manner that matches the player's understanding of what is happening, and with assistance acquires more information. In this fashion, the player is encouraged to begin to perform tasks independently.

In educational terms Vygotsky's concept of "scaffolding" is closely tied to the notion of "zone of proximal development" which "pushes" a student from one level of understanding to the next level of framing and understanding.<sup>64</sup> Similarities can be found in video games. If learning in game environment operates outside of the player's resources, the player is frustrated and stops pursuing the previously established goal. At this point both player and learner operate from the Frustration Zone, where helplessness takes over and instead of progress the focus lies on struggle and failure.<sup>65</sup> In educational settings, putting into practise the characteristics of growth mindset discussed in the first chapter, prevents individuals from failing and staying in

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<sup>63</sup> Ryan Rogers, "The motivational pull of video game feedback, rules, and social interaction: Another self-determination theory approach." *Computers in Human behavior* (2017): 447.

<sup>64</sup> Debbie Silver and Dedra Stafford, *Teaching kids to thrive: essential skills for success*. (Corwin Press, 2017), 72.

<sup>65</sup> <sup>65</sup> Ryan Rogers, "The motivational pull of video game feedback, rules, and social interaction: Another self-determination theory approach." *Computers in Human behavior* (2017): 447.

the Frustration Zone. Therefore, its reinforcement in video games could encourage persistence, high engagement and motivational ability, enabling players to stay in the Zone of Proximal Development (ZPD) even if arising challenges are difficult to manage at first.

### 3.2 Feedback

In video games feedback relates to real-time information of a player's progress toward a certain goal and should instil confidence and a feeling of autonomy in a player. Clear and concise feedback has significant value for the player and helps to attain goals. Therefore, feedback should aim to elevate the feeling of possible achievement and prevent the player from pursuing noneffective actions in order to optimise their movement and decision-making. According to research engineer Ryan Rogers, video games with flexible rules that promote a wide range of behaviours elevate feelings of autonomy and with it comes competence and confidence. However, while the quality of feedback in video games plays a huge role in players engagement, it can also "work against itself."<sup>66</sup> It may increase the feeling of limitation and lack of competence if it is not carefully applied.<sup>67</sup> Too much feedback may overwhelm the player and result in "information overload."<sup>68</sup> Rogers findings suggest that this will serve as a barrier instead of a valuable source of information, and will obstruct the player's ability to cognitively digest provided evidence and evoke negative feelings. It is crucial to structure feedback so that it provides meaningful information and avoids "cognitive overload."<sup>69</sup>

Research shows that feedback is understood differently by players. Not every player perceives feedback as a source of information in order to improve their skills or succeed. Rogers states that "feedback needs to be more subtle or engrained in other game mechanics in order to be effective" and encourage further exploration of perceiving feedback.<sup>70</sup> This opens up the door for including growth-oriented approach to feedback.

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<sup>66</sup> Ibid., 447.

<sup>67</sup> Ibid., 447.

<sup>68</sup> Ibid., 447.

<sup>69</sup> Ibid., 447.

<sup>70</sup> Ryan Rogers, "The motivational pull of video game feedback, rules, and social interaction: Another self-determination theory approach." *Computers in Human behavior* (2017): 447.

### 3.3 Challenge

Research shows that players who value challenge "report a significantly higher mastery-orientation" than those who do not thrive on challenges.<sup>71</sup> This shows that players who value challenging video games tend to persist when dealing with setbacks or difficult tasks that might result in failure.

Assistant professor in computer science, Alena Denisova states that it is "hard to design such optimal challenge for players with varying levels of skill, experience, and motivation."<sup>72</sup> Denisova and her team of researchers investigated "types of perceived challenges" which includes physical, performative, cognitive, and emotional challenge.<sup>73</sup> These types of challenge are present in different kinds of games. Physical challenge is implemented in tactical games where the player is mostly cognitively challenged. Emotional challenge is present in narrative based games, where the character-driven story evokes emotions and provokes emotional responses.<sup>74</sup> Performative challenge is based on dialogue in combat video games that deliver high performance challenges. Decision making challenge focuses on responding to obstacles by making clearly defined decisions. Then, to effectively maximize the player's activity it has to be "equivalent to maximizing the probability that the player" will continue to move toward the "high engagement state" during the gameplay that takes into account different types of challenge.<sup>75</sup> The same research suggest that "player's heterogeneity" and state of engagement incites different reactions to game-play outcomes.<sup>76</sup> Therefore, researchers propose an algorithm that considers the "player's current engagement" (low, medium or high engagement) and the "player's class."<sup>77</sup> By accurately applying the algorithm that accepts difference between "low-/medium state players" and "high-state players" it keeps both players engaged in the game and adjusts the challenge to their needs.<sup>78</sup> In this way, the proposed algorithm will harmonise players requirements "for satisfaction and challenge in order to

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<sup>71</sup> Yan Huang, Stefanus Jasin, and Manchanda Puneet, "'Level Up': Leveraging skill and encouragement to maximize player game-play in online video games," *Information Systems Research* (2019): 942.

<sup>72</sup> Alena Denisova, Paul Cairns, Christian Guckelssberger, and David Zendle, "Measuring perceived challenge in digital games: Development & validation of the challenge originating from recent gameplay interaction scale (CORGIS)," *International Journal of Human-Computer Studies* (2020): 2.

<sup>73</sup> Ibid., 2.

<sup>74</sup> Ibid., 12.

<sup>75</sup> Yan Huang, Stefanus Jasin, and Manchanda Puneet, "'Level Up': Leveraging skill and encouragement to maximize player game-play in online video games," *Information Systems Research* (2019): 942.

<sup>76</sup> Ibid., 942.

<sup>77</sup> Ibid., 942.

<sup>78</sup> Ibid., 942.

maximise gamers' satisfying needs for competence (high total scores) and challenge."<sup>79</sup> As a result, the player that does not thrive in challenging game world may stay in the game because the environment adapts to the player's actual needs applying challenges in a more considered way.

### 3.4 Rewards system

When considering rewards it is important to evaluate how players experience rewards. Assistant professor Amon Rapp states that in-game experiences are a reason for playing games and that game mechanics responsible for rewards are perceived as valuable by different players.<sup>80</sup> Rapp classifies rewards into "social classifications," goods exchange with other players, and incentives.

The first classification represents rewards that focus on players' ability to unlock access or develop a new skill, anything that contributes to their advancement in the game. This allows the player to take an active role in the game and provides alternative ways to act. Rapp states that "If players value the enabling rewards for their power of increasing their agency in the game, their main experiential effect is to enhance the players' performances and motivation, by pushing them to perfect their in-game abilities."<sup>81</sup>

The second type of reward refers to the goods that can swapped or traded with others. They are received after performing a particular action, for instance, in farming or when completing a quest. These kind of rewards (also gold) are accumulated to buy equipment, potions, minerals, weapons, clothes etc.<sup>82</sup>

The third class alludes to incentives that correspond to gamers' subjective values. They may embody different values but are achieved at the end of an in-game journey and can be collected, preserved or showed to other players and externalise their achievements and outstanding abilities. Players attach various values and meanings

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<sup>79</sup> Ibid., 942.

<sup>80</sup> Amon Rapp, "From games to gamification: A classification of rewards in World of Warcraft for the design of gamified systems," *Simulation & Gaming* (2017): 389.

<sup>81</sup> Ibid., 390.

<sup>82</sup> Amon Rapp, "From games to gamification: A classification of rewards in World of Warcraft for the design of gamified systems," *Simulation & Gaming* (2017): 393.

to these rewards which are determined by their goals, personalities, and personal preferences.<sup>83</sup>

According to growth mindset theory the reward system emphasises the importance of the process rather than the result. Praising the progression highlights the effort that was put into a series of steps taken to achieve a particular goal. Studies show that incentive structures in a form of “brain points” have positive influence on fostering growth mindset because it rewards performance and encourages behaviour associated with malleable intelligence.<sup>84</sup> Educational video game *Refraction*, focuses on “brain points” that award effort, strategy, and “incremental progress.”<sup>85</sup> In order to learn the concept of fractions rooted in splitting, individuals had to play the game. The study shows that when the game delivered instantaneous feedback to the player by message highlighting the employment of new ideas, the effort to solve mathematical problems, the start of a new level, and/or moving around the game, players persisted for longer. This study suggests that in-time rewards supported by the growth mindset oriented statements increase performance and persistence as well as foster the idea of “productive struggle.”<sup>86</sup> This approach to stimulating the growth mindset is adopted in many settings, and as research shows, can successfully support growth mindset behaviour in video games.

### 3.5 Language

Players are exposed to linguistic communication where not only graphical representation but also language elucidates opportunities or obstacles. The meaning players make also proceeds from linguistic structure that functions as a logic communicator and generates thoughts and assumptions player makes during the play. According to Linguist Benjamin Lee Whorf and anthropologist-linguist Edward Sapir, linguistic communication “influence[s] the way people think – and perhaps the way in which whole cultures are organised. Since thought and language are intimately

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<sup>83</sup> Ibid., 393.

<sup>84</sup> Eleanor O'Rourke, Kyla Haimovitz, Zoran Popović, Christy Ballweber, and Carol Dweck. “Brain points: a growth mindset incentive structure boosts persistence in an educational game.” *CHI '14: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, (2014): 3347.

<sup>85</sup> Ibid., 3339.

<sup>86</sup> Ibid., 3347.

connected, some form of close relationship between the two has often been assumed.”<sup>87</sup> According to cognitive scientist Lera Boroditsky language shapes thought and worldviews because some native tongues are gender specific while others are genderless. Her work shows that German and Spanish speaker portray the word “bridge” differently, because the femininity or masculinity determines the perception and associations that relate to that word. In German the word “bridge” is masculine and in Spanish feminine. Native speakers were asked to write three adjectives associated with that word and describe it in English. The goal was to determine whether the descriptions were in any way related to the gender of the word. Spanish speakers associated the word with “big,” “strong,” “towering,” and “sturdy,” whereas German speakers chose “slender,” “beautiful,” “pretty,” and “elegant.”<sup>88</sup>

S.L. Thorne et al. states that “exposure to language and opportunities for situated communicative activity are massively influential developmental forces.”<sup>89</sup> For example, some players have a tendency to play in competitive ways that leave other players behind. This is because players in the community vary and have different methods of solving problems and achieving their goals. Some players choose to live in a community to maximize trade, others are more inclined to select a remote area to expand their land. Video games reflect the way people operate and make decisions just like in a physical world. Therefore, to mitigate this problem, the implementation of language units characteristic to growth mindset theory would lead to the internalisation of this frame of mind. It would extend behaviour that revolves around trying new ideas and following them with perseverance, incremental progress and the use of various tactics. However, changing language structure is not enough and an additional support system that shows how to effectively incorporate growth-oriented mindset is needed.

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<sup>87</sup> Jordan Zlatev and Johan Blomberg, “Language may indeed influence thought,” *Hypothesis and Theory* (2015): 1.

<sup>88</sup> David Shariatmadari, “How much does our language determine behavior?,” *Behavioral Scientist*, last modified January 23, 2020, accessed June 3, 2021, <https://behavioralscientist.org/language-dont-believe-a-word-sapir-whorf-hypothesis/>.

<sup>89</sup> Steven L. Thorne, Ingrid Fischer, and Xiaofei Lu, “The semiotic ecology and linguistic complexity of an online game world.” *ReCALL* 24, no. 3, (2012.): 279.

<b>INSTEAD OF</b>	<b>TRY SAYING</b>	<b>BUT THEN....</b>
I'm not good at this	What am I missing?	I don't know what I'm missing!
I give up	I'll use a different strategy	If I had a different strategy I wouldn't have given up
It's good enough	Is this really my best work?	Yep! Turns out it is my best work
I can't make this any better	I can always improve	I don't know how to improve on this!
This is too hard	This may take some time	I spent the time and still don't know how.
I made a mistake	Mistakes help me learn	That mistake proves I haven't learnt!
I just can't do that	I'm going to train my brain	How do I change my brain?
I'll never be that smart	I will learn how to do this	How do I learn this?
Plan A didn't work	There's always a Plan B	How do I create Plan B?
My friend can do that	I will learn from them	I can't work out how my friend does that.

*Table 3. Examples of growth mindset statements<sup>90</sup>*

I have shown how rules implanted in the game world are shaping game consciousness, how this contributes to mindset formation and assumptions about the game. When a player takes an active role in shaping the game world, she practises her agency in an environment that provides best opportunities to learn because it stems from the ZPD. By providing a wide range of behaviours through which critical thinking and growth mindset is encouraged, the player has more opportunities to “soak” in the logic and transfer the growth-oriented patterns of thinking to the next video games. This can be stimulated by implementing encouraging feedback, appropriate language and adequate reward system where challenge is infused with perseverance. By taking into consideration the above elements, the logic of growth mindset, the next section will look at two case studies to assess how growth mindset is applied in practise.

<sup>90</sup> James Anderson, “Change your Mindset, then change your words!,” *Mindful by design*, last modified May 1, 2018, accessed June 3, 2021, <https://mindfulbydesign.com/change-mindset-change-words/>.



## Chapter 4

### Case studies

This chapter will investigate two video games, namely *Eco* and *Cuphead*, from the perspective of growth mindset theory with the framework discussed in the previous section. This point of view will be explored under four different headings: reward systems, challenge, feedback and language.

The video game *Cuphead* has rich handcrafted visual design inspired by the golden age of American animation. Its surrealistic qualities are seen in all three levels that consist of shoot and run, shoot 'em up, and platforming battles where the player has to manage dozens of moving elements. This fast paced and hectic 2D environment consists of simple, normal, and difficult mode. The latter evokes strong feelings of frustration and determination because the players focus on the mechanics of each individual character fight. It can be played as a single player or as co-op with two players. In contrast, the video game *Eco* is a first-person cooperative survival game with solid multiplayer gaming experience. However, it includes a single player option. The virtual simulation encourage a harmonious yet thriving relationship with both environment and other players. In *Cuphead*, the dynamic focuses on a competitive style of play whose objective is to target attacking enemies, whereas the game arrangements in *Eco* promote the idea of extending the players' freedom by understanding its diversity and direct impact upon the player. Since both games contrast each other and carry the characteristics of the growth mindset, in most incidences, these games allow for easy and practical identification of the features of growth mindset.

## 4.1 Eco

*Eco* is an educational video game that simulates planet Earth, where players have 30 days to save the world from the crushing asteroid. This is encouraged by the gentle use of natural resources. *Eco* can be played in a single player mode, low player mode or multiplayer mode. This paper will focus on multiplayer mode as the game is designed with collaboration in mind.

### 4.1.1 Challenge

Designing a game that optimises challenges and skills that affects the player's motivation, progression and learning would ideally keep the player in the zone of proximal development, which means the player would be operating in the state of "flow" while facing obstacles. This suggests that incrementing challenges must slightly exceed, to a minor extent, the current skills and knowledge of the player. Thus, uncertainty in video games is a part of the challenge and the unknown aspect that needs to be discovered motivates the player to move forward when confronted with setbacks or lack of access. The hidden information and difficult tasks contribute "to the level of challenge" that increases the engagement with the game where the player makes an effort to apply their skills.<sup>91</sup> This indicates a level of freedom when making decisions in the virtual world. This way the player is exposed to the idea that every step she takes has consequences that impacts the lives of the collective. For example, choosing a skill-based profession like mining opens up a wide range of opportunities as it requires skills that are used for other professions, such as pottery or masonry. The player uses this skill; this continues evolving as a major supply chain between the miners and potters. Then, this product can be sold to other players and open the economy to a new form of trade. To transport the goods to other players, it is fundamental to build roads. To avoid building private roads the players can establish a government to discuss important issues generating fund through taxation.

Thus, making autonomous decisions about what skill to learn will eventually affect players, and set the future course of the entire game world. This requires strategic and

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<sup>91</sup> Yan Huang, Stefanus Jasin, and Manchanda Puneet, "'Level Up': Leveraging skill and encouragement to maximize player game-play in online video games." *Information Systems Research* (2019): 942.

cooperative thinking, where the player uses her abilities to build a plan and to execute it even if conditions are continuously changing. This way keeping the player in the challenging zone is not overwhelmed, but rather she is kept within the frames of her own capabilities. When the players' potential gradually exceeds her range of capabilities and skills are expanded, this leads to continuous accomplishment. This indicates that the player operates in the ZPD. Therefore, the motivation rises and the cognitive abilities are stretched to form patterns of thinking that keep her engaged and immersed in the game.



Figure 1. List of professions and specialties available in Eco

The game provides players with tasks that are not too simple nor too difficult and the level of difficulty seen in *Eco* includes just enough information to make the player's existing knowledge seem incomplete. For example, if player's goal is to master carpentry, it is compulsory to become familiar with chopping trees and moving logs. In order to be extremely efficient, it is crucial to follow the instructions in the carpentry bench, to note the requirements and the quantities needed to build a house or any other form of construction. The tasks involved will lead to mastering the carpentry skill. This would lead to the development of the next skill in line, which is basic engineering. By this means, the player advances throughout the game with the help of the guided instructions (Vygotsky's scaffolding), and acquires new skills that are interdependent and therefore cannot be separately developed. This way the game keeps players

engaged and eager to look forward to next challenge, both on their own and collaboratively.

In connection to growth mindset, the challenges in *Eco* stems from Vygotsky's concept of "scaffolding" and "zone of proximal development" that encourage self-efficacy. This game environment is full of opportunities that instruct and direct the development of a growth-oriented nature. Thus, it keeps the player in the state of optimal performance which in turn supports the growth-oriented mindset.

#### **4.1.2 Feedback**

In *Eco*, the in-game feedback is based on the player's decision-making ability and certain actions are pursued. It is grounded in the idea of cause and effect that displays the relationship between objects and events, where results of one action are coming from a preceding cause, and the effects are externalised in the world or the game. That being the case, *Eco* provides visual feedback that affects the entire system of the game. This might lead to abundance of opportunities or lack of purpose. This is illustrated by using an example of how skill combination can degrade the flow of money, or pollution.



*Figure 2. Abandoned property*

For example, when the player learns skills like masonry and pottery, both of which rely on crushing rocks to achieve mortar, she needs sand that comes from sandstone or

granite. To make cement she needs to crush limestone rocks. To make bricks she needs mortar and crushed shale rocks. Crushing any rocks requires mining skill, but if the player already learned masonry and pottery the most conventional way of approaching this problem might be to acquire a new skill to solve the problem. However, this approach would reduce the opportunity of economic growth and prevent others from making money. This in turn would lead to poor economics and a dying server because lack of opportunities will take away motivation, purpose and advancement. Because *Eco* supports collaboration, a complete set of skills is discouraged, the game instead favours the exchange of goods and skills, even at the cost of setting high prices. This means the environment reflects back to the player the consequences of her decisions and re-evaluation is an automatic requirement without the implementation of linguistic communication.



Figure 3. Polluted water. The matte shade represents pollution

This form of feedback helps the player to re-evaluate their decisions and indicate that certain actions might be required to stop the damage. Therefore, the simulation reacts to player's actions and this reaction serves as a clear feedback to the player. This is what lies at the core of the game design. So the game does not point out whether actions taken are logical or incorrect. Instead it shows logical consequences that prompts the player to seek knowledge in order to find solution.

The player has full control of the character. Feedback, or the consequences of her actions, is shown in ways that adjust the entire environment in response to player's behaviour. However, it does not provide ways to improve behaviour and if the player lacks knowledge, she would never be in a position to try and learn more effective ways of solving problems (pollution for instance). This limitation might be enhanced by assimilating instructions or tutorials that explore various ideas. In *Eco* this can be seen in the implementation of the virtual encyclopaedia *Ecopedia*. However, as Gee stated, the individual learns best when they are in a position to comprehend and internalise complex linguistic concepts "when they are functionally and lucidly tied to specific practices."<sup>92</sup>

The visual form of feedback in *Eco* does not refer to the intelligence or cognitive abilities of the player for it shows errors as a result of certain actions. In connection to the growth mindset theory, the visualisation insinuates a need to improve the performance without emphasising the players' deficiencies. The game points out some form of direction in *Ecopedia*, but it is not specific, and the player is deprived of guided direction.

#### **4.1.3 Reward system**

Rewards that focus on unlocking access to the development of skills, also opens new opportunities. This can evoke curiosity to explore undiscovered territories. When the player begins to play, she finds herself in the middle of nowhere. In her inventory she has access to a tent that contains pickaxe, shovel, small workbench as well as other little elements to help her start the game. Her next step is to claim a territory and set the tent. Once the land is claimed, the player can start building a house and focus on developing the first skill. Digging and levelling the territory might require using too much of physical strength. In order to save a lot of time and calories the player needs additional tools like a wooden cart to move materials.

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<sup>92</sup> Steven L. Thorne, Ingrid Fischer, and Xiaofei Lu, "The semiotic ecology and linguistic complexity of an online game world." *ReCALL* 24, no. 3, (2012.): 298.

The accumulation of new goods relates to rewards in the form of incentives. In another words, clearing the area of dirt or any unwanted materials, pushes the player to acquire a cart from another player. This implies that first form of reward (like a tent with its contents) leads to earning an experience that gradually progresses into gathering virtual items (wood to build a house, or a cart to transport the wooden material). Now the player is able to build a house and remove the dirt by using the cart. To do so, she is obliged to convert it into dirt ramps. This eventually leads to a stock pile full of dirt that can be turned into ramps. Because the surface of the planet is uneven, ramps can be used to reshape the surface to flatten the territory and to build a city. In addition, government buildings, skyscrapers and factories can be built. This can be a huge source of achievement and satisfaction. These buildings can be seen as incentives, because they allow the player to stand out from others they show what she values.

Nevertheless, there is no in-game recognition of rewards in the sense that game clearly. communicates information to a player. This takes away the idea of rewarding the player's abilities by using a form of clear communication. Apart from unlocking skills that open new possibilities and receiving stars for keeping a healthy balanced diet, *Eco* does not promote statements that would in any way resemble growth mindset type of reward. For example, the concept of "brain points" is absent and the game does not leave any room for phrases that contribute to the most efficient and ecological ways of approaching the game. Of course, there are many different variations to play the game, but, as research shows, the implementation of "brain points" might encourage players to persist and to seek solutions instead of moving away from the problems.

This suggests that optimising the growth-oriented approach in game like *Eco*, focus must be placed on inculcating a sense of internal accomplishment. This is in line with the reward system known as "brain points." However, rewards system in the form of "brain points" is absent from the game . this absence is not encouraging players to find, try or apply unconventional new creative ideas or unconventional strategies.

#### 4.1.4 Language

Because *Eco* is mainly a collaborative game, the language used by players cannot be controlled by the server. However, every game establishes a rule-governed framework that instils a particular mind frame. *Eco* gives full agency to players who establish rules by creating government, constitution, and much more. But the important part is that the player enters the game with a particular set of skills that are transferred from other games. Even though the game employs science - based decisions to prevent the destruction of the planet, these decisions are based on experiences and they instil thought patterns that are taken from other video games. Such use of language does not stand apart from other commercially available video games that shape the discourse, the communication dynamic and the experience in the game world (tasks like mining might be approached in similar way as they approached in *Minecraft*, where activities are focused on exploitation and self-reliance instead of collective cooperation). Thus, players are transferring their abilities, skills and habits they've learned in previous video games.

This implies that expanding the game by incorporating written information grounded on instructive guidance that supports new activities and promotes wide range of behaviours, would contribute to enhancing not only critical skills, but also growth mindset. However, linguistic communication does not incorporate growth-oriented statements.

#### 4.2 Cuphead

The second case study analyses the run and gun video game interspersed with boss fights performance action. In this cartoon world the protagonist and Mugman are in a quest to collect the devil's debtors to save their own souls. *Cuphead* is a single player game that stylistically emulates the cartoons from 1930. It provides a co-op option where two players are running across the linear 2D levels to eliminate enemies and to win the game. To provide a better contrast between the previously discussed *Eco*, *Cuphead* will be investigated from a single player experience.



### 4.2.1 Challenge

Before starting the game, the character goes through a tutorial that deals with how to use their moves in order to progress in the game world. This form of assistance prepares the player for a hectic environment that is ready to attack from every corner. Obstacles that operate in high-speed are difficult to fight, and the player has three lives by default that can be lost very quickly. As can be seen in the previous example, such pressure can contribute to rising frustration. But frustration will not prevent the player from her own progress, because it becomes self-evident that through practise the player becomes more skilled and gains confidence in dealing with setbacks, which in turn pushes her to keep moving forward. Good preparation, assistance and practice instils a sense of competence and it is up to the player to recognise when and how to move, when and how to apply new strategies, and what adjustments must be made. When the player recognises what is within her reach, it strengthens her self-efficacy. Therefore, success is only a matter of time. It can be said that the game operates on the idea of Vygotsky's "scaffolding." The tutorial at the beginning of the game serves as a facilitator that helps the character to learn the possibilities that are within the tangible capacity of the player.



*Figure 4. Baroness Von Bon Bon in "Sugarland Shimmy"*

The ongoing challenge lies in the relentless battles, which is what makes this run and gun game captivating. It demands immediate reactions where the player is not in a

position to think for too long. The surroundings are difficult to discern and the constant shooting at the small fast-approaching enemies, whilst simultaneously targeting the primary object, requires effort, skilful targeting and the ability to avoid ongoing attacks. There is no clear indication of what scenario will come next and the player is taught and exposed to expect the unexpected. For example, in *Sugarland Shimmy*, Baroness Von Bon Bon sends different creatures to defeat the player. When facing the dancing jelly fish, it is crucial to jump over it; when an aerial projectile is fired up the player must avoid it by all costs. This is only the beginning of the fight. There are five more mini-bosses appearing in a random order that each demand a different approach and strategy. Such a performance requires a wide range of skills that are still in the developed stages and so not quite mastered. This stage of development and the accompanying level of inexperience requires the player to stretch their capability to accomplish the goal independently. This shows that the player performs a task within a domain of her own ability and it highlights the difference between what the player is capable of on her own and what she can yet accomplish. Therefore, this is aligned with Vygotsky's concept of ZPD as it allows the player to persevere and thrive during the struggle and adjust the manoeuvres in order to take the right course of action and persist when dealing with setbacks.

The player develops increased levels of self-efficacy throughout the game, whilst simultaneously navigating from the ZPD. This implies that the wide range of actions sustains the idea of the growth mindset for it puts an emphasis on the process and the continuity instead of on the target.

#### **4.2.2 Feedback**

Feedback plays an important role in game design. It occurs whenever player successfully performs a particular action. In *Refraction*, when the player makes a move she receives immediate feedback that displays concrete information about what kind of achievement was being accomplished. For example, when the player expresses a new idea, the message is: "You worked hard and tried new ideas!"<sup>93</sup> However, in

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<sup>93</sup> Eleanor O'Rourke, Kyla Haimovitz, Zoran Popović, Christy Ballweber, and Carol Dweck. "Brain points: a growth mindset incentive structure boosts persistence in an educational game." *CHI '14: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (2014): 3343.

*Cuphead* some areas lack visible feedback and the player has to wait to complete a particular section in order to receive information about her performance, which is a display of the score system with listed achievement points. This score table presents time, bonus, parry, meter, and skill level as well as the grade of the overall performance. It is crucial to point out that the visual presentation does not show the level of damage of the characters. Therefore, graphical feedback is reduced to showing defeated enemies and a score table.



Figure 5. Score table

The virtual character in *Cuphead* is very responsive. The endless shots are at the player's disposal and the fluid game mechanics makes the gameplay very responsive. The player can rely on unlimited shots. This provides a form of a back-up that helps the player to fully concentrate on controls and her abilities. Even when frantically pushing the buttons, the controllers respond accurately. This indicates that the overall interaction allows full control of the Cuphead. Moreover, the player can move in ways that control the attention on the screen, thereby showing the player that she is in full control. For this reason, any mistake made by the player feels like her own fault and contributes not only to the feeling of frustration, but also persistence despite the difficulty. This might be due to the fact that the game instils a deep sense of agency framed with in the concrete rules of the game, and it becomes obvious that the player

is the one responsible for her actions even if she deals with extremely difficult obstacles.

With reference to growth mindset theory, the feedback does not contribute to re-evaluating previously made decisions or applied strategies, but rather it focuses on responsive controllers that instantaneously react to players' fingers. The game lacks growth-oriented feedback, and it contains element of the fixed mindset strategy for it sends messages that alludes to outcome not the process.

### **4.2.3 Rewards system**

The game is built on the premise that the greater the challenge, the more satisfying is the reward. There are many obstacles that attack the player from every corner of the game and each level has a large amount of enemies. In *Cuphead*, even jumping on an enemy without losing points seems to be a form of reward, as one expects not to have too many options. For instance, in the first of six levels in the run and gun section, the player goes through Forest Follies. The player must collect five virtual items in the form of gold coins that allow the purchase of a range of weapons and charms at Porkrind's Emporium. If the player completes each sublevel without using her weapon to eliminate the little creatures, she will earn the grade "P." This grade, if attained in all six sections, will contribute to unlocking the Black and White mode. This gives a sense of advancement in the game. However, there is no indication of how much damage is caused or improvements are made. This lack of transparency might have an opposite effect as a reward isn't explicitly given and it does not reflect the amount of effort and perseverance the player invests in playing the game.

The main indication of "job well done" are the score system, the disappearance of the enemies and the announcements made at different stage completions that include statements like "Bravo!," and "Victory!" The other responses include: "You failed!," "Now go!," "And begin!," "Knockout!" On the contrary, it can be argued that statements like "You failed!" or "Victory!" promote fixed mindset as they allude to the current abilities of the player. Those announcements could have been improved by incorporating the highlight of the player's performance and the different strategies they

applied throughout whilst playing. Instead, these fixed statements as mentioned above, decrease the player's effort and so if the player loses perseverance to pursue the challenge, they might be discouraged and not proceed through the challenges, or they maybe move to the simpler version of the game.

As can be seen, there is a visible gap between the reward system propagated by the growth mindset and the one present in *Cuphead*. In *Cuphead*, praise and phrases reward the effort and persistence but through incentives that value the ability to earn gold, score, high points and have a good time. Praising players for the end-result and for their fast reactions to the hectic game environment, fit into the characteristics of a fixed mindset. So, in terms of rewards, the game lacks growth mindset qualities that could more transparently highlight persistence through struggle and creative adaptation of new strategies. The game is fixated on direct statements and this approach limits the growth-oriented frame of mind.



Figure 6. Gold coin Forest Follies

#### 4.2.4 Language



The structure of language affects the player's perception and attitude towards the game. It influences the way in which the player forms thoughts about the game. This in turn determines the behaviour of the player within the game world. In *Cuphead*, the player is not exposed to multiplayer communication and so she strongly relies on the and is encouraged or dissuaded by the game's choice of words as the only dialogue the player interacts with is the game itself. The video game incorporates phrases that send concrete and repetitive information to player:

"A good day for a swell battle!"

"This match will get red-hot!"

"A brawl is surely brewing!"

"A great slam and then some!"

"Here's a real high-class bout!"

"Here goes!"

"It's on!"

"You're up!"

"Now go!"

"And begin!"

"Knockout!"

"Bravo!"

This implies that the announcements seen in *Cuphead* bear strong connotations that impact the perception and experience of the game. According to growth mindset, to effectively transform patterns of perception, the emphases shall be on the process not on the result of an action. Some phrases deployed in *Cuphead* suggests that fixed statements are used. The advantage of this is that the constant repetition may reassure the player of their reasonable application and the emphasis on current abilities demonstrates what improvements in skills and strategies need to be made. From this perspective, such statements as mentioned above, can be beneficial. But when these are the main emphasis, they give more importance to the fixed mindset, because the attention commands action and does not stress the importance of progression. So, It appears that in *Cuphead*, the linguistic communication strongly relies on fixed mindset tendencies that stands in opposition to emphasising the malleable abilities of the player.

### 4.3 Conclusion

In connection with the above, both games implement some aspects of growth and fixed mindsets. Both videogames *Eco* and *Cuphead*, as explored in this chapter, are grounded in Vygotsky's concept of scaffolding and ZPD. In *Eco*, the player adapts to challenges with ease regardless of the difficulty level. This is the most satisfactory state that the growth mindset helps to maintain. The level of challenge corresponds with the player's capabilities as *Eco* sustains the interest and motivation of the player, even if no indication of effort or perseverance is made. The fast-paced scenario of *Cuphead* sustains the idea of the growth mindset for it puts an emphasis on the process and the continuity where overcoming challenges are seen as opportunities to advance in a game.

The feedback used in both games does not fully support the growth-oriented frame of mind. In fact, *Cuphead* encourages a fixed mindset due to the linguistic expressions used to communicate failure or victory. *Eco* on the other hand, insinuates that the player must re-evaluate her decisions by displaying visual results. Hence, this particular game uses different techniques to communicate feedback. Even still, this approach is far from a guided reflection based on growth mindset. The visual form of feedback in *Eco* relates to the idea of growth mindset for it does not allude to lack of skills or capabilities of the player. The feedback implies improvement of the skills and the knowledge in an indirect, yet evident way. In *Cuphead* on the other hand, feedback bears resemblance to fixed mindset, for it directly refers to the players' quality of the game and skills.

The reward systems used in both videogames encourage some elements of the growth-oriented approach. In *Eco*, incentives call attention to internal accomplishment. This is what "brain points" are based on. However, there are no indications of rewards that are in line with the growth mindset. The growth-oriented approach in game like *Eco*, is indicated in the form of internal accomplishment. However, this kind of reward has its limitations and does not correspond to reward structure encouraged by growth mindset. In *Cuphead*, the method of praise and phrases imitate the rewards system promoted by growth mindset. However, the praise is announced by fixated statements.

The use of language in *Cuphead* has fixated connotations deeply rooted in old-fashioned standards from the 1930s. In the same way, *Eco*'s technical language leaves no room for communicating in ways that matches the growth mindset. So, although language is different in both games, they both have failed to implement language that focuses on progress and process. *Eco* incorporates instructions that serves as an additional source of knowledge and this way provides support in terms of the growth-oriented theory. However, language used in both video games does not provide any indication of growth mindset.



## Summary and Conclusion

In this work I have investigated the presence of growth mindset in video games with the goal of optimising its implementation by utilising characteristics that already are present in game design, namely challenge, reward system, feedback and language.

The first chapter discussed the meaning of the fixed mindset and the growth mindset. This showed the vast discrepancy between them. This highlighted the traits of the growth mindset and why this mind frame stands apart from the fixated way of thinking. Since those attributes are not easily incorporated into one's own frame of mind, the fourth part of this chapter provided some methods that help to encourage growth mindset in educational centres.

The second chapter took the findings developed in the previous chapter and estimated to what degree those characteristics foster the growth-oriented theory. By clearly defining their corresponding angles, I have shown how fitting they are.

The third chapter concentrated on the theoretical framework to lay a structural foundation of the study. This section discussed how the rules of game design led to the theories of game development that are rooted in Vygotsky's developmental concepts. These concepts further unravelled the importance of designing the world of the game in ways that accommodate critical thinking as well as the growth mindset theory. This evaluation set the stage for distinguishing the four central elements of the game design, that is, challenge, reward system, feedback, and language.

In the fourth chapter I have examined two case studies, *Eco* and *Cuphead*, based on the results of the third chapter. Both cases were dealt with in terms of their usage and application of challenge, reward, feedback, and language. This section also

showed in what ways these games have corresponded with growth or fixed mindset, or perhaps not at all.

Limitations encountered whilst undertaking this study, were time-constraints as well as Covid-19 restrictions. The latter impacted the quality of the research as these restrictions prevented access to equipment on campus. Therefore, a more in-depth analysis of the case studies was not possible. Further research tasks that lie beyond the scope of this paper would need to be carried out to investigate the existence of both fixed and growth mindsets in videogames in more detail. Further research would be required as it has been observed through this work that video games have great potential to help build a growth mindset if designed in accordance with growth-oriented features. More research needs to be done with users to look how effective they could be.

## References

- Adachi, Paul JC, and T. Willoughby. 2013. "Demolishing the competition: The longitudinal link between competitive video games, competitive gambling, and aggression." *Journal of youth and adolescence* 2 (47): 1090-1104.
- Adams, Ernest. 2010. *Fundamentals of Game Design*. Berkeley: New Riders.
- Aithal, P.S., P.M. Kumar, and V. Shailashree. 2016. "Factors & elemental analysis of six thinking hats techniques using abcd framework." *International Journal of Advanced Trends in Engineering and Technology* 2456-4663.
- Anderson, Craig G., Kathryn Campbell, and Constance Steinkuehler. 2019. "Building persistence through failure. The role of challenge in video games." 1-6.
- Blasini, Maxie, Nathalie Peiris, Thelma Wright, and Luna Colloca. 2018. "The Role of Patient-Practitioner Relationships in Placebo and Nocebo Phenomena." *International Review of Neurobiology* (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6176716/>) 139: 211-231.
- Boaler, Jo. 2016. "Mistakes "Grow" Your Brain." Stanford University Graduate School of Education.
- Burnette, Jeni L., Jeffrey M. Pollack, Rachel B. Forsyth, Crystal L. Hoyt, Alexandra D. Babij, Fanice N. Thomas, and Anthony E. Coy. 2020. "A Growth Mindset Intervention: Enhancing Students' Entrepreneurial Self-Efficacy and Career Development." *Entrepreneurship Theory and Practice* (SAGE) 5 (44): 878-908.
- Cambridge, Dictionary. 2021. <https://dictionary.cambridge.org/>. Accessed 02 28, 2021. <https://dictionary.cambridge.org/dictionary/english/mindset>.
- Chalvo, D. R., and P. Bak. 1999. "Learning from mistakes." *Neuroscience* (Elsevier Science) 4 (90): 1137-1148.
- Chen, Cheng, and Louis Leung. 2015. "Are you addicted to Candy Crush Saga? An exploratory study linking psychological factors to mobile social game addiction." *Telematics and Informatics* 1-12.
- Cheska, Robinson. n.d. "Growth mindset in the classroom." *Science Scope* 2 (41): 18-21.
- Craig G., Anderson. n.d.
- Crum, Alia, and Barry Zuckerman. 2017. "Mindsets to Enhance Treatment Effectiveness." *American Medical Association* (jama.com) 317 (20): 2063-2064.
- Denisova, Alena, Paul Cairns, Christian Guckelssberger, and David Zendle. 2020. "Measuring perceived challenge in digital games: Development & validation of the challenge originating from recent gameplay interaction scale (CORGIS)." *International Journal of Human-Computer Studies* 102383.
- Dweck, Carol. 2009. "Mindsets: Developing Talent Through A Growth Mindset." *Olympic Coach* 21 (1): 4-7.
- Dweck, Carol S. 2010. "Even Geniuses Work Hard." *Educational leadership* (ASCD) 1 (68): 16-20.
- Dweck, Carol S. 2017. *Mindset. Changing the way you think to fulfil your potential*. Great Britain: Robinson.
- Dweck, Carol S. n.d. "Mindsets: Developing Talent Through a Growth Mindset." *Olympic Coach* 21 (1).
- Dweck, Carol S., and David S. Yeager. 2019. "Mindsets: A View From Two Eras." *Perspectives on Psychological Science* (SAGE) 14 (3): 481-496.
- Frasca, Gonzalo. 2001. "Rethinking agency and immersion: video games as a means of consciousness-raising." *Digital Creativity* 12 (3): 167-174.
- Gee, James Paul. 2007. *What video games have to teach us about learning and literacy*. New York: PALGRAVE MACMILLIAN.

- Gee, Paul James. 2013. "Games for learning." *Educational Horizons* 91 (4): 16-20.
- Heggart, Keith. 2015. *edutopia.org*. 4 02. Accessed 03 01, 2021.  
<https://www.edutopia.org/discussion/developing-growth-mindset-teachers-and-staff>.
- Hochanadel, Aaron, and Dora Finamore. 2015. "Foxed and Growth Mindset In education And How Grit Helps Students Persist In The Face Of Adversity." *Journal of International Education Research* 11 (1): 47-50.
- Howells, Robertson, Judy Howells, and Cathrin Howells. 2008. "Computer game design: Opportunities for successful learning." *Computers & Education* 50 (2): 559-578.
- Huang, Yan, Stefanus Jasin, and Manchanda Puneet. 2019. "'Level Up': Leveraging skill and encouragement to maximize player game-play in online video games." *Information Systems Research* 927-947.
- Jeffs, Cheryl , Nancy Nelson, Kimberley A. Grant , Lorelli Nowell, Brit Paris, and Nazia Viceer. 2021. "Feedback for teaching development: moving from a fixed to growth mindset." *Professional Development in Education* (Routlage Taylor & Francis Group) 1-15.
- Juul, Jesper. 2009. "Fear of failing? the many meaning of difficulty in video games." *The video game theory reader 2* 237-252.
- Juul Jasper. 2013. *The Art of Failure: An Essay on the Pain of playing Video Games*. Massachusetts: The MIT Press.
- Lara-Alvarez, Carlos , Hugo Mitre-Hernandez, Juan J. Flores,, and Humberto P ´erez-Espinosa. 2018. "Induction of Emotional States in Educational Video Games through a Fuzzy Control System." *IEEE Transactions on Affective Computing* 1-12.
- Lee, Yu-Hao, Carrie Heeter, Brian Magerko, and Ben Medler. 2012. "Gaming Mindsets: Implicit Theories in Serious Game Learning." 190-194.
- Lee, Yu-Hao, Carrie Heeter, Brian Magerko, and Ben Medler. 2012. "Gaming Mindsets: Implicit Theories in Serious Game Learning." *Cyberpsychology, Behavior, and Social Networking* 15 (4): 190-194.
- Murphy, Fiona, and H I Gash. 2020. "Can't Yet and Growth Mindset." *Constr. Found* 15: 83-94.
- Ng, Betsy. 2018. "The Neuroscience of Growth Mindset and Intrinsic Motivation." *Brain Sciences* 20 (8): 1-10.
- O'Rourke, Eleanor, Kyla Haimovitz, Zoran Popović, Christy Ballweber, and Carol Dweck. 2014. "Brain points: a growth mindset incentive structure boosts persistence in an educational game." *CHI '14: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 3339-3348.
- Rapp, Amon. 2017. "From games to gamification: A classification of rewards in World of Warcraft for the design of gamified systems." *Simulation & Gaming* 381-401.
- Rogers, Ryan. 2017. "The motivational pull of video game feedback, rules, and social interaction: Another self-determination theory approach." *Computers in Human behavior* 446-450.
- Ryan, Korstange. 2016. "Developing Growth Mindset Through Reflective Writing." *Journal of Student Success and Retention* (Research gate) 3 (1): 1-27.
- Schamroth Abrams, Sandra, and Hannah R. Gerber. 2013. "Achieving through the feedback loop: videogames, authentic assessment, and meaningful learning." *The English Journal* 103 (1): 95-103.
- Schroder, Hans S., Megan E. Fisher, Yanli Lin, Sharon L. Lo, Judith H. Danovitch, and Jason S. Moser. 2017. "Neural evidence for enhanced attention to mistakes among school-aged children with a growth mindset." *Developmental Cognitive Neuroscience* (ELSEVIER) (24): 42-50.

- Creating student agency through self-efficacy,. 2017. *SAGE Publishing Company*. Accessed 1 2021. [https://us.corwin.com/sites/default/files/silver\\_stafford\\_chapter\\_3.pdf](https://us.corwin.com/sites/default/files/silver_stafford_chapter_3.pdf).
- Thorne, Steven L. , Ingrid Fischer, and Xiaofei Lu. 2012. "The semiotic ecology and linguistic complexity of an online game world." *ReCALL* 24 (3): 279-301.
2014. *To Master Material, Give Your Brain a Break*. 09 05. Accessed 03 22, 2021. <https://www.sciencefriday.com/segments/to-master-test-material-give-your-brain-a-break/>.
- Vaajakallio, Kirsikka. 2012. "Design games as a tool, mindset and a structure."
- Wang, Hao, and Chuen-Tsai Sun. 2011. "Game Reward Systems: Gaming Experiences and Social Meanings." *Proceedings of DiGRA 2011 Conference: Think Design Play*. Authors & Digital Games Research Association DiGRA. 1-15.
- Wehmeier, Sally. 2000. *Oxford Advanced Learner's Dictionary of Current English*. Oxford: Oxford University Press.
- Zhang, Qian, Cao Yi, and Tian JingJin. 2021. "Effects of violent video games on aggressive cognition and aggressive behavior." *Cyberpsychology, and Social Networking* 1 (24): 5-10.
- Zlatev, Jordan, and Johan Blomberg. 2015. "Language may indeed influence thought." *Hypothesis and Theory* 1-10.