ABSTRACT

Internet and digital mediums are catalyzing the creation of unprecedented amounts of affordable learning resources. Yet few follow through with their aspirations to learn from them. How might we empower learners with skills for self-directed, self-regulated learning?

I explore this challenge in the domain of video game developers learning how to draw. Even though learning resources are available, self-directed learning doesn’t come with advantages of formal education; art schools provide structure, assignments, feedback, community, a motivating physical space, and a fast pace that brings students to competent levels in a short amount of time. I set to design alternative ways to experience these within the constraints of our target learners.

Starting from learning goals on the task, process and self-regulation level, I applied learning theories to extract the properties of a learning environment that would facilitate reaching these goals. I arrived to a solution of a video game that focuses on instruction and feedback at the self-regulation level, situated into a virtual world rich with legitimate peripheral participation so that self-regulation naturally leads to acquiring required processes and production of artworks.

During user testing of learning materials I’ve established a baseline for measuring user retention. However, the game design resulting from that research is yet to be proven in practice. We’ll know we are on the right path when we see increased participation rates, learners taking choices that lead to more efficient learning, and reports that they feel more self-efficacious.
1. CHALLENGES OF LEARNING ON YOUR OWN

Throughout my life I’ve interacted with people passionate about professions and skills that were not being taught in schools. My brother and I learned how to create video games in the 90s when this was not something you could learn at school. At first we relied on books and magazines until the Internet and emerging Web 2.0 communities took our learning to the next level. Nothing would stop us—except perhaps ourselves. My project, a video game called Pixel Art Academy, is dedicated to empowering people to learn on their own, in their free time. The ultimate motivation is for them achieve their most ambitious dreams and the game does so by helping them acquire skills they need to get there.

1.1 Target learners

I focus on working with game developers, motivated to create graphics for their own games. Their goal is to rise above the level of "programmer art", a term used to describe placeholders created in absence of an artist on the team.

![Image]

*Figure 1: Example of programmer art by Filip Samotor and the same level redrawn by Primo Vovk*

I specifically concentrate on helping people learn pixel art, a visual style that evolved through old video games (Kopf and Lischinski, 2011). Because it developed in the 1980s and 90s it makes it particularly popular with today’s adults that were growing up in those times. My average learner is about 30 years old and I focus on solving their particular challenge of trying to acquire a new skill while leading a busy life.
Games are a highly visual medium so having good art to represent your work is an important component (Yu, 2013). This drives developers to learn how to draw—either in absence of having another artist on the team, or simply to pursue a new creative venue.

To understand the specific needs of our target learners, I conveyed a survey and identified the following common challenges: no prior art training, low self-efficacy, and belief that they don't have artistic talent. On the other hand they are very passionate about games and show a high fondness of the medium and hope to be able to achieve their goal despite the challenges.

Lastly, the learners can't commit to full or part-time formal art education, which pushes their learning efforts into the realm of self-directed learning.

### 1.2 Self-directed learning

Self-directed learning is a learning process driven by personal interests and managed by the learners themselves (McLoughlin and Lee, 2010; Bracey, 2010). The internet brought the ability for people to globally connect around their interests in distributed virtual communities, significantly increasing the possibility for individuals to learn from each other through legitimate peripheral participation (Seely Brown, 2008). Legitimate peripheral participation is the process that naturally
happens as newcomers progress towards being full participants of a community of practice (Lave & Wenger, 1991). People want to connect, help each other, and exchange ideas and knowledge. The internet enabled this on a much larger scale. The popular art website DeviantArt is a nice example:, its members share their artworks and create collective learning resources such as tutorials, how-to documents, works-in-progress and improvement memes (Jones, 2015).

Learning on your own doesn’t come without shortcomings. The retention rates of massive open online courses (MOOCs) is relatively low compared to high school graduation rates at 82% (National Center for Education Statistics, 2015). In a typical online course the amount of students that finish is at best one third (Hone & El Said, 2016) with the average at less than 10% (Alraimi et al., 2015).

I performed a study using my own learning materials and experienced similar results and conclusions as Hone & El Said. The daily average dropout rate was at 20% with one quarter of participants completing the 6-day course (Jan, 2016).

![Figure 3: Retention results from a user study with my learning materials (Jan, 2016).](image)

Figure 3: Retention results from a user study with my learning materials (Jan, 2016).
The most common response in my exit survey, from those that dropped out, was lack of time as it got occupied by other priorities:

"Once real life stops abusing me I plan on finishing this tutorial."

"I still plan on finishing and feel bad about not but I got very busy and could not control my schedule."

As explained by Boekaerts (1999), self-regulated learners struggle to follow through with their desire to learn because such intentions aren’t well protected from competing needs. Zhu (2016) highlights this problem when contrasting informal learning with the advantages of going to art school. He attributes increased learning outcomes of dedicated schooling to the difference in amount of hours art students spend practicing. Learners who aim to improve on their own lack the pre-allotted hours for practice, as well as external pressures. Zhu lists several that keep formal students in the system: having like-minded classmates, friendly competition, homework, teacher feedback, motivation from fast improvement and stimulating studio surroundings. Without these external pressures that keep motivation high in formal environments, learners are much more likely to quit.

While time management seems to be the problem for day-to-day commitment, the level of frustration learners feel due to the difference between their current and desirable skills plays a major role (Glass, 1998; Teo and Kuciara, 2016; Thacker and Fus, 2014). This was confirmed by a short survey I conducted among my target learners. To my question, "What are some of the reasons you don't sketch more often?", the top answer with 28% votes stated, "My sketches look ugly and I give up." The time issue (response "I'm too busy to sketch.") was in third place at 18%, but also expressed through second most voted reason at 23% which stated:

"I'm slow or a perfectionist, so it often feels like a larger time commitment and work-like (vs. play). Then I end up procrastinating on it."

Other surveying I conducted revealed related topics such as lack of self-discipline:

"Lately I've been craving some kind of creative outlet, but can't really stick to drawing every day."

the need for motivation:

"I've signed up for some online courses and I've really desired knowing it but I've struggled staying motivated and working through the nitty gritty (Fundamentals, Color Theory, Practice, Practice, Practice)."

and the need for a plan:

"My attempts all those years ago were basic, badly thought out and barely planned at all."
It is important to notice that none of these problems indicate a lack of learning resources about drawing. Instead, all are targeted at the self-regulation level (time management, self-efficacy, goal setting). We should then aim at designing a solution for the self-regulation problem and because this is not domain-specific it will provide a general approach for empowering self-directed learners across disciplines.
2. SELF-REGULATED LEARNING

2.1 Learning outcomes

In their model of feedback, Hattie & Timperley (2007) present a framework of looking at feedback in four levels: "the level of task performance, the level of process of understanding how to do a task, the regulatory or metacognitive process level, and/or the self or personal level (unrelated to the specifics of the task)." We will use the first three levels (task, process and regulation) to help position our learning outcomes.

On the surface, task level, the desired outcome is for learners to be able to produce aesthetic and personally pleasing pixel art. Learning resources at this level are focused on the artworks, covering art fundamentals such as composition, color and light, anatomy, perspective and depth. The internet and art books are abundant with materials on these topics.

![Figure 4: A worksheet from a prototype tutorial designed for our project.](image)

On the process level the focus shifts from artworks to their creation, namely answering the question how to come from a white page to a finished illustration. Static properties of art theory are replaced with explaining the drawing process from the idea phase, thumbnailing and sketching, to drawing, coloring, shading and refining. At this stage the outcome is for learners to master the tools and acquire technique with which to produce artworks. Resources here are plentiful as well, most of them in form of how-to tutorials, and timelapse videos.
The least amount of drawing-specific information is available for improving at the regulatory level. Interviews with masters somewhat fill the void, but can be supplemented with general time management books and self-development articles. Realizing that this area is an important factor of successful learning is crucial; while the two previous levels enable one to know what and how to draw, the self-regulatory learning outcomes enable learning at those two levels to happen at all.

If self-directed learners are to successfully navigate over the mentioned aspiration gap between their current and desires skills, they will need to know how to commit and protect their time, create a motivating learning environment, choose direction and assign goals that will help them go there, find and use learning materials, cultivate deliberate practice through self-assessment, seek outside feedback and be able to receive critique, balance the distribution of learning and creating, take advantage of social aspects of learning environments, and other skills of self-regulated learning (Zhu, 2016; Dabbagh & Kitsantas, 2010; Hattie & Timperley, 2007; Bracey, 2010; McLoughlin & Lee, 2010). My project must aim to address these requirements.

2.2 Learning theory

With knowledge of learning theories I analyzed the learning outcomes and transformed them into characteristics of a learning environment that will help deliver them. The assumption is, if I construct a solution that follows the theory, I should arrive to the outcomes the theories inform.

Appendix A offers a comprehensive list of guidelines I identified and the learning theories they are derived from. The areas that apply include andragogy, a model of assumptions developed to describe learning in adults (Knowles, 1970); self-directed learning model with its three overlapping dimensions of self-management, self-monitoring, and motivation (Garrison, 1997); four-phase model of interest development that we can use to see the shift from extrinsic to intrinsic motivation (Hidi & Renninger, 2006); attainment of expert performance through deliberate practice (Ericsson et al., 1993); already mentioned legitimate peripheral participation (Lave & Wenger, 1991); personal learning environments, a concept specifically developed to describe our use of online resources to facilitate self-directed learning (McLoughlin & Lee, 2010); multiple approaches to understanding feedback, an important tool for reaching desired goals (Fishbach & Finkelstein, 2012; Cutumisu et al., 2015; Hattie & Timperley, 2007); finally, I look at advantages of the protégé effect to mitigate negative feedback (Chase et al., 2009).

As I have defined the learning outcomes and characteristics of the learning environments (collected in Appendix D), I proceeded to design a solution that addresses these requirements.
3. DESIGN PROCESS

3.1 Design goal

Through a synthesis of the guidelines presented in Appendix D, I concluded that I should design a learning environment that addresses the following:

- Learning should be a natural activity of completing real-world projects.
- Learners need to be the ones choosing goals and how to get there. We provide the structure, scaffolding and tools for them to design their path.
- Learning environment should be rich with interests and activities to develop them.
- Long-term engagement should be supported by learner-driven, collaborative projects.
- Learners' artifacts must be an essential part of interaction.
- A system should be in place to monitor learners' self-efficacy, mood, and knowledge level, so that appropriate feedback can be chosen in respect to them.
- Design solution should provide the ego-protective buffer to the learners.

From here we can choose further characteristics that will accommodate target learners and the ideal environment:

- To achieve low costs and self-direction, the solution must be highly scalable and without the need for outside teacher intervention. Analytics should be an automatic part of the system that serves to personalize the environment.
- It is an on-demand system, readily available at any time the learner desires.
- Interactivity must be high and lead to a high branching factor of experiences (wide possibility space). This enables learners to choose their own path that will achieve their goals.
- To support development of interests and provide an emotionally positive experience, the solution is a highly visual, stimulating, immersive environment geared towards target learners' interest in video games and pixel art.
- To focus on interactivity between learners and foster long-term commitment, we have to support small to large groups of people to communicate and collaborate on big-scale projects.

I propose that an interactive, online computer system addresses these desires best. Furthermore, the form of a video game captures the learners' interests the most, with game characters serving as teachable agents that players control in the game. Online format allows users to communicate and shape the overall experience. Game storylines present scenarios that simulate real-world activities of game artists. An art school environment offers a basis for the availability of tools and (virtual) teachers. Artificial intelligence (AI) can control what direction and feedback teachers provide to learners, based on statistics collected individually for each player. Overall, the form factor is both fitted to the specifics of our target learner (they like video games) and as a design solution that...
addresses all technical demands (interactive, personalizable, collaborative, automated environment).

### 3.2 Use of existing solutions

Although I am not the first to incorporate learning of drawing into video games (see Appendix B for an overview), I am, to my knowledge, the first to focus on the regulatory part of the learning process. Instead of focusing on providing activities and instruction on the task and process level as my predecessors, I am creating an environment that surrounds these activities.

To promote self-regulated learning I guide the players to use existing resources available on the Internet to gather the necessary knowledge. This should lead to efficient learning outside the scope of the game and for the most proactive learners to also share back to the community and create learning materials themselves.

### 3.3 Design methods

I am dividing my design efforts into three areas: knowledge (what people need to learn), behavior (what they need to do), and environment (what resources and tools they have). This is an ongoing process as I continue to design the features of the game.

On the knowledge level, Backward Design (Wiggins & McTighe, 2005) allows me to create an art curriculum that best serves my target learners. I am following the three steps of identifying the desired results, designing how I will know they’ve reached it, and finally, planning the learning experience and instruction to achieve that. This approach helps me start with overarching concepts and principles (composition, lighting or anatomy), and convert them into concrete, project-based activities (creating an environment tileset, designing a game character, illustrating promotional artwork).

Second, I employ Behavior Design based on the work following the Fogg Behavior Model (Fogg, 2009). Here I aim to help users reach the amount of hours they want to spend on learning. The focus is on making the behaviors as easy to do and providing a clear structure of triggers that will entice these behaviors. To plan a continuous stream of triggers, I apply core loop analysis and make sure users continuously go through steps of evaluating (what should I do?), planning (how will I do that?), acting (executing the plan) and receiving a reward (reinforcement of the behavior).
Finally, I am taking the desired characteristics of the learning environment (Appendix D) and generating possible features that will encompass them. I map these features by how easy or challenging they are to implement and how impactful they would be.

*Figure 5: Process of mapping the features by value (highest on top) and effort (easiest on right).*
3.3 Game Design

There are three main learning systems in the game: storylines, interests, and organizers.

The main activities in the world are driven by storylines, sets of quests within a certain topic. The player chooses an aspiration for their character, similar to a major in college, which gives them a progression of goals. They then follow through a nonlinear network of quests that brings them closer to their next goal. The first storyline I am developing revolves around creating a video game. You meet a programmer on campus and decide to create a game together. This leads you to a series of tasks such as creating characters, environments, and even deciding on the game design. The player has a very actionable goal in front of them that closely matches real-world game art making (without the necessary friction and waiting for developers to code and implement game features). The storyline system in this way provides the goals and tasks for the player to achieve.

To help players along the way, the interest system is the knowledge hub of the game. Presented through an in-game illustrated encyclopedia, interests describe all concepts in the game's world, from art theory and styles to process terms and even learning theories. Each interest comes with a list of materials that are stored in the player's virtual library. They get exposed to players by
exploring the world and then gather materials from characters in the storylines. They can refer to them anytime they need help on a topic.

Finally, organizers serve the user’s self-regulating needs. Each student is given a virtual mobile device with a set of apps that help them plan their learning path. They set available practice times on a timetable and track commitment on a calendar, checking off completed days (also known as the Seinfeld method (Trapani, 2007)). They commit to long-term, high-commitment goals such as improving for 100 days. We've seen great community engagement when people undertake such goals, specifically within the Giveit100 community, which was a network of people that dedicated themselves to do something for 100 days (Berkowitz, 2013).

Game features are further broken down in appendix C.

Figure 7: The in-game calendar feature is where you tracks your daily commitment.
4. MEASURES OF SUCCESS

Different approaches and formats of learning resources have been tested throughout the design phase of the game.

The first study examined the use of existing Internet resources to drive learning (as opposed to creating our own, unified, custom resources). The results were positive and all 5 participants showed progress between a pre and post-instruction task (Jan, 2015). No negative signs were observed, which gives us good grounds to proceed with this strategy for gathering curriculum resources.

![Figure 8: Progress of a participant in the study about using existing Internet resources.]

The second, two-part study aimed at determining what kind of motivation works best for deliberate practice, as well as measuring a baseline for participant retention (Jan, 2016). In the first, participation part, I was able to correlate dropout with user’s reported loss of available time. In the second part, the 3 types of motivational content didn’t show a significant difference between their effects. All three intervention conditions outperformed the control group when expressing intention to practice drawing, but failed to have significant effect for actually performing practice. This led me to conclude that when designing materials for self-regulated learning, optimizations should be focused on increasing the time aspect of ability rather than motivation.
Figure 9: Although the three conditions that included a motivational boost (Work/Improvement/Community) gathered more sign-ups, the amount of people actually following through by following the program after sign-up quickly equalized with the control group.

Building on the conclusions of the second study, one last study used Behavior Design to construct a self-regulated learning course with even more minimal time requirements (5 minutes per day). Conclusions from this research informed the move away from ability to focus on the trigger component.

Our current approach focuses on scaffolding the player from an extrinsically supported set of triggers created through core loop design towards self-initiated time management strategies with which the player controls their own schedule of triggers. This strategy is yet to be tested.

In combination with other game features from appendix C, we aim to raise above the 25% retention of our own study and the 32% reported by Hone & El Said (2016). At that point we will have an exemplary pilot implementation of a video game specifically designed to support self-regulated learning.
5. CONCLUSIONS

The amount of learning resources available to self-directed learners has increased during the Internet-era. To improve learning success we must now shift from creating new resources at the task and process level towards solutions that work on the regulatory level.

I showed by analyzing learning theory, that video games offer a great medium for constructing a learning environment for self-directed, self-regulated learning. Unlike passive learning resources in form of books and talks, video games require active participation through the very nature of the format (when designed for interactivity). This allows experiential learning to take place when acquiring self-regulated learning techniques, as suggested by the field of andragogy.

My next step is to put this theory into practice and test my design with users. There has been a lot of interest from target learners for using the video game. This will allow me to run a pilot study with 800 learners this Fall and additional 2,000 in Winter. I plan to maintain the research standpoint as the development continues towards creating a commercial product for learning how to draw. The hope is for the focus to stay on increasing learning outcomes first and foremost.

Figure 10: Target look of the finished game.
REFERENCES


APPENDIX A: LEARNING THEORIES

We start with our target learner and first turn to andragogy, a model of assumptions developed to describe learning in adults (Knowles, 1970). Knowles' work fits so well with the circumstances of our learners that most implications of those assumptions apply directly to our learning problems. The assumptions are as follows:

- Learners have moved from dependency to self-directedness.
- They learn better from experience.
- The need to learn must stem from real-life tasks or problems.
- They see learning as developing increased competence to realize their potential in life. Instead of being subject-oriented they are performance-oriented.

Proposed characteristics of learning environments according to andragogy are respectively:

- They encourage and nurture self-directedness of learners.
- They include experiential activities such as laboratory experiments, discussion, problem-solving cases, simulation exercises, field experience.
- Create conditions and provide tools and procedures for helping learners discover what they need to know. They are organized based on applications in life, and sequenced according to the learners' readiness to learn.
- Gained knowledge needs to be directly applicable.

Knowles further warns that pre-planned activities result with apathy, resentment and withdrawal. Instead, according to self-directivity, learners need to be involved in planning of their learning. The offered units should not be describing what they are about though, but what the learners will get out of them.

A great direction given to designers of learning experiences by Knowles is:

“The critical function of the teacher, therefore, is to create a rich environment from which students can extract learning and then to guide their interaction with it so as to optimize their learning from it.

Based on the first assumption of andragogy we move onto self-directed learning. Garrison (1997) proposed the self-directed learning model that includes three overlapping dimensions: self-management (task control), self-monitoring (cognitive responsibility), and motivation (entering and task). The characteristics that these add to andragogy are:

- Learners should be given choice how to proactively carry out the learning process.
- The environment should provide resources, suggest approaches, accommodate flexible pacing, and provide feedback when needed.
- To establish entering motivation, learners need to select goals and intentions, and decide to participate.
Learning goals need to meet the needs of learners and be perceived as achievable.
We must create conditions where motivation comes from authentic interest and desire to construct personal meaning.

We can find clues for realization of this last point in the four-phase model of interest development, one of the first descriptions of how individual's interests progress over time (Hidi & Renninger, 2006). As an individual moves through the phases of triggered and maintained situational interest to emerging and well-developed individual interest, they move from being supported by external forces towards sustainable internal motivation. Characteristics that we can extract from this research are:

- Sources of new interests can lie in environmental or text features such as out of place, surprising information, character identification or personal relevance, and high intensity.
- Maintaining an interest can be achieved through meaningful and personally involving activities such as project-based learning, cooperative group work, and one-on-one tutoring.
- The move towards individual interest requires positive feelings, stored knowledge and stored value. External support can be provided in the form of expert and peer interactions, and presented in the form of tasks or environments that challenge and provide opportunity.
- To support well-developed interest, the learning environment should offer long-term constructive and creative endeavors, and provide opportunities that include interaction and challenge that leads to knowledge building.

Bringing learners to this last phase is essential for those that want to reach the highest levels of competency. "A learner with well-developed individual interest will persevere to work, or address a question, even in the face of frustration." This is the precursor to entering the zone in which learners can improve the fastest with use of deliberate practice, which is the most effective path to mastery, but not inherently motivating (Ericsson et al., 1993). It needs to be applied in limited bursts and should be reserved only for those that have reached the necessary commitment for it not to be detrimental.

To better support the wider range of spectrum of learners, from those who want to be masters, to those who want to just observe from the sidelines, we need not look further than legitimate peripheral participation (Lave & Wenger, 1991). This is a process of learning that happens in a situation where a newcomer progresses towards a full participant of a community of learning. It gives us foundation for talking about concepts like apprenticeship and communities of practice, which are common parts of art practice as well as online personal learning environments.

A personal learning environment is a concept describing how we integrate online tools, form and join communities, and create, consume, remix and share materials to serve our informal, self-directed learning needs (McLoughlin & Lee, 2010). Characteristics derived from this concept are:
• Value is placed on student created products as a primary content source in order to
increase engagement, promote self directed and self regulated learning as well as
collaboration and knowledge sharing.
• In a knowledge-building community, members make responsible decisions and
contributions that benefit the community as a whole.
• Providing options and choice while supplying the necessary structure and scaffolding leads
to self-direction.
• Teachers have a supportive role (introducing new ideas) and a diagnostic role (continually
examining students’ interpretations of activities to help determine an appropriate direction
for subsequent steps). They facilitate a dynamic learning process, assisting learners in
drawing links between their learning and real world, and being a consultant, guide and
resource provider.
• Critical challenge is to design learning experiences that scaffold the development of key
competencies, including visual, technological and information literacy and the soft skills of
communication and teamwork.
• The learner must play an active role in negotiating the type of contextual, social and task
support needed.

As learners progress from passively consuming instruction to actively creating artifacts of their own
learning, they will eventually be exposed to feedback in one form or another. As a powerful tool
that it is, we also need to explore how to provide it as a system, and how to teach learners to apply
it themselves in terms of self-assessment. From various sources about the influence of feedback on
persistence (Fishbach & Finkelstein, 2012), effect of feedback on learning efficiency (Cutumisu et al.,
2015), and general power of feedback (Hattie & Timperley, 2007), we draw these properties of
feedback to be considered when designing our learning environment:

• People express greater motivation to persist on a goal after they receive either positive or
negative feedback.
• However, simply providing more feedback is not the answer, because it is necessary to
consider the nature of the feedback, the timing, and how a student receives this feedback.
• Positive feedback is good for persistence and higher interest. When it is done at the
self-regulation level it will increase motivation, but only if the activity is something the
learner wants to do (it is detrimental if it’s something they feel they have to do).
• Error correction should be immediate on the task level, but not on the process level (it’s
better to let the process play out and reflect at the end).
• We should be conscious of how self-efficacious the learner feels. If they are, early feedback
will boost their confidence so they cope better with disconfirmation later on. If they aren’t,
positive feedback is unpredictable (they might feel patronized) and disconfirmatory
feedback has negative impact on motivation and performance (they more often attribute it
to their fixed ability, instead of current effort).
• It’s very important to always include corrective feedback, which enhances learning new
skills/tasks. Corrective feedback following a disconfirmation gives the learner things to
improve whereas disconfirmation alone lacks information value.
Knowledge must be sufficient to see the error, so decide wisely between feedback or simply more instruction.

Negative feedback should be chosen to be received by the learner. Choosing to receive it helps so learners don't dismiss it as they might with unwanted (unsolicited) feedback.

Choosing negative feedback is more efficient for learning than positive feedback as negative feedback increases the time learners ponder the feedback and how much revision they do.

Positive feedback (especially mastery experiences) increases sense of self-efficacy. Failure and negative feedback weaken sense of self-efficacy.

Positive feedback elicits positive affect, feelings, including emotions and mood. The experience of positive affect and feelings can become implicitly associated with the goal and thus increase the perceived value of the goal.

In the discrepancy model of self-regulation, negative feedback is better as it promotes goal-directed behavior more than positive or no feedback. People increase their effort because they feel their progress towards the goal is slower than expected (they feel bad about it).

Positive feedback on goal completion results in disengagement or post-fulfillment inhibition. The goals you're working on inhibit competing ones, but once a person receives positive feedback on goal attainment, the focal goal is inhibited and competing goals become accessible and readily pursued.

Negative feedback undermines learning motivation under fixed mindset (intelligence is unchangeable), but less with growth mindset (work increases intelligence) who infer they have not put enough effort into the task.

We need to distinguish how feedback is interpreted: does the learner feel it confirms their commitment or instead their progress. In the commitment case, positive feedback strengthens goal pursuit, and negative hinders it. In the progress case, positive feedback weakens goal pursuit (I've done enough) and negative strengthens it (I need more effort).

Feedback on missing actions to complete the goal increases the level of aspiration more than feedback on completed actions (it directs individuals to focus on making progress). Feedback on completed actions increases commitment and satisfaction with the present level of engagement.

Feedback on completed actions increases the intrinsic incentives and experience of enjoyment, involvement, or importance, whereas feedback on remaining actions increases the extrinsic incentives with making progress and attaining the goal.

Experts focus less on commitment and focus on monitoring progress/discrepancy.

Finally, with the importance on being able to receive negative feedback, we explore the concept of the ego-protective buffer (Chase et al., 2009). In their research on using teachable agents to increase learning, Chase et al. give three factors that contribute to the so called protégé effect, the concept that students make greater effort to learn for their teachable agents (virtual characters) than they do for themselves:

- The ego-protective buffer shields students from forming negative beliefs about themselves. If their character is failing, it absorbs part of the blame.
- If the teachable agent is failing, the fault can be on the teaching part (something that can be improved with effort), instead of fixed ability of the learner.
- Ego-protective buffer promotes revision (if the learners believe it will be effective). The incremental improvement then in turn promotes incremental view of intelligence (growth mindset).
- Teachable agents also give a sense of responsibility to the learner and elicit more learning and preparation before submitting tasks.

This research gives us very good arguments to find a way to incorporate learning via proxy entities.
APPENDIX B: EXISTING DRAWING GAMES

There have been numerous video games and apps about drawing.

Nintendo DS portable console has seen the most due to its stylus input method and dual screen design (one screen can be used for drawing, the other for instruction). Let’s Draw! (2010) focuses on providing image references for the player to recreate. Art Academy series (2010–2015) also provides step-by-step instructions. These apps focus on providing a drawing tool and instruction, both of which I do not aim to replicate as I consider already abundantly present in separate forms.

The second style of games include story-based gameplay with drawing as a core mechanic. For example, Drawn to Life (2007) requires you to draw your in-game characters and other story elements. I employ similar intertwining of story and drawing for moving the player between units of the curriculum.

There have been many coloring storybook apps, from early attempts (Art Alive!, 1991; Color a Dinosaur, 1993; Fun 'n Games, 1994) to an abundance on today’s mobile devices (Color Me, 2012; Colorfy, 2015; Pigment, 2015; Toonia Colorbook, 2015). These offer a scaffolded introduction to art aimed at kids or a relaxation activity for adults. Both sentiments are something to draw upon.

Yet another genre is competitive drawing games like Draw Something (2012), where you have to guess what the other person is drawing. They hardly provide a way to learn or improve drawing skills, but might provide inspiration for more enjoyment-focused supplementary activities.

Finally, the whole concept of gamification (Deterding et. al, 2011) can be applied to drawing, which makes all the skill improvement and habit building apps appropriate for gamified support of drawing practice. Some apps are more directly linked to games, most notably the RPG-themed Habitica, while others represent generic habit tracking apps (Productive, Coach.me, Momentum … (Cooper, 2014)) and task managers (Todoist, Wunderlist). Pixel Art Academy holds many parallels with such apps and draws inspiration from communities like Giveit100 (Berkowitz, 2013) that also enabled members to achieve their goals. In the game this shows mainly through available tools and systems of extrinsic motivation.
APPENDIX C: GAME FEATURES

Aspirations, goals and tasks

This system is at the core of personalization, of constructing your own path through the art curriculum.

There are four main professions:

- Fine art, drawing for its own sake with application in the (in-game) gallery world.
- Illustration, visualizing stories and scenes with application in publishing and advertising (books, comics, box art, covers).
- Pre-production, drawing concept art to design characters, locations, items etc. Includes art direction and style planning.
- Production, creating final game assets such as character sprites with animations, tile-maps and backgrounds.

Depending on the chosen profession the game can provide better suggestions for the types of quests to go through. Each quest has a clear goal and you can only have a handful of quests active at the same time to maintain focus (ice-cream sampler metaphor). Each quest is comprised of clear tasks that need to be completed to reach the goal. A to-do list of remaining tasks provides negative feedback.

Formative assessment

Exercises are created that demand some concrete aspect of art theory or practice to complete. The player tries to complete the exercise to the best of their knowledge and then compare the provided correct result with their solution (and other player's solutions). This leads to a confirmation of satisfactory knowledge of the subject or identification of a gap that should be filled with instruction. Learning materials are provided and the player can retry the assessment after consulting them.

Multiple exercises can be given on a topic to facilitate deliberate practice of that aspect. Exercises in a range of difficulty can be provided to assess efficacy, and to promote progress/improvement.

Interests

Interests represent every specific topic in the game, from art concepts and historical styles, to genres, themes and activities. Interests are used to measure player's involvement with the topic and assess their extrinsic vs. intrinsic involvement with it. Based on that, different scope of quests can be given to complete.
Interests also serve as knowledge units, each represented with an entry in the games encyclopedia called Illustrapedia. They hold collective value and player has to explore the world to get exposed to them, upon which they gain access to quests, learning materials and resources connected with the interest.

**Timetable**

Time management is the cornerstone of self-regulation in the game. In a weekly calendar the player sets real-life time blocks when they plan to play the game. These times serve other systems:

- Daily check-ins during the time slots track user's commitment and give positive feedback for it. Challenges such as #Givelit100 and methods such as Tiny Habits rely on this feature.
- Planning phase provides tools to calculate your weekly and yearly time commitment (Meaningful & Manageable analysis, deliberate practice contribution), helping with user-regulation of their time investment.
- Time blocks provide windows of opportunity to send trigger events to players, reminding them to log into the game. Once there, systems like notifications and quests help them find something to do.

**Virtual Library**

Serving organizational and discovery purpose, the virtual library catalogs all materials, especially learning resources. It is the basis for the knowledge needed to perform tasks in the game.

Content is tagged by interests on a unit and section basis, meaning that each resource (for example a tutorial) can be subdivided down into smaller pieces that each get their localized tags.

A big picture overview is provided in terms of a knowledge map that is organized either by subjects and concepts, or by application. Each can be used to help someone navigate from beginning steps towards their goal, be it a certain subject or activity.

**Journal and artist profile**

Journal allows you to track your progress and share your story with the community. It promotes self-regulation, self-assessment, as well as provides a way to show someone's progress over time.

A complement to the journal, the artist profile is used to showcase one’s work in a more curated way as well as connect the game character to the real-life person and their social media presence.

**Quests**

Quests are basic units of game storylines that give you certain goals. Before a player accepts the goal, an overview will be given about its content, such as:
Which interests are involved and what are the prerequisite levels.
- Goal difficulty levels (easy, medium, hard—can give multiple for player to choose) in terms of time/effort commitment.
- Available languages (translations).
- Cost requirements (does it use only free materials, paid, or a choice of either).

**Flow assessment**

Questionnaire about how challenging the task was and how well the player felt their skills were to solve it. Serves to inform the game’s systems about player’s efficacy, motivation and ability levels.

**Game setting**

The game’s narrative loosely follows the traditional arch of the Hero’s journey, a plot device where the protagonists moves from their ordinary world into an adventure experience where they achieve victory in face of great challenge and get transformed before returning back to their normal life (Campbell, 1949/2008). The story will transports the player from a busy life in the real world into the world of creativity at the Retropolis Academy of Art. The Academy serves as an imaginary learning environment, focusing on constructivist methodology and self-guided exploration (Rogers, Montessori, Dewey). Inspiration for the utopian society comes from Walden Two (Skinner, 1948/1976), giving the basis to research-oriented, self-improving practices at the academy.

![Greeting from Retropolis](image)

*Figure 11: The utopian city of Retropolis where the game takes place.*