Bachelor's Thesis – Creative Technology

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# Developing a gamification program to motivate users in pre-existing e-learning courses

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# Abstract

Open e-learning courses such as MOOCs have low completion rates due to students' lack of motivation. This is an issue as education is shifting to online platforms. This research explores the use of gamification and persuasive system design to create a software system to motivate users in learning data science. The proposed solution is developed via iterative design in three iterations, which are separately evaluated with potential end users. The results indicate that gamification can be a motivating tool in learning data science, showing potential for improving student motivation in e-learning platforms.

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# 1. Problem Statement & Research Questions

Many companies nowadays use MOOCs (Massive Open Online Courses) to teach their clients about end-to-end data solutions. In these MOOCs, students follow an online curriculum provided by online course providers containing different courses to learn these various skills about data. The upside of these e-learning courses is that they are cheap and students can start them whenever.
However, the completion rate turns out to be one of the weak points of MOOCs. often less than a mere 15% [1]. This is concluded by the lack of motivation that MOOCs provide. This research aims at improving the completion rate by applying gamification and persuasive design. Gamification is the addition of game-like elements, increasing user engagement and motivation. Redesigning the MOOCs with gamification improves user motivation in completing online courses [2].

In particular, this paper aims to find means to motivate users in existing MOOCs about data science by developing a game-like program. To reach this goal, the following research questions need to be answered:

-How can gamification be applied to MOOCs about learning to build end-to-end data solutions?
-What gamification aspects used in MOOCs increase the motivation of users in MOOCs?
-How can people who work with data be motivated by gamification?

The questions are answered as in-depth as possible via a literature review and design solution while keeping time and other constraints in mind. The design solution has been created via iterative design and has been evaluated with four potential end users. The proposed solution is presented in figure 1.

*Figure 1: Final Prototype of the proposed solution*

The proposed solution is a desktop application aiming at improving motivation in users via gamification and persuasive design. The design allows users to study a MOOC via an interface that monitors and guides the user through the lessons. As the user studies, they are rewarded with gems,

which the user can use to buy different avatar personalization as a gamified long-term goal. The users are motivated both short-term via a multiplier system and long-term via a streak system. Users are also motivated by exploring the art style that changes as the user progresses throughout the MOOC. The results of the evaluation indicate that the design is motivating users in studying both short-term and long-term.

In this report, the work and research are presented to develop the system and prototypes. The process is done in an order that fits the Creative Technology Design Process [27]. In chapter 2 the state of the art is researched. In particular, this chapter focuses on researching literature and investigating existing systems. Chapter 3 focuses on the Requirement Capture and Concept Generation. The initial requirements were made by the client and documented along with the development of the concept. This chapter is concluded with a small specification and final requirements. Chapter 4 focuses on Realization. The prototype development and evaluation are documented. In particular, the prototypes are developed with iterative design. Chapter 5 summarizes the multiple iteration evaluations, followed by discussing the findings. Chapter 6 then rounds it off with Limitations and Recommendations for future development.

# 2. Literature & State of the Art

In this chapter, the state of the art is investigated. In the first part, literary sources are investigated and used as a basis to discuss working examples found in the second section. This discussion is concluded with an outlook on where opportunities can be found.

## 2.1. Literature

The goal of this literature section is to gain knowledge on the motivation techniques behind gamification. This is important as blindly implementing a reward system without having researched why it works can create the opposite effect on motivation. This section will focus on the effectiveness of gamification in literature. This is followed by theories surrounding gamification, such as the self-determination theory and the flow theory. Finally, research on the persuasive design model is discussed and its underlying theories are.

### 2.1.1. Gamification Aspects

Gamification is slowly being implemented into all forms of education but is primarily effective in online education [2]. Since 2011, academic literature focusing on gamification has been increasing [9]. The main benefit of gamification in MOOCs is to increase engagement. This highlights the impact gamification could have since the percentage of people completing MOOCs is less than 15%. Studies have already shown the positive impact of applying gamification to MOOCs [10].

The first theory upon which gamification is built is the self-determination theory [3], which was originally developed in 2012 by Deci and Ryan [11]. In the theory, motivation is divided into extrinsic and intrinsic motivation. A person who is extrinsically motivated will do an activity because an outside source motivates them. On the contrary, an intrinsically motivated person will do the activity because it is enjoyable or interesting. Extrinsic motivation is caused by an external outcome resulting from doing the task, not from doing the task itself. The more students are externally controlled, the less interest they have in value or effort [11]. If external rewards are available, students might shift their motivation from intrinsic to extrinsic. This is because over time the intrinsic motivation might diminish as their interests shift, but the external rewards might keep them coming back. Students

might choose to do a MOOC because they find a subject enjoyable. In successfully improving MOOCs, a key strategy is to promote a more active and self-determined form of extrinsic motivation.

Niemic and Ryan further expand the self-determination theory [14]. Intrinsic motivation is satisfied by the aspects of competence, autonomy, and relatedness. Competence is when a student has the ability to do the work. Autonomy is when students can determine when to study. Relatedness is when a student can relate to the material. The first two aspects, competence, and autonomy are required to be intrinsically motivated. This is in line with the statement by Deci and Ryan, where if the student is controlled on when to study (even when they are competent), their interest in value and effort reduces, and so their intrinsic motivation does as well.

The second theory often used in gamification is the flow theory [3][12]. Flow is defined as the loss of awareness of time while doing a certain task. Strong concentration allows the feeling of time flying by because of the feeling of being challenged perfectly. When you are 'in the flow' nothing else seems important, since you are in an optimal state of intrinsic motivation. Flow theory can help determine when to set rewards and how to define them. Good spacing of meaningful rewards will keep students in the flow, by encouraging them to go for the next reward.

Now that some theories are outlined, it would be beneficial to know what works in MOOCs in combination with the theory behind it. The goal of gamification in MOOCs is to increase engagement with the courses. Engagement is often used to increase completion rate (retention rate), participation, and/or motivation [3]. The completion rate is arguably the most important goal, as the goal of doing a course is to finish them. This makes it the most reported goal in articles and is often defined as:

$$completion\ rate = \frac{n_{students\ completed\ course}}{n_{students\ enrolled}}$$

To have this number as high as possible it is important to know what motivates the students in the course. It is therefore very important to know the user group so that all gamification elements could be made according to the students' relatedness and competence.

From a teacher or course provider, it seems the goal is to complete the entire course, but Wilkowski et a. argued that the users' personal goals are more important [14]. They asked students about their MOOC via a questionnaire about their intent. The results showed that students had varied goals ranging from completing the entire course to only one specific part. They concluded that 42.4% at least met their personal goal set before enrolling. Furthermore, in a follow-up questionnaire, they found that 51.8% of students who didn't complete the entire course agreed they met their personal goals. This proves that thinking about the users' goals is important for structuring the course (and then how to structure the gamification elements around it). By this logic one wouldn't want to calculate the completion rate, but how many students reached their personal goals. Antonaci et al. [16] proposed a new formula to calculate if a student achieves their personal goal and a formula for the overall achievement of these goals combined:

UIR (User Intention Ratio): course percentage the user intended to complete

PCR (Personal Completion Rate): course percentage completed by the user

$$personal\ goal\ achievement\ rate = PGAR = \frac{PCR}{UIR}$$

$$overall\ goal\ achievement\ rate = \frac{1}{n * \sum PGAR}$$

When designing the MOOC and gamification elements it would be beneficial to think about the goals of the students. These are just as important as the view of the course providers.

### 2.1.2. Gamification Aspects in MOOCs

There is quite a wide number of elements used in gamification in MOOCs. Marek Milosz and Elzbieta Milosz found in a review of 48 articles that "The analysis of gamification elements and techniques used indicates that the following natural game elements are most commonly used: Points (92%), Leader boards (56%), Badges/medals (50%) and Levels/iterations (46 %). Avatars are rarely used (4%)." Milosz and Milosz remark avatars are seldom used because they are hard to implement. Other possible gamification elements are Storytelling, Visualizations, Progress bars, punishments, challenges, and feedback. Other studies by Marta Jarnac de Freitas, Chang, and Wei reported similar findings. They found that Virtual goods, redeemable points, Team leader boards, trophies and badges, peer grading, checkpoints, skill points, memory-game interactions, and feedback had the most engagement. The most effective elements of gamification in MOOCs seem to be points, leader boards, trophies/badges/medals [2]. The effectiveness does not decline by age [17][18], however, the ease of use does. The older a user is, the less easy to use the gamification features are. It is also recommended for gamification designers to focus on distinct areas appealing to the target group [18].

In the field of data science MOOCs there have been a small number of studies on how to improve engagement. A significant finding is that an intervention moment to supply assessment feedback improved students' activity in the online courses [5]. This would create more of an interaction between the student and the system as the system seems to be reacting more to the knowledge of the student. A student could make repeated mistakes of the same type and halfway through a lesson, the system would show a message about improving this type of mistake. The impact of assessment feedback showed less weekly dropout rates. Another theory promoted is the use of challenges/levels interspersed with feedback moments [6]. These challenges would have fictitious data that the student has to analyse and model. By interspersing feedback moments throughout the challenge students keep active throughout the challenge. It also mentions how a community atmosphere should be established around the courses/challenges. A forum-like environment where a student could interact and share ideas. A forum could work well in conjunction with providing assessment feedback by having other students provide peer feedback on the forum. The downside to this idea is that it is relatively complex to implement. So, for MOOCs focused on data science in particular, it is important to have moments of assessment feedback.

### 2.1.3. Persuasive Technology

A theory that is closely correlated to gamification is persuasive system design (PSD) by Oinas-Kukkonen [26]. The PSD model is a framework helpful for designing and evaluating persuasive (motivating) systems. They describe what types of functionality can be found in products to motivate users in certain behaviour. Figure 1 summarizes all functionalities and categorizes them.

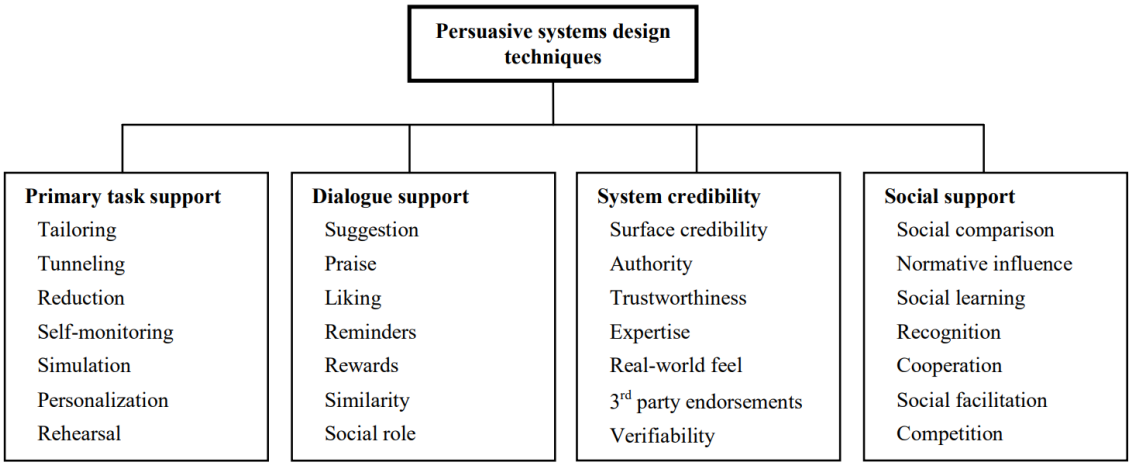


*Figure 1. Persuasive systems design techniques [36].*

The different functionalities can be categorized. Some functionalities help finish the primary task, while others are useful for system feedback or make the design more credible (and therefore more persuasive). The basic functionalities themselves are design principles. If you want a system to be tunnelling then the system should guide users in the process by providing ways to bring them closer to the intended behaviour. For a system to include the liking functionality the system should have a look and feel incorporated that appeals to the user. The great amount and variation of techniques act as a toolbox the designer can use to add types of features to make the system more persuasive. The different techniques can be mixed and used to strengthen each other.

The different design techniques are based on several lessons learned from psychological theories [36][26].

1. Information technology is never neutral – There is always a goal of behaviour change.

2. People like their views about the world to be organized and consistent – If the system supports the making of commitments, then it is more persuasive.

3. Direct and indirect routes are key persuasion strategies. – This lesson is tricky. It implies the user's background and use situation influence their information processing. If the user is, for example, in a hurry they will use different ways to process information than if they are leisurely mood. In these persuasive systems, both moods need to be considered and the system should therefore try to incorporate a direct route and a more indirect route for persuading.

4. Persuasion is often incremental. – It is easier to get people into doing a series of activities rather than with one consolidated action. An application should try to persuade users one step of the process at a time.

5. Persuasion through persuasive systems should always be open – It should be clear what the designer wants from the user. If it is unclear the persuasiveness is decreased or it may even seem like the designer is misleading the user.

6. Persuasive systems should aim at unobtrusiveness. – They should avoid disturbing users in working towards the main goal. If they hinder, they will not be persuasive.

7. Persuasive systems should aim at being both useful and easy to use. – They should be serving the needs of the user. If a system is not easy to use, it will not be persuasive.

### 2.1.4. Discussion literature

In this section, two central concepts have been explored. Gamification in a general and the PSD model. The theories of gamification and PSD have quite a bit of overlap. For instance, the reward technique from the PSD is equivalent to the points and badges gamification element. Similarly, the personalization technique is equivalent to the avatar customization game element. The PSD model essentially underlines the different gamification techniques and their PSD categories. Some game elements create social interaction, help the user with the primary goal, or create motivating feedback systems. Due to this relation, the PSD model can be used not only to evaluate how motivating the design is by looking at different amounts of techniques, but also to evaluate the different gamification aspects and their goals. This can be done by evaluating how well the techniques encapsulate the descriptions of the techniques given by Oinas-Kukkonen.

The lessons on which the PSD model is based are important to know when designing the system as they explain why the persuasion techniques work. These lessons are also used as heuristics while designing the system.

The results of the different gamification aspects show what are the most realistic to implement while also being effective. These results are only surface level as they don't go into details on how gamification can be implemented. For a more in-depth analysis existing examples should be analysed.

## 2.2. State of the Art

The remainder of this chapter focuses on already existing examples of (online) products that use gamification elements. First, a lot of the examples are generally explored. Then the different applications of gamified elements and persuasive design are compared in the discussion segment. From this comparison, conclusions are made.

### 2.2.1. Duo

Duo [7] has a workshop that teaches data science, it is relatively short (8 lessons), where the lessons are taught in the form of challenges. The lessons would take one hour, and teams would try to take on solve as many challenges as possible. The challenges would consist of fictional datasets. Players would have to find summary statistics, create visualizations, or transform the data in different ways to find the answer to the question. These challenges' answers could be found via a flag, which could be collected by individuals or teams by completing the challenges. The flags have points attributed to them to give the participants an idea of how far and how well they are doing. Challenges with a higher difficulty have more points attributed to them. Some aspects of the gamification that could be improved are more flexible answers, better progress reporting, and harder challenges for advanced students who get bored by the easy challenges.

### 2.2.2. Duolingo

Another good example is Duolingo, an app where you can do bite-sized lessons to learn a language. Duolingo quickly grew to a large scale of 300 million users due to its effective implementation of gamification. In particular, Duolingo makes great use of the flow theory by interspersing difficult activities with small rewards [13]. The app rewards users with points for completing lessons,

ranks/leader boards for the number of points collected each week, and a streak system where the user is encouraged to at least do a lesson a day. The lessons take only 10 minutes a day, so after the user finishes one, they are encouraged to try another small one. This keeps some users in the flow. The app also has a playful and fun-themed UI, making it feel like learning is fun.

Another important aspect that is less tied to gamification, but is still relevant, is that Duolingo gives a lot of notifications that effectively nudge users back into learning their language. I suspect an issue with Duolingo is the ability to redo lessons makes users focus on the points instead of the learning goal. Since users already completed the lessons and are familiar with them, they can complete them quickly and earn quick and easy points to get higher on the leader boards. A reward system like this should not reduce the intrinsic motivation of learning a language because the extrinsic motivation to earn points is increased. No literature proof has been found on this; it is personal experience from using the application. Future research could be done in the direction of what gamification aspects are hindering the studying more than helping.

### 2.2.3. Kahoot

Kahoot is not a standalone program but a tool. It is used in combination with a physical classroom. On the beamer/smartboard, a quiz will appear with multiple choice answers. Students can answer questions on their phones. If you are correct, you get points determined by how quickly you answered. At the end of the questions, the top 5 students are represented with their scores. This application is rather simple, but the friendly competition and little quizzes are very effective at motivating students in participating since the names of the top 5 get displayed on the beamer/smartboard. The functionality is far from my design, but the simplistic yet effective implementation of quizzes is a good example.

### 2.2.4. Minecraft Education Edition

Minecraft Education Edition uses a special version of Minecraft to teach about shape, math, locations, volume, area, and more. In this, the teacher is given tools to make their own stories to tell kids about the topics. This product requires the teacher to design their course (The existing worlds are limited), it requires effort and time to set up for each new lesson/world but allows for greater freedom since the teacher can make anything in the game, limited by the variety of blocks in the game. On top of the game allows for strong collaboration between students in problem-solving. The 3d virtual sandbox environment gives students a dynamic and interesting learning experience.

### 2.2.5. Ruby Warrior

Ruby Warrior is an online game made to teach people about artificial intelligence and Ruby language. It does this via levels represented on floors of a tower the user has to climb. On every floor, the user has to write a script to control the warrior to solve the level. The user must give the warrior enough artificial intelligence to act. The user knows what each level contains, but not exactly what will happen. The game uses levels/challenges in combination with a scoring system. A user can get a high score by defeating enemies, rescuing a captive, passing the level in a certain time, and a final bonus for beating all enemies and rescuing all captives.

### 2.2.6. CodeCombat

CodeCombat is a game where users learn about coding languages such as JavaScript and Python in combination with the fundamentals of computer science. This is mainly for junior developers. It is similar to Ruby Warrior when you type code to solve levels. In this game, you get awarded points for

completing the level. Each level has an optimal score the user could try to reach. This score (shown by a little bar) incentivizes users to complete the level with few steps as possible (which gives them a better understanding of the code). For completing levels you can get points to buy items, which you can put on your character. This personalization in combination with the big level screen gives the game a very fun tool to learn to code.

### 2.2.7. Discussion State of the Art

The previously found working examples have been plotted against different persuasion techniques from the PSD model in table 1. If the example contains the technique in some sort of way it is marked with 'yes', otherwise the cell is left blank. The examples are plotted against persuasion techniques instead of gamification elements as the PSD model is broader and contains more approaches to motivating users.

| | Udemy/ Coursera | Duolingo | Ruby Warrior/ CodeCombat | Minecraft Education Edition | Kahoot |
|---|---|---|---|---|---|
| Tunnelling | Yes | Yes | Yes | | Yes |
| Personalization | | | Yes | Yes | |
| Self-Monitoring | Yes | Yes | Yes | Yes | Yes |
| Rehearsal | Yes | Yes | Yes | | |
| Rewards | | Yes | Yes | Yes | Yes |
| Liking | | | Yes | Yes | |
| Praise | | Yes | Yes | Yes | |
| Social learning | | | | Yes | Yes |
| Social Comparison | | Yes | Yes | Yes | Yes |
| Competition | | Yes | | Yes | Yes |

*Table 1: Persuasion techniques contained in State of the Art examples*

Table 1 is noted that popular platforms to host MOOCs Udemy/Coursera don't contain many persuasion techniques. They only guide their users throughout the vast amount of lessons where the user can keep track of which ones they finished. The user can go back to redo these lessons for rehearsal. Compared to more motivating examples such as Duolingo, Ruby Warrior/CodeCombat, and Minecraft.

Duolingo is more motivating than Udemy and Coursera as it contains a lot of additional elements to praise and reward users via gamification elements. On top of that, it contains a leader board where users can perform a limited amount of social competition and comparison. These social elements are not as strong as examples that allow users to participate together in real-time, such as in Minecraft and Kahoot. The drawback of the strengthened social elements is the lower user autonomy as they can't always study whenever they prefer. For if they want to participate with other students there needs to be a schedule. In the examples with weaker or no social elements, the user can perform the studying whenever they desire.

What Duolingo lacks is a strong liking in the form of visuals and sounds such as Ruby Warrior/CodeCombat and Minecraft. It is the same case of personalization. Both of these persuasion techniques take resources to implement. A great art style costs a lot of time and effort as an artist needs to be hired and the art needs to be fitting to the whole design. When one does not want to invest in this a minimalistic design is easier to produce. Personalization in the form of player customization is also effort-consuming as shown by the literature section.

Minecraft education edition is very strong in social elements and scores quite well in the number of persuasion techniques. The aspect that is not portrayed in the table is the ability to implement a MOOC in the type of idea. Within the game, it is almost impossible to reset a level that allows users to rehearse lessons. Minecraft Education Edition as a platform could physically not host the integration of a MOOC as the game can't integrate the API of platforms on which existing MOOCs are based (a requirement set by the client, this will further be discussed in the next chapter).

Derived from the table is that there are a lot of chances in the existing examples for the addition of extra persuasion techniques. These examples will be used as base ideas in the concept generation section of the next chapter, and the results from this State of the Art is used to grade concepts in the concept condensing section.

# 3. Requirements Capture and Concept Generation

This chapter focuses on capturing the requirements of the e-learning system. These are generated via an initial interview and the problem statement written by the client. They are further expanded via use-cases that the client reviews and comments on. Furthermore, all persons directly or indirectly involved with the project will be investigated via a stakeholder analysis. From this analysis, it is concluded that the actual end user's demographics are partially undefined. These are fundamental for designing the system as they have to use it, so the design should fit the user's needs and likings. Via user research in the form of 6 personas, these stakeholders are defined. The ideas of the brainstorming session are described and methods of condensing the ideas into a single concept are described. The chapter is rounded off with the final design specifications in the form of a high-level design overview and a list of final requirements.

## 3.1. Initial Requirements

After an interview about the specifications with the client, Cumlaude, numerous requirements for the design were established:

•The system needs to be built around one or multiple pre-existing MOOCs, which means the system needs to be able to play videos and display quizzes. Some platforms for hosting MOOCs offer a partner API to integrate functionality with external developers. Via this API the MOOCs would be able to be integrated into this design. Both Udemy and Coursera, two of the bigger platforms, offer this to partners [21][22].

•A second requirement is that the clients should be able to add or remove new courses to the program. The client should be able to change the order of the videos shown or insert new ones somewhere arbitrarily in the course. The client should be able to create their exercises and integrates these into the program. The system should therefore be modular.

•A Third requirement is that the program should be able to house study material worth six months. A fourth requirement is that the program will be completely software-based and should be able to be run as a web app or as an executable.

•Students should be able to submit work in the design. Students should be able to correct other students' work via peer-to-peer feedback.

•The design should not incorporate a platform for employees of the client to correct student submissions.

## 3.2. Stakeholder Analysis

Stakeholder analysis is performed to explore requirements for the e-learning system further. Every person involved has their wishes for what functions the system should be able to achieve. By analysing who has involved a more accurate description of what tasks the system should be able to achieve. The motivation of stakeholders and their connections to other stakeholders will be explored.

| Stakeholder | Description | Interest | Influence |
|---|---|---|---|
| **End-user (Student)** | A student who studies at Cumlaude University in the future. They are already certain they like the subject and want to work in the field of data science. This is guaranteed by the recruitment process before interaction with the e-learning system. Since the student is the actual end-user, the user group needs to be researched for their demographic. The students will use the program the most so the program needs to be acceptable to them. The end users will be explored in a later section via personas. | high | low |
| **Client (Cumlaude)** | The client Cumlaude is the owner of the e-learning system. They have a vision of the project and have financial interests in it. Recruiting students via both online and offline marketing and via client companies is part of their role. They dictate what study material goes into the course of the e-learning system via a course organizer. There is also an employee who manages potential assignments done by students in the e-learning environment. | high | high |
| **Course Organiser** | An employee of Cumlaude who will create and manage the six-month study. This thesis only contains the earlier design and prototype phases. The course content in the prototype will be designed by the designer as the emphasis is not on the course material, but on developing the e-learning system. The course will be organized while the e-learning system is developed fully in later phases beyond the scope of this project. The designer will not have direct communication with the course organizer. | low | low |
| **Corrector** | An employee of Cumlaude who will correct students' work and gives feedback. They will correct via the Learning Management System, which is a separate project from this e-learning system. Therefore there will be no direct interaction between them and the designer. They will directly interact with students to correct and client. | low | low |
| **Client Company** | Client company containing employees to be trained at CU. These stakeholders have no meaningful effects on the design since they never directly interact with the design. They indirectly want an effective design as they have students that need to be trained in the e-learning | low | low |

| | | | |
|---|---|---|---|
| | system. | | |
| **Designer** | The designer's responsibility is to design an e-learning system that is acceptable to all the stakeholders involved. During different phases of the design, the client and potential students are consulted. Potential students are people who have the same demographic as the actual students. Actual students aren't used as they are only students in the future when they sign up with Cumlaude. To test the system for user acceptance, potential students are used instead. | medium | high |

*Table 2: stakeholder description and level of interest and influence*

In a nutshell, the primary stakeholders to consider along the different phases of the design are the end-users and the client. The client has financial interests in the project and has a vision for it. Students are the actual end-users, meaning the system needs to be tailored to their liking. The other stakeholders' needs will be incorporated without their direct input as they have not much influence over the design or they are (future) employees of the client. Since the end-users are undefined a study needs to be performed to discover their demographic.

## 3.3. End User demographics

To get an accurate depiction of the end users, personas are developed that represent the end users. Miaskiewicz points out the benefit of using personas in user-centred design. "*The most significant benefit of personas is their ability to focus product design teams on the actual goals of the target customers. Instead of talking about general 'consumers', personas bring the target consumers to life and help to integrate their needs and goals as a central driver of design processes*" [19]. Furthermore, this increased audience-focused design process leads to overcoming the disconnect between the designer and end-user. Since general consumers are humanized into actual people, the designer can more accurately design aspects for them as it is easier to sympathise with individual people than with the concept of age groups or other abstract demographic aspects.

The six personas are verified and corrected by the client, who already teaches the field of data science to their clients. As they are already integrated into the field they have an expert opinion of the demographic and therefore can validate the accuracy of the personas. The first four personas represent typical edge cases of the range of end-users, while the last two personas are the most typical and most common end-users.

According to the expert opinions of Cumlaude, about 80% of their clients who would be considered end-users fall somewhere in the range of personas. This is the core of end-users and should be focused on when designing the e-learning system. The other 20% are more varied: they are older than 35 years or have more foreign backgrounds. An important demographical limitation set by the client is that all of the user group resides in the Netherlands and preferably around the Randstad or in travel distance of it. The system can't be designed for every type of client as when a design is tailored to everyone there is no tailoring. The full personas can be found in "Appendix A: Personas". A synopsis of the estimated users can be found below. This synopsis is based on both additional demographical data from the client and the personas.

•Average age is between 23 and 35 years.
•Not all students necessarily have a technical aptitude. This means that the user group has at least basic technology handling skills.
•Appr. 36% Of the candidates are Women.
•Students have MBO or higher in terms of education.
•All users reside in the Netherlands and can speak Dutch.
•All users live in urban residents.
•The majority have a Dutch background and come from the middle classes.
•Motivations include current job disappearing in the future, making a career switch, wanting an affordable education, wanting to improve their skillset, or a promotion. The most common is that no job can be found in their current field or just wishing to get extra training for their job interests.

The most important take-away from the user study is that the end-user's age and technical aptitude guarantee that they can handle everyday technology like phones and desktops competently and confidentially. This is amplified by the fact that if the system is deployed in 5 years then the users would be 18 and 30 as of this writing. The confidence with technology means users have good visual recognizability of different GUI aspects. A tutorial about the functionality of the buttons and other elements is therefore not necessary. (Unless it is discovered during the iteration phase that the users need it. This will most likely be found out in iteration 0 or the succeeding iteration) Since all the important stakeholders are now well defined more system requirements can be formulated in the form of use cases.

## 3.4. Use Cases

Via a second interview with the client, a list of use cases was established. Use cases are useful in gathering the requirements of a system [20]. These requirements are largely focused on the system's design and not on technical aspects. Use-cases wouldn't describe what code language would be used for the project. With a complete list of all use-cases, a complete list of all the design requirements is given. All functionality requirements can then be incorporated into the design by realizing a design that fulfils all use-cases. Below is a list of all the generated use cases. Important to note is that not all previously-identified stakeholders have use-cases as it was determined that these stakeholders have no direct interaction with the design. Only the primary users have use-cases.

**Student-related use-cases:**
A student can only do one lesson at the start.
A student can later branch out into differently themed courses.
A student could start any available modules from the start and follow lessons via a linear path.
A student can start any module with one starting lesson.
A student unlocks a lesson once they complete the lesson before it.
A student completes a module once they complete the final lesson in the module.
A student can choose to return to a previously finished lesson to refresh himself.
A user must complete all courses to complete CU (Cumlaude University).

A student could reach different badges for completing different courses/modules in CU.
A student could get different optional badges by completing optional requirements.
*(These requirements could range from doing 10 lessons in a day to completing a set of avatar*

*customization.)*

A student must complete lessons in specific timeframes.
A student must complete lessons before deadlines set by a course organizer.

A student should be motivated to study at least once per day.
A student should be motivated to study as much as possible on a day.
A student should receive feedback within a specific timeframe set by the course organizer.
A student should receive and give feedback via peer-to-peer correction.

*(This might be good for more interaction between students, which is good for motivation. On the other hand, this might put more work/stress on the students)*

Students could be able to compete in a fun way that isn't direct competition.
Students could be able to compete in some sort of weekly leader boards.
Students can get points for completing lessons successfully.
A student should be able to skip gamification elements if they are obtrusive to their learning style.

*(like a big avatar creation menu)*

**Corrector-related use-cases:**

A corrector should correct student work within a specific timeframe.
A corrector could give points to users depending on the quality of the student's submission.
A course organizer should be able to add or remove lessons/courses.
A course organizer should be able to add new lessons/courses.

*(E.g. It should be modular)*

A decent number of use cases have been developed. These use cases are used to develop the final system requirements in chapter 4.

## 3.5. Concept Generation and condensing

Before creating a design with the use cases, a brainstorming session is performed to create ideas for the design. These ideas then need to be condensed into a single design. These steps will be performed with the Six Thinking Hats technique [23]. The importance of the brainstorming session is generating concepts regardless of the pre-requisites. Therefore only the green hat will be worn. This hat symbolizes creativity. Search for new ideas regardless of how good or bad they sound. Then in the condensing phase, the black hat will be worn. This hat stands for being critical. Ideas will be sifted with a critical eye depending on several factors.

### Idea 1 Lootboxes

The idea is based on Lootboxes, which can be found in several modern online games. At the end of a game session, the user gets a box or chest. This chest generates random items with varying functionalities and rarities. The functionalities include aesthetical skins used for customization, exclusive weapons or armour, new music tracks, backgrounds, and display-able icons. The rarities range is usually tiered: common, uncommon, rare, etc. lootboxes have yet to be adapted to gamification, but research has proven that they can be effective at gamifying non-gaming contexts [24].

### Idea 2 Magic the Gathering

Collect cards as lessons are completed. These carts could be used in a card game against other

players in friendly competitions (Heart Stone) or monsters/going through a dungeon (Dungeon Cards).

### Idea 3 Streak per day/Combo per lesson

Streak symbolizes the intermediate steps of the lesson and makes it satisfying to complete a lesson with a playful progress bar. Experience bar (and levels) to signify progressive clearly and playfully to the user. Once a set of classes has been completed the user could achieve a certain rank (bronze, silver, gold, platinum). There could be a mentor rank for people who have completed the courses. They could maybe help out others in some way. A streak could be used to incentivize people coming back for more. The streak works well for small tasks that are preferably done daily. This idea is inspired by Duolingo from the state of the art.

After completing a lesson the user would get a puzzle piece. This puzzle piece could be placed on a board for the user to slowly fill in as lessons in the course are completed. This idea can be elaborated by having each puzzle piece have a fixed position. Once a lesson is completed and a puzzle piece is placed nearby spaces that are empty corresponding to new lessons could be done.
This could be expanded into an AI distorted painting. At the start it is abstract, and slowly it becomes more clear and defined what the original picture is. The intrinsic motivation is seeing what the picture is, in the end, would motivate users to keep doing lessons. Maybe tell the client who is going to do the courses that there is a picture that fits him somehow. This would provide motivation and curiosity for the user if it slowly appears.

### Idea 5 Battle AI

Place characters down in small 1 minute battles. These characters are won from completing lessons in the course. You can then put them down on the battlefield. There would be offensive and defensive tactics one could employ with different characters. The characters would move by themselves when a battle started.

This could be combined with ranks or tournaments to have meaning to winning. Turn-based gameplay could also be done where you have to earn moves (and maybe form pacts)

A twist on this could be company A vs company B. Where the two companies will duel against each other, creating more collaboration within the company.

### Idea 6 Maquette

This idea is a continuation of the previous idea. The battles could be visualized on a big physical maquette/board. The playing field would be big enough to house all players. This physical maquette could be housed at the place Cumlaude University is located.

### Idea 7 Platformer Elements

A platformer in combination with steps to do in the lesson, like Super Mario. Present some of the steps as moves you could do or somewhere you have to jump to. This would be specific and would cost resources to design levels per curriculum

### Idea 8 Rollercoaster Tycoon/Cookie Clicker

Data visualizer game where you have to build dashboards. If the dashboard has certain criteria it could get a higher score, which results in a lot of clients buying it. Make it fun in the same way that Zoo Tycoon or Rollercoaster Tycoon is so fun. A lot of clients are buying it so you get a high multiplier

for a high score. The user would get taught why and how the dashboards are successful and the possible criteria. So, it would become a game of building the dashboard with the best high score. Players would be faced with the challenge of maintaining the operation of their dashboards while trying to improve productivity, efficiency, sustainability, or other aspects that could determine a high score. This could be combined with the idea of managing a passive income like in Cookie Clicker.

### Idea 9 Minecraft World

Minecraft is a game where the intrinsic motivation stems from being lost in a world that you can call your own. creativity is one of the key aspects, since the player could have a cool idea of building a house or castle (or whatever the player can think of!) the motivation would come from wanting to see it finished. This creativity can come from numerous sources including finding a cool building block, seeing something in real life, or finding a cool view in-game.

Another one of its key elements is the randomly generated world. As a player, you don't know what you could find over the next hill, or what could be found in a cave around the corner. So, intrinsic motivation is found in exploring the unknown and the thrill of discovering landscapes.

### Idea 10 Mario World Styled Level Screen

This second key element could be used in a scenario list/ world map. I would often wonder what different worlds in Mario games would look like and make the journey through all the levels (level could be replaced with curriculum lessons) to see how it ends.

A small story could be connected to it, but this would not be modular in design unless different stories are used for different courses bundled together.

### Idea 11 Defenders

Defend your dashboard/company from invasions. There would be multiple challenges to defend yourself from the outside. Deadlines would slowly attack you from the outside and they slowly approach over time. If they aren't completed in time, part of the company/dashboard is lost as the deadlines hit your dashboard/company.

### Idea 12 Code Combat

Users would learn to make dashboards playfully. In code, combat players control the player with code. Every level is about coding the right moves. Maybe this could be translated to having to make the right dashboard on every level.

### Idea 13 Avatar as Rewards

This would work well in tandem with other ideas. The idea of customizing a character via rewards. There would be different sets that motivate to collect the whole set if the user already has 3 of the 4. Acquiring these cosmetics would be sparsely handed out to make them more special/rare.

### Idea 14 Invitation A's rewards

This is more of an external even outside of the game for if it becomes a fully-fledged Cumlaude University. The top students would get invitations to special events like a 'borrel' night. A rewarding event that wouldn't be discouraging to others who didn't make it.

### Idea 15 Kahoot

Another idea from the state of the art. Use quizzes as a friendly competition between students.

## 3.6. Concept Condensing

After a variety of concepts have been generated they are condensed methodically. This is done by evaluating them depending on various criteria. The criteria are listed below together with questions that are asked during the evaluation. The criteria are based on the requirements set by the initial requirement interview and the use case requirements and have been reviewed by the client.

| Criteria | Elaboration on criteria |
|---|---|
| Market | Is the concept unique? Is there a well-working example out there? |
| Achievability | Is the implementation realistic? |
| Costs | Are there costs to create? To maintain? To deploy? |
| Company Vision | Does the concept match up with the vision of the client? Is it professional? |
| Persona's | Would the persona accept and use it? |
| Modularity | Is the concept easily expandable? Is it easy to tweak parts? |
| Literature | Is there proof of it in literature? |
| Off the Shelf | Is it easy to buy it instead of making it? |
| Fit | Does the concept integrate with the MOOC? Thematically as well? |

*Table 3: Criteria and elaboration questions on how concepts were graded*

| | Market | Achie-vable | Costs | Vision | Persona's | Modular | Literature | Off the Shelf | fit | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Lootboxes | 1 | 4 | 2 | 1 | 2 | 4 | 1 | 1 | 3 | 19 |
| MTG cards | 1 | 2 | 3 | 1 | 3 | 4 | 3 | 1 | 2 | 20 |
| Duolingo | 4 | 5 | 5 | 4 | 3 | 5 | 5 | 4 | 4 | 39 |
| Puzzle | 2 | 5 | 5 | 2 | 4 | 5 | 2 | 3 | 4 | 32 |
| Battle AI | 3 | 2 | 3 | 4 | 4 | 5 | 3 | 2 | 3 | 29 |
| Maquette | 3 | 4 | 2 | 5 | 5 | 3 | 4 | 1 | 2 | 29 |
| Platformer | 2 | 2 | 1 | 2 | 3 | 1 | 4 | 1 | 1 | 17 |
| Cookie Clicker | 1 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 3 | 18 |
| Minecraft | 3 | 1 | 1 | 1 | 4 | 1 | 4 | 3 | 1 | 19 |
| Level Screen | 5 | 5 | 4 | 4 | 5 | 4 | 5 | 3 | 4 | 39 |
| Defenders | 4 | 3 | 2 | 4 | 4 | 3 | 3 | 3 | 4 | 30 |
| Code Warrior | 5 | 1 | 1 | 4 | 5 | 2 | 5 | 1 | 5 | 29 |
| Avatar | 5 | 3 | 3 | 4 | 4 | 4 | 1 | 2 | 3 | 29 |
| Invitation A's | 3 | 5 | 2 | 5 | 2 | 5 | 2 | 5 | 2 | 31 |
| Kahoot | 4 | 5 | 4 | 5 | 3 | 4 | 5 | 4 | 5 | 39 |

*Table 4: grading of concepts based on criteria from Table 1*

In the rest of this section, the results of table 4 are elaborated on. First, the three high-scoring ideas will be commented on, and afterwards the low-scoring ideas. Finally, the medium-scoring avatar idea is elaborated on as it is incorporated into the design.

**Duolingo** scored quite well. It is easy to develop since it is mostly a 2D interface and very modular. The concept is well-founded by literature: It uses various gamification elements and persuasion techniques effectively.

The **level screen** also scores high. With tilesets, it becomes easy to develop and modular. Tilesets allow for re-using art assets and create a level screen by putting the repeatable art assets in various formations. If new levels are added and the level screen size is doubled, the course programmer can just use the existing art to fill in the new parts of the level screen. If there wasn't a tileset, The whole image that is the level screen would have to be redrawn/expanded by an artist. This idea fits quite well with other ideas as this idea is a component

The **Kahoot** idea scored quite well since it is a small, effective, and easy-to-implement idea. However, this idea is very dependent on the number of quizzes that can be made from the study material, since the idea works well with multiple quizzes in a row. Another major drawback is for the interaction between quiz-taking students to work students need to take the quiz concurrently and be in the same physical space. Because of these drawbacks, this idea will not be incorporated into the specification of the design.

The first low-scoring idea is the **lootboxes**. This idea doesn't take much effort to implement and is modular. It is known to have persuasive elements to hook users as it borders on gamblification as well as gamification. Gamblificating has shown effectiveness in MOOCs [24]. However, lootboxes and their gamblificating effects have a major drawback. While they are used a lot in games they have been in a negative light the last couple of years. Lootboxes are considered unethical design as the gamblification becomes so addictive irresponsible users have spent a great amount of real money or time. There are two implications to this. The first one is that incorporating this idea could harm the company's image as they are unethical. The second implication is that regulations on lootboxes are not stable. 18 different EU countries have backed a report that calls for better regulation on consumer protection from lootboxes [25]. If the loot box idea is developed further, future regulations could prohibit aspects of the design.

The **MTG cards** and **platformer** ideas scored low because a whole card game or platformer needs to be designed and balanced separately, which makes the idea score low on achievability. While students play the card game or platformer they aren't studying either so it is more like studying with a separate game on the side, instead of game-like elements integrated into the studying. These ideas also do not fit the company's vision.

The **cookie clicker** idea scored low for similar reasons as the MTG cars and platformer ideas, an upside of this idea is that the client liked the idea of exponential rewards. As you spent more time the rewards get bigger and bigger, so the user is motivated to keep playing more as the numbers keep increasing. The client also thinks this aspect fits the company thematically as long as it isn't too gamified. It fits thematically because exponential distribution is a fundamental statistical distribution in data science. Cookie Clicker itself is too much of a game for the company's vision.

The **Minecraft** idea while being unique is simply unrealistic in implementation. A MOOC cannot be integrated into Minecraft's systems without suffering the design.

The **avatar** idea, while not scoring high, is also incorporated. Literature hasn't proven directly that it works in motivating students, as it isn't often used. This is not an argument against implementing it. If it is used as a reward then it can be persuasive, It especially gives more meaning to reward points by being able to buy avatar cosmetics with points. The points are not just points anymore as students can then spend them.

In conclusion, the final condensed idea is a combination of the Duolingo, level screen, avatar, and (part of) the cookie clicker idea. The best-scoring ideas are Duolingo, level screen, and Kahoot. Kahoot is difficult to implement since the project is software-bound in this phase until the design gets developed further. Kahoot is therefore not incorporated into the design. The avatar idea, while not scoring high, is also incorporated, since this could be implemented effectively with the other two ideas as a reward system. Now that an idea is chosen it can be fleshed out more into design specifications

## 3.7. High-Level Design Overview

This chapter is finished off with a high-level design overview (followed by the final requirements). This way the specifications of the system are given so it can be implemented. The high-level design overview will perform as a description of how the different menus are connected and go in-depth on the functionality of the design.

The program consists of multiple menu screens. After a logging-in screen, the user is taken to the main menu. The **main menu** contains a top bar with buttons for different other screens. The items on the top bar are a log-out button, a shop button, and a progress button. These buttons take the user to their respective menus. Below the top bar is the space background. This background consists of a tileset and not a single image. The tileset consists of multiple smaller square images that tile with the other images in the tileset. Some contain just the night sky while others contain different arrangements of stars. These tiles can be put next to each other in random formations to create variation in the background without having to redraw the entire background if something needs to be changed. The tilesets allow for modularity that single-image backgrounds don't allow for.

In front of the background are the player's space rocket and multiple planets. The player space rocket represents the player. The player can customize this rocket with different parts in the shop menu. Each planet represents a new lesson. Clicking on a planet will make the rocket fly to it. A prompt will also appear with a description of the lesson, a button to start the lesson, and a description of the number of gems. These gems will be rewarded to the player when they finish the lesson. If the user clicks on the continue button they will start the lesson on the lesson screen.

On the **lesson screen,** the video of the MOOC is displayed. For the user to continue to the next screen they have to watch the video. After the video has been finished the user can press the continue button to go to the progress menu. The continue button is greyed out as long as the user hasn't finished the video. If the user presses the continue button they are rewarded with the promised gems and their amount of lessons on that day is incremented. If this is their first lesson of the day then the streak is incremented. The lesson screen can have variations with different study activities. Quizzes or exercises could be displayed as well as videos.

The **progress screen** can be reached in two different ways. The first way is via the lesson screen while the second way is by pressing the progress button on the top bar of the main menu. On the progress screen, the progress of rewards is displayed. On the top left is the streak of the player (which is represented with a crown icon) and a stimulating message to keep coming back every day. On the bottom left the amount of gems is displayed (which is represented with a gem icon). On the bottom right, the current and future multipliers are displayed. This multiplayer is based on how many lessons the user has done. If the user has done only one lesson they get a 1.0 multiplier on

their gems. With two lessons x1.5, three lessons x2.0, all the way up to x4.0. This system rewards users for doing multiple lessons on a given day. The multiplayer is applied to the gem rewards from the lessons. On the top right there is a line graph to visualize the number of gems the user got each day of the past week. On the bottom, there is a continue button to go to the main menu.

From the main menu, the user can go to the **shop screen**. The shop screen contains a list (with scrollbar) for all the different ship pieces the user can purchase and equip on the left. On the top right, the ship of the user is displayed. The user can click on any item in the list to make the rocket update it, but if the user hasn't unlocked it won't stay equipped when going back to the main menu. Once an unpurchased item has been selected. The user can buy it if they have the required amount of gems with a purchase button. The user can go back to the main menu with the back button.

## 3.8. Final Requirements

Below is given a list of final requirements in the form of a list of final features. These features are arranged via the MoSCoW method. The MoSCoW method categorizes the requirements as Must-have, Should-have, Could-have, and Will-not-have (at this time) [27]. The requirements in the must-have category have the highest priority and must be implemented for the system to be functional. The should-have category contains requirements that are a little less important. The could-have requirements are even less important. They will-not-have requirements that are part of the design not be implemented.

**Must-have:**
- A linear layout representation of lessons.
- Integration of video-type lessons
- A gem reward system that rewards gems for completing lessons.
- A streak reward system that rewards users for using the system multiple days in a row.
- A multiplier reward system that rewards users for completing more lessons on a given day.
- A way to load and save progress between sessions.

**Should-have:**
- Art direction that makes users feel like they are exploring space as they learn.
- Customizable rocket ship acting as a player avatar.
- Integration of quiz-questions type lessons

**Could-have:**
- A badges reward system for achieving milestones.

**Will-not-have:**
- Integration of hand-in assignment type lessons
- Being able to see other players' rocket ships and progress.
- Correction system for correctors.
- Peer-to-peer feedback
- Ability to access multiple MOOCs

In conclusion, this chapter underlined the process of initial requirements to final requirements. This process involved stakeholder analysis, from which was discovered that a user study needed to be done. Via personas, the user was better defined. With the user in mind, a brainstorming session was

held which resulted in 15 ideas. These ideas were condensed methodically into one idea. Finally, the idea was fleshed out via a high-level design overview and a list of final requirements.

# 4. Realization

In this chapter, the realization of the design is discussed. The design is developed via iterative design [35] in combination with codesign. In standard software development, the waterfall method or the V-shaped method is used. In iterative design, the development is like a loop. Where every loop is a small realization and evaluation of its own. The results of the previous loop are used to make the next loop better. For this reason, the first loop is very resource-light to make it so that if the iteration is deemed unacceptable during evaluation it can be redesigned/discarded easily without having wasted much time or effort. The loops can slowly cost more resources as more certainty on features is introduced and the design is more polished [33]. The codesign comes into play as potential end-users and the client are asked for feedback on the different iterations.

Three different iterations are performed in the realization process. The first iteration is a lo-fi prototype that is evaluated with the client and a potential end user via the thinking aloud method. The second iteration is three smaller iterations all performed during the development of the hi-fi prototype. These smaller iterations are also evaluated with a potential end-user via the thinking aloud method. The final iteration, the hi-fi prototype, is evaluated by 4 potential end-users over 5 days followed up with a structured interview.

## 4.1. Iteration 1 (Lo-fi Prototype)

Now that the high-level design overview and the final requirements are developed, the next step is to develop a lo-fi prototype. The easier and cheaper it is to make, the better. The goal of the prototype is to be able to get feedback from the client and potential end-users quickly. These potential end-users would be compared to the personas to evaluate if they are appropriate for representing an end-user. If a major part of the prototype is rejected, it can be redesigned quickly. This prototype is developed via the pen-and-paper method, in which the application is drawn out on paper and written out with a pen. It is evaluated by the client and potential end-users with the thinking aloud method.

### 4.1.1. Implementation of a lo-fi prototype

They are shown the prototype and asked to interact with it while saying out loud what they think. This can show problems or inconsistencies early into the design process without having put much time and effort into an existing into coding a design. Basic functionality can be recreated. If the user ‘clicks’ on a button to go to a page, the paper with this new page will be shown to the user.

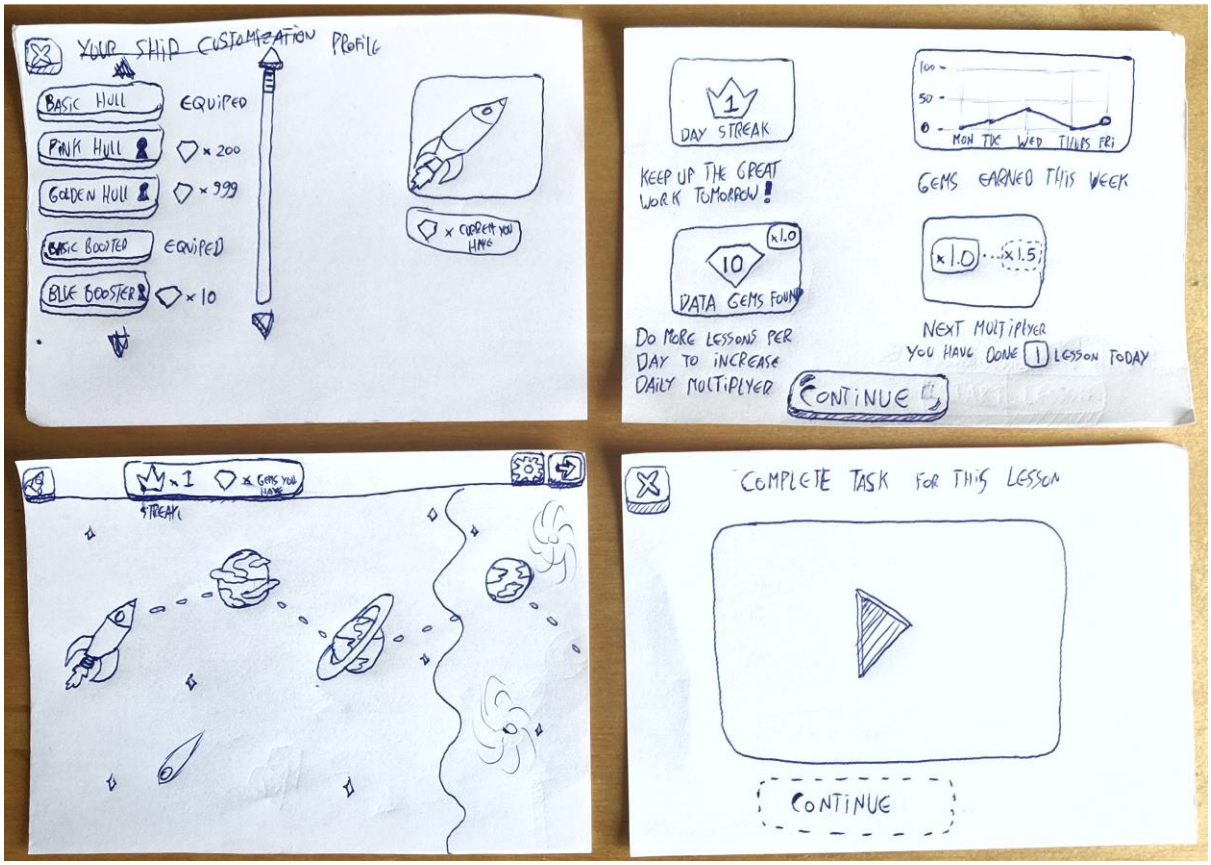


*Figure 2: Elements of the Lo-fi Prototype. From top-left to bottom-right: The shop screen, The progress screen, the main menu, and the lesson screen.*

The goal of this iteration is to get acceptance from the client and feedback from a potential end-user. Figure 2 shows the pen and paper prototype. Only the basic functionality of the system is portrayed. Menus that are worked out are the main menu, shop screen, progress screen, and lesson screen. If the user clicks on a screen that is not made they are shown an 'under-construction' screen. Furthermore, there are small cut-outs that can be overlayed for certain components such as different gem amounts, a lesson prompt when clicking on a planet, and different values on the progress screen.

### 4.1.2. Requirements for lo-fi prototype

Table 5 is a list of the system requirements from section 4.1.2. Requirements that made it into the prototype are marked green, while the requirements that we're unable to be implemented are red.

| | **Must-have:** |
|---|---|
| | - A mockup of the main menu with a linear layout representation of lessons. |
| | - A mockup of the lesson screen with a mockup video |
| | - A gem reward system that rewards gems for completing lessons. |
| | - A streak reward system that rewards users for using the system multiple days in a row. |
| | - A multiplier reward system that rewards users for completing more lessons on a given day. |
| | - A mockup of the progress screen that displays rewards to the user. |
| | **Should-have:** |
| | - Art direction that makes users feel like they are exploring space as they learn. |

| | |
|---|---|
| | - A mockup of the shop screen with a customizable rocket ship acting as a player avatar. |
| | **Could-have:** |
| | - A badges reward system for achieving milestones. |
| | **Will-not-have:** |
| | - Functional video playability. |
| | - Integration of hand-in assignment or quiz-question type lessons |
| | - Being able to see other players' rocket ships and progress. |
| | - Correction system for correctors. |
| | - Peer-to-peer feedback |
| | - Functionality that is not illustrative |

*Table 5: final requirement fulfilment of lo-fi prototype.*

All the must-have requirements are implemented. From the should-have requirements, there are two missing requirements. The art direction is not portrayed in the lo-fi prototype, since it is a quick and dirty prototype and a proper art direction takes time. The only could-have requirement, which is the badge system, hasn't been implemented. This is not an issue as the basic functionality of the gamification aspects and menus can be conveyed. None of the will-not-have requirements are implemented for obvious reasons.

Based on this brief analysis it can be concluded that the basic functionality is implemented and can be conveyed to the client and potential end-user during evaluation.

### 4.1.3. Evaluation of lo-fi prototype.

From evaluation, it was found that the client accepted the design and would like to have it developed further as it is in its current state. They in particular liked the gem multiplier and the concept of exploring space via an evolving background as the user completes lessons. Since this last concept is particularly liked it will be explored with extra detail in the next two iterations. From this iteration, the following changes are made to the specification:

- Write streak and gems in the main menu on the top bar and make the progress menu button separate
  (these were previously combined)
- Remove the scrollbar as it feels clunky. Replace it with a click and drag feature with the mouse.
- Rename "shop/customization" to just "shop"
- Make the levels in the level screen less uniform in a placement to create a more dynamic level layout.
- Unify the continue and back buttons more in terms of placement, text, and future iterations colour. Users would recognize the button functionality better because the position and size is shared.
- Add social comparison by making other users close to you visible, These would be 10 lessons in front and 10 lessons behind you. Users shouldn't get demotivated by people too far in front of them.
  And users should know there aren't users far ahead who are looking down on them. So users can see other users who have similar progress. Their customized rockets are displayed together with their name. Their position signifies how far they are with the lessons. Another extension of this is that they could set a badge to show to other players as a trophy.

In conclusion, the system seemed easy to use and apart from a few inconsistencies easy to understand. These inconsistencies will be tweaked in the next iteration. When asked, the users found it engaging to use and imagined that it would make watching videos of a MOOC more motivating due to the gamification elements. The persuasive elements such as rewards (gems, streak), tailoring (rocket ship customization), and praise (encouraging messages on progress screen) seem to work in motivating students. A new persuasive design principle was added to the specification. By using social comparison in the form of being able to see other rocket ships in space the system is more social as users can see other users in the system. This is hard to realize in these prototypes, so developing and evaluating it falls out of the scope of this project and should be considered in the future. The system will be made more usable in the coming iterations as the system gets more realized.

## 4.2. Iteration 2: Interface Improvements

The second iteration consists of multiple smaller iterations in between Iterations 1 and 3. This iteration consists of developing the system in Unity and engaging the user more tightly in the developed process. The final Unity design is evaluated as the third iteration in the next section. In that section, the specifications of the design are also further explained. With every instance of a completed menu, a potential end-user is asked for their input via the thinking aloud method while interacting with the menu. It is made sure that the same end-user is never asked for their input twice throughout the experiment to avoid bias of knowing the system from a previous iteration. There are three smaller iterations in this iteration to evaluate the main menu, progress screen, and shop screen.

From **evaluating the main menu** it was found that the button highlight colour needs to change to a more active colour. The highlight colour was green, a bright orange activates a feeling of activeness and energy and would be more fitting for users to gravitate toward clicking the buttons [29]. They fit well with the blue/purple colours that are already present since orange is blue's complementary colour. The second tweak is the addition of flags on the planets that have been completed. This way the user can see what lessons the user has completed more clearly. The third specification tweak is the addition of an options menu. The user found that the prompt for starting a lesson was hard to read, so they suggested an options menu for different text scaling options for users. This way the user can customize the interface more to their liking. This can be expanded further by adding accessibility options for colour-blind people. A fourth and final tweak is to make different planet aesthetics dependent on the number of gems they give, which is dependent on the length of the video. Planets with one ring signify that the video is longer than 5 minutes and that the user gets 20 or more gems instead of the regular 10 (not factoring in the multiplier).

From **evaluating the progress menu** it was found that it wasn't clear to the user how many gems they had gotten on this particular screen. To fix this the received gems * multiplier was added to the top left of the total gems. A second tweak is that the potential end-user found it unclear what the crown + number meant since it wasn't explained underneath similar to the gems and multiplier. To fix this a description mentions the functionality in this message if they have a streak of 0. If they have a streak of 1 it will praise the user and explain it. In higher streaks the user will receive just a praise message as then the user will recognize the icon.

From **evaluating the shop menu** it was found that this menu was rather unclear in functionality due to the cluttering amount of buttons and lack of explanation. Due to the whole system being finished (this was the final screen to be finished) and DUE to time limitations, this screen is not redesigned. However, a tweak was made to make the menu clear by adding a description of how the menu works.

For future recommendations, it would be appropriate to redesign parts of the shop menu. The main issue is that all the buttons feel cluttering and overwhelming when glancing at the screen after arriving at it. Every individual rocket ship item has its buy button with the price on it. This could be unified into a singular purchase button next to the total gems of the user. The buttons to select the ship pieces should have a darker colour to signify that they are not unlocked yet. If one of these is pressed the preview still gets updated, but on the button to return to the main menu it shows a message: “You haven’t unlocked these ship pieces, your ship will revert unpurchased items if you continue.” The selected item will get highlighted in the list and the purchase button text is updated with the amount to be paid if the user presses it.

In conclusion, the three different mini iterations received mainly feedback on little tweaks to the menus to make the system more user-friendly in combination with two major changes to the specifications. The first major change to the specification is an options menu with accessibility options. Possible options include text size, colour blind options, resolution options, and a volume slider. The second major change is a redesign of the shop screen. While the screen is functional, the transparency of the functionality suffers from too many buttons that clutter up the screen. This can be redesigned with a singular purchase button that purchases the selected item in the list.

## 4.3. Iteration 3 (Hi-fi Prototype)

The final prototype is a fully developed version of the mini iterations. First, some of the technicalities are explained, followed by the actual implementation, followed by remarks on the requirement fulfilment afterwards.

### 4.3.1. Implementation Hi-fi Prototype

This iteration and the previous are developed in Unity in the programming language of C# and use Object-Oriented Design. Unity is a game engine that has a lot of the framework for interface development implemented. Using Unity allows the developer to focus more on the design aspects and less on coding the functionality of buttons, screens, controls, camera movements, and scene switching. Unity also has a feature for easy scaling of the application to the user's screen. This way the menus don’t look wrong on a desktop screen with a different aspect ratio. While developing the scaling feature in Unity it was kept in mind that the application is for 16:9 and 4:3 aspect ratios. While the system is designed to be modular with new levels and an easy-to-edit background, the hi-fi prototype is not due to time constraints. Another reason to use Unity is that it can easily export projects so it can be run as a web app or as an executable (Windows, IOS, Linux). One Additional library that is used is TextMesh Pro [30] for extra functionality on text components. It improves Unity’s build-in text components and improves control over text formatting. In particular, the extra text styles are used to create a more pleasing aesthetic.

The prototype itself is very similar to the lo-fi prototype, but the functionality is programmed in. When a lesson is completed the gem, multiplier, and streak rewards are updated and saved in the system. Other objects that are saved in the system are the acquired rocket ship pieces, their progress in the videos, and the last-played date. The last-played data is used to update the streak after the first lesson of a new session. The system loads the data when the program is starting up. In future versions, the loading would be down once the user logs in on the logging-in screen. When the user starts the program they are shown the main menu as illustrated in figure 3 and figure 4.


*Figure 3: Main Menu of the hi-fi prototype*


*Figure 4: Main Menu of the hi-fi prototype after progress has been made*

The user can use their mouse to click and drag to move the background to the left. The further the user goes to the right the more the background changes. This way the user's progress is simulated by the background changing and the increased rings on planets. This simulated progress is motivating the user along with the visual attractiveness of the system via a unified art style [26]. The user can click on a planet to open up the prompt to start a lesson (see figure 5). The prompt can be clicked away or the user can start the lesson. On the lesson screen (see figure 6). The user can then cancel the less with the back button, or watch the video by pressing the watch video button followed by pressing continue after the video has been completed.


*Figure 5: Lesson prompt of hi-fi prototype*

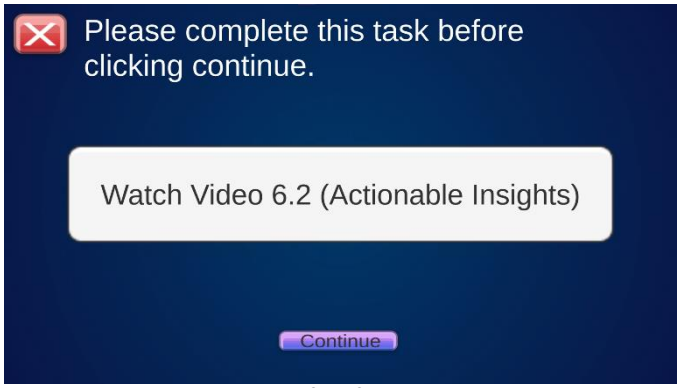


*Figure 6: Lesson screen of hi-fi prototype*

After the lesson has been completed the user is taken to the progress screen (See figure 7). The updated reward value is displayed in the panels and depending on these the descriptions underneath are dynamically updated. In the example below the user has reached the maximum multiplier of x4.0 by completing 9 lessons. They had 10 gems and got 10 x4.0 from the previous lesson, so their total is 50. A difference between this prototype and the lo-fi prototype is the lack of daily gem visualization in the top right. Since it is a complex feature to code that doesn't add much in terms of gamification elements it has been dropped in favour of time to polish out other features. The feature itself does provide an easy way for users to self-monitor their progress.

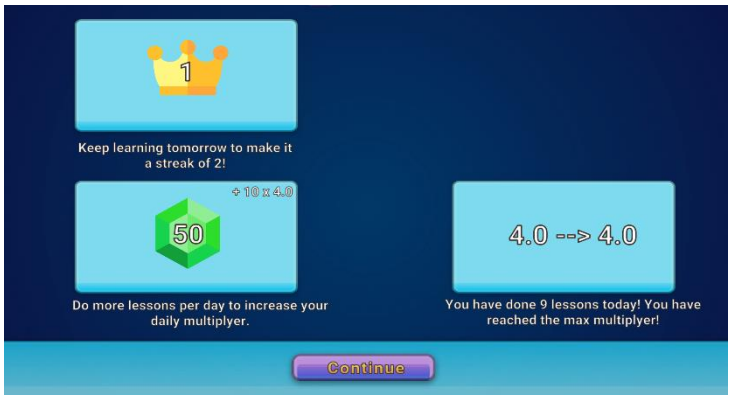


*Figure 7: Progress screen of hi-fi prototype*


*Figure 8: Shop screen of hi-fi prototype*

From the main menu, the user can click on both the progress and the shop buttons to reach their respective screens. The continue button will take them back to the main menu again. In the shop menu (see figure 8) the user can click the buttons in the left column to update their rocket ship. If they haven't bought the item then they don't get applied when the continue button is pressed. In this example, the user has all the standard items and bought the candy hull and the gold wings.

### 4.3.2. Requirements for hi-fi prototype

In this section, the requirements of the hi-fi prototype are discussed. Below is a table similar to section 4.2.2. where the requirements of the lo-fi prototype were evaluated.

| | |
|---|---|
| | **Must have:** |
| | - A functional main menu with a linear layout representation of lessons. |
| | - A functional lesson screen with the integration of video-type lessons. |
| | - A gem reward system that rewards gems for completing lessons. |
| | - A streak reward system that rewards users for using the system multiple days in a row. |
| | - A multiplier reward system that rewards users for completing more lessons on a given day. |
| | - A functional progress screen that displays rewards to the user. |
| | - A system to load and save progress between sessions. |
| | **Should have:** |
| | - Art direction that makes users feel like they are exploring space as they learn. |
| | - A functional shop screen with a customizable rocket ship acting as a player avatar. |
| | - Integration of quiz-questions type lessons |
| | **Could have:** |
| | - A badges reward system for achieving milestones. |
| | **Will not have:** |
| | - Integration of hand-in assignment type lessons |
| | - Being able to see other players' rocket ships and progress. |
| | - Correction system for correctors. |
| | - Peer-to-peer feedback |
| | - Ability to access multiple MOOCs |

*Table 6: final requirement fulfilment of lo-fi prototype.*

The functionality of the hi-fi prototype remained similar to the lo-fi prototype resulting in the requirements remaining largely similar as well. The table below illustrates the requirements of the hi-fi prototype. The most notable differences are a fully developed art direction, videos being able to be played and non-illustrative functionality being fully present when compared to the lo-fi prototype.

Not all should-have requirements are fulfilled as one should-have and one could-have requirement is not fulfilled. The uncompleted should-have requirement is the integration of quiz-type lessons. This feature could have been present by developing custom questions. The used MOOC doesn't have questions, so they would have to be developed. This functionality is non-essential as it only mixes up the actual learning part of the system by introducing questions as well as videos. The focus of evaluating this prototype is the gamification aspects, which the quizzes don't directly strengthen.

In the could-have sections, the badges reward system is not implemented due to time restrictions. Again, the will-not-have requirements are all naturally not present due to obvious reasons.

Following this requirement analysis, it can be concluded that the hi-fi prototype is almost functionally complete. All the essential functions are developed while two non-essential features are missing. This makes the prototype sufficient enough to be tested.

### 4.3.3. Evaluation of hi-fi prototype

The goal of evaluating the prototype is different from that of the previous iterations. The previous iterations focused on short-term user interaction, while the hi-fi prototype evaluation focuses on long-term interaction. More specifically, the goal is to determine if the product motivates users long-term and not just short-term. Instead of a test that lasts only one session, the test will include 5 sessions in a row. Users are asked to study with the system and aim for using the system for 15 minutes per day (more or less time is allowed). After these 5 sessions, they are interviewed on their progress and motivations. These results will be discussed along with an update to the specification.

The chosen 4 participants are all potential end-users who would fit in with the personas developed in section 3.3. Bias is avoided by not reusing participants who previously participated in previous iterations.

The questionnaire was divided into two parts. The first set of 22 questions is a mix of open and closed questions focused on the motivation and functionality of the program. The second set of 10 questions are closed questions that focus on evaluating the usability.

The first set of 22 questions is based on questions by Schell and Högberg et al. The lens of motivation is used by Schell by incorporating the related questions into the interview [33]. For example, the question "What motivations do players have to play my game?" is rephrased to "What motivates you while learning". Högberg's validated questionnaires also are used as cornerstones in formatting the questions [34]. The full questions can be found in Appendix B.

The last 10 questions are closed questions that are part of the SUS (System Usability Score) developed by Brooke [31]. Even though the SUS score has been designed in 1996 it is still a good tool today [32]. The sus score allows for a quick and dirty scoring of the usability while applying to different technologies. In particular, the questions generate a single score that is easy to interpret. how to derive the score from the questions is also explained in Appendix B.

The table below summarizes the quantitative data derived from the interview questions. The four participants (labelled as A-D for the sake of anonymity) were asked to rate how much motivation they got from different elements. These were rated from 1 (not motivated) to 5 (greatly motivated).

| Participant | A | B | C | D | Average |
|---|---|---|---|---|---|
| Days spent with the prototype | 5/5 | 5/5 | 4/5 | 1/5 | 3.0/5 |
| Number of lessons completed | 21/21 | 13/21 | 11/21 | 4/21 | 12.3/21 |
| Motivation from Streak | 3 | 4 | 3 | 1 | 2.75 |
| Motivation from Gems | 4 | 5 | 4 | 2 | 3.75 |
| Motivation from Multiplier | 5 | 4 | 5 | 1 | 3.75 |
| Motivation from rocket ship customization | 5 | 4 | 3 | 1 | 3.25 |
| Motivation from the background and art style | 4 | 5 | 4 | 3 | 4.0 |
| SUS score | 87.5 | 82.5 | 90.0 | 82.5 | 85.6 |

Table 7: quantitative results of hi-fi prototype

### Quantitative Data

Discussing the results it is found that participant A completed the entire course, participants B and C got halfway while participant D quit after 4 lessons. The first three participants performed 4 or more days, while participant D only interacted with the application for one day. This same pattern is also repeated throughout the gamification aspect motivation questions. From the quantitative data, it can be concluded that participant D is the least motivated short-term and not motivated at all long-term. An explanation for this can be found in the qualitative data. Participant D elaborated that it is hard for them to get motivated in general. This type of learning environment does not work beneficially for them as their preferred way of studying involves a physical teacher and taking notes, so this e-learning system is not designed for him them. On the other hand, this doesn't mean they didn't appreciate certain aspects. They found the art style and space exploration theme a motivating factor in the limited interactions. Furthermore, the gem rewards seemed well integrated with other rewards to motivate the intended users. This is why they rated the motivation from gems with 2 instead of 1. They rated the usability of the system excellent with a SUS score of 82.5, so they found the system easy to use.

The streak system was the least motivating gamification aspect. This can be explained for a couple of reasons. The streak system doesn't strengthen any other reward systems as it rewards users only by updating their streak. This streak increase was a motivating factor to keep coming back, but it lacked further positive consequences. It was suggested by participant A to incorporate the streak system into the gem system by giving a few gems when increasing it. This way it is more motivating to increase the streak as a more direct meaningful reward is given.

The most motivating aspect was the background art in combination with the art style. From interviews, it was found that participants were enticed to try lessons by the first impressions of the art style. Once they saw the background and planets changed by progressing they were more motivated to make more progress.

One of the big limiting factors of this experiment is the sampled participant group. 4 participants make the results less statistically significant as the results are more prone to being skewed. The

results of Participant D were greatly lower in the total average being significantly lower than the average of participants A B and C together. The other way around can be noted as well. Maybe the results are high from the lack of more results that score similar to participant D. We cannot determine from this small sample size that the results of participant D are a (far) outlier from the quantitative data. This is partly mitigated by the qualitative interview. From this interview it was found that this application is not made by participant D. The results of them were lower not because of the implementation of motivation aspects, but because these types of motivational aspects (and e-learning in general) don't motivate them. Knowing this information, it can be assumed that the data is skewed negatively because of the results of participant D.

### Qualitative Data

The rest of this chapter will focus on observations from the qualitative data. In particular, it will focus on points of improvement suggested by participants similar to previous prototype evaluations.

The first point is **deadlines** were conceived to be one of the main motivators for participants A B and C. In particular, the 5-day 'program' concluding with an interview played a big role in participants returning. While this could be perceived as a bias in motivation, it mimics the outside motivators of the program once it is deployed and used by actual end users. Actual end users in the 6-month program would have deadlines as well to make certain progress is made. Furthermore, it can be noted that deadlines were not the singular motivator to participants so the gamification elements are additional motivators to study with the program as well as deadlines.

The second point made is that the incongruency in the **multiplier lacks an icon**, while the streak and gems do have one. A proposed change is a red cross. This symbol's shape and colour make it easy to recognize from other elements in the program.

Two participants mentioned the start-up of the program being abrasive because of the **lack of an introduction**. They were quickly overwhelmed on the main menu, where the program starts when booted up. This can be fixed with the addition of an introduction screen. Something to keep in mind with this is that in a more developed version there would be a log-in screen before seeing the main menu. In such a version people would not be thrown into the main menu after booting the program.

Two participants mentions that **more gem functionality** could be introduced. Gems currently only have player customization features, this could be expanded to unlocking bonus assignments with gems. This could be expanded to unlocking streak repairs or other functional items. A streak repair could be used to fix the streak if the user misses a day. A streak freeze could be used to save your streak from resetting for one day.

One participant found the **movement** of the **main menu unintuitive**. They suggested either using arrow keys/WASD to move the screen or clicking on planets to make the camera centre around it. Another option is to hold the mouse to the edge of the screen to move it in that direction.

It was suggested to use space fog or the edge of the screen to **hide new parts of the level screen**. This would strengthen the mystery and sense of wonder of what could be beyond if the user studies more.

Additionally, **more animations** could make the art style and aesthetics more powerful. Due to time limitations, these are not developed, but they should be looked into in further versions.

When asked at the end of the interview what participants would change the new points are first to add **more interaction** in the form of peer-to-peer feedback or different type of assignments than just

videos or quizzes. Second, a **recap of the lessons** without having to rewatch the videos would be beneficial. If a participant forgot what a video contained they had to rewatch it. A small list of the contents after the video has been completed would serve as a refresher.

# 5. Evaluation

In this chapter, a summary is first given of the evaluation phases of the multiple iterations and what changes it brings to the specification. Second, The evaluations in combination with literature are used to discuss the research questions.

## 5.1. Summary Evaluations

Multiple iteration cycles were evaluated with potential end-users. These end-users would be compared to the personas to evaluate if they are appropriate for representing an end-user. The first two tests were tested with the thinking aloud method, while the last iteration was tested over the course of 5 days concluding with a structured interview. From these evaluations, the following conclusions were made.

From the first iteration, the gems and streak on the main of the user were made more prominent by giving their icon and having them displayed the same on every menu they are relevant to. This was later expanded on in the third iteration by giving the multiplier value a red cross icon to match the other two elements. The main menu changed similarly. The long scrollbar at the main menu was replaced with a click and drag, but a different user found click and drag unintuitive, so small buttons were added on the side of the screen that users can click. Additionally, users can now hold the mouse to the edge of the screen to make it move.

From the first iteration, the change was made to make the planets less straight of a path. This could be taken further in future versions by making the background also move up and down and create a level screen that is not just about going left and right. The final major change from the first iteration is the addition of displaying other users in the system with similar progress. This adds an element of social comparison to motivate users. Users could display their rocket ship and progress to other students. The minor changes of the first iteration include a lot of tweaking to the UI screens to make them consistent among the program.

During the second iteration, an options menu was added to the design. This options menu could allow options for better usability such as different screen resolutions, text sizes, volume sliders and options for colour-blind people.

During the third iteration, it was found that the streak system was not motivating enough. The change made to the design is to reward gems to the user when they increase their streak. Additionally, more meaning is given to gems by allowing users to buy streak freezes or repairs. This gives more meaning to the gems as a central reward. Furthermore, more interaction in the form of peer-to-peer feedback and different type of assignments than just videos or quizzes were added to the design. Finally, it was established a recap of completed lessons would be beneficial as a refresher to users.

From the quantitative data and qualitative data of the third iteration, it is found that 3 out of 4 users found the gamification elements motivating. It was concluded that the program was not for the fourth person as they are unable to study via e-learning platforms, so the negative assessment of the motivation from gamification aspects isn't related to the actual implementation being unmotivating in particular. 3 out of 4 participants used the program all 4 or more days while also finishing half of all the study material. The usability rated with the SUS score was 85.6, noting that the usability of the system is "Great" [31]. From this data, it can be concluded that the third iteration of the implemented design uses gamification well, with minor room for improvement.

## 5.2. Conclusions

With this information and literature, we can return to the main goal of this thesis: To answer the research questions. They are given below, each separately followed by the answers found throughout this thesis.

### How can gamification be applied to MOOCs about learning to build end-to-end data solutions?

This main research question is answered via the two underlying questions below. The first of the sub-questions focuses on the implementation of gamification in MOOCs while the second sub-question focus on how the target user group can be persuaded.

### What gamification aspects used in MOOCs increase the motivation of users in MOOCs?

From literature, it was found that Points, Leader boards, badges/medals, and levels are used the most frequently.

Furthermore, it was found from the development and evaluation of the design that the individual gamification aspects can be strengthened by combining systems. This is implemented by using a central reward such as gems acquired every lesson. There are two different rewards, multiplier and streak, that act as short-term and long-term rewards to motivate users in getting gems. The multiplier rewards people for doing more lessons in a session, resulting in more gems per lesson. The streak rewards people for doing a lesson on consecutive days by giving gems each day. Since the gems are the central reward the user is motivated short-term and long-term to increase the gems. Following this, it was discovered that the reward needs to be meaningful. If the gems don't feel like they have a purpose then a user wouldn't be motivated to collect them. In the design, the purpose is given by using the gems for player customization. The player can customize their rocket ship that can be displayed to other users (introducing a social comparison aspect). However, in the final iteration, it was found that this wasn't enough purpose for the gems so it was proposed to make users unlock extra levels/assignments. The more functionality for the gems is added, the more important collecting the gems will be for the users.

### How can people who work with data be motivated by gamification?

People's motivation can be divided into extrinsic motivation and intrinsic motivation according to the self-determination theory. In extrinsic motivation, the outside source motivates them, while intrinsic motivation is based on the user finding the activity enjoyable or interesting. The extrinsic motivation shouldn't be extreme, as then the user will have less interest in value or effort. If the user receives too much outside pressure, they aren't interested in the task themselves anymore. This

means that extrinsic motivation should not come from deadlines tight. Instead, the design should allow for more open deadlines while extrinsically motivating the user via the PSD model.

The PSD model contains different persuasive design techniques. The design techniques form the basis of gamification. For instance, a user can be rewarded (PSD model) via game points (gamification elements). Important to note with the persuasive design techniques is that they need to be tailored to the user. Therefore, a user study is recommended to cater the design to the people who work with data. Important demographics are their age, competency in technology, and education. This is used to set the tone and aesthetics of the design. Once the users are known the design of the persuasion techniques can be evaluated with end users or potential end users.

A motivating technique specifically for the user group is to create an art style and feel that caters to the users' liking. With the user group, this is a vector-based style with a colourful palette themed around space. By incorporating this playful and fun style the design makes users more motivated to explore the design and get motivated to explore the contents of the design.

# 6. Limitations and Recommendations

## 6.1. Limitations

Naturally, every research has limitations. One of the primary limitations was time. For the thesis, the planned time was 6 months. This time constraint means that parts of the design were not fully implemented. Most notably, the full design did not get realized in the hi-fi prototype. This means that the entire design is not fully evaluated. The biggest feature missing is a badge reward system. With extra time an additional iteration cycle would be implemented. Within this fourth cycle, the features and tweaks from the evaluation would be implemented and evaluated. Additionally, with more time the first and second iterations would have been evaluated more extensively with extra participants. The combined amount of the first two iterations were 5 participants, which is meagre considering they don’t all evaluate the same states of the prototype. This is not a major issue, as these evaluation goals are to collect qualitative data and this data was collected. However, it would have been beneficial to get more feedback on the design early on before it got developed into a hi-fi prototype.

A second limitation is the number of participants in the third iteration evaluation. As mentioned in the evaluation of the third iteration this low number of participants leads to statistical bias. This introduction of bias makes the quantitative results have less sense of validity to them as only 4 participants were part of the evaluation. The data doesn’t completely represent a larger target group as the data could be skewed by one participant’s results being an outlier.

A third limitation is the lack of an extensive literature review. With more avenues researched than just the PSD model and gamification, a wider outlook could have been taken on developing persuasive designs. Some of these avenues include the topics of web 2.0, e-learning strategies, persuasion through values, behavioural change techniques, and even technology as a social actor. This additional research would have given a better understanding of the role of the program for the end users. These future research topics are already recommendations for future work.

## 6.2. Recommendations

Based on the previously mentioned limitations several recommendations for future development and research are made. First, testing with more people would make the quantitative results of the interview questions more accurate and provide more qualitative results, with which the program can be improved further. Second, a fourth iteration featuring a full implementation of the updated high-level design overview is recommended. This could be evaluated with the same methods as iteration 3, but with more participants. Thirdly, it is recommended that any future prototypes are evaluated with the SUS score. It has been shown that when new features have been added the usability of the system often suffers [32].

While a developed art style has been developed, the brand or image of the client Cumlaude was not kept in mind. If the client wishes to realize the project it is recommended to alter the art style to match the identity of the client more. Furthermore, the client's vision for the far future included physical classrooms. Because of time constraints combined with this thesis only exploring early stages of physical classrooms or physical social aspects have not been researched. There might be chances to introduce physical aspects to motivate students even further.

# Literature List

1: Chiappe, A. Castillo, B.-D.-L. (2020). *"Retention in MOOCS: some key factors"*. Ensaio Avaliação e Políticas Públicas em Educação 28(109) (pp. 1-23). DOI: 10.1590/S0104-40362020002802667

2: Milosz M. Milosz, E. (2020) *"Gamification in Engineering Education – a Preliminary Literature Review,"* 2020 IEEE Global Engineering Education Conference (EDUCON). (pp. 1975-1979) doi: 10.1109/EDUCON45650.2020.9125108.

3: de Freitas, M. J. da Silva, M. M. "*Systematic literature review about gamification in MOOCs"* Open Learning: The Journal of Open, Distance and e-Learning Learning, 1–23. doi:10.1080/02680513.2020.1798221

4: Chang, J.-W., & Wei, H.-Y. (2016). *"Exploring engaging gamification mechanics in massive open online courses"*. Journal of Educational Technology & Society, 19(2), (pp. 177–203).

5: Cobos, R., & Ruiz-Garcia, J. C. (2020). *"Improving learner engagement in MOOCs using a learning intervention system: A research study in engineering education".* Computer Applications in Engineering Education. doi:10.1002/cae.22316

6: Aaron Isom (2019*)"Establishing a Data Science 101 Pedagogy"* CS6460 Educational Technology at Georgia Tech [online] Available: https://smartech.gatech.edu/handle/1853/61026

7: E. Chan (2020) *"Gamifying Data Science Education"* [online] available: https://duo.com/labs/research/gamifying-data-science-education

8: 2020 *"What is Duolingo"* [online] available: https://support.duolingo.com/hc/en-us/articles/204829090-What-is-Duolingo-

9: Koivisto, J., & Hamari, J. (2019). *"The rise of motivational information systems: A review of gamification research".* International Journal of Information Management, 45, (pp. 191–210). https://doi.org/10. 1016/j.ijinfomgt.2018.10.013

10: Vaibhav, A., & Gupta, P. (2014). *"Gamification of MOOCs for increasing user engagement*". In 2014 IEEE international conference on MOOC, innovation and technology in education (MITE) (pp. 290–295).

11: Ryan, R. M., & Deci, E. L. (2000). *"Intrinsic and extrinsic motivations: Classic definitions and new directions"*. Contemporary Educational Psychology, 25(1), (pp. 54–67). https://doi.org/10.1006/ceps.1999.1020

12: ezgin, S., & Yüzer, T. V. (2020). *"Analysing adaptive gamification design principles for online courses."* Behaviour & Information Technology, 1–17. doi:10.1080/0144929x.2020.1817559

13: Schroeder, R. C. (2021_) *"Duolingo and HelloTalk: analyzing and evaluating language learning applications using SLA theory and user feedback"* [online] available: https://www.ideals.illinois.edu/handle/2142/113036

14: Niemiec, C. P., & Ryan, R. M. (2009). *"Autonomy, competence, and relatedness in the classroom: Applying self-determination theory to educational practice".* Theory and Research in Education, 7 (2), (pp. 133–144). https://doi.org/10.1177/1477878509104318

15: Wilkowski, J., Deutsch, A., & Russell, D. M. (2014). *"Student skill and goal achievement in the mapping with google mooc"*. In Proceedings of the first ACM conference on learning@scale conference (pp. 3–10).

16: Antonaci, A., Klemke, R., Stracke, C. M., & Specht, M. (2017a). *"Gamification in moocs to enhance users' goal achievement".* In 2017 IEEE global engineering education conference, EDUCON 2017, Athens, Greece, April 25-28, 2017 (pp. 1654–1662). Retrieved from https://doi.org/10.1109/EDUCON.2017. 7943070

17: Koivisto, J. & Hamari, J. (2014). *"Demographic differences in perceived benefits from gamification".* Computers in Human Behavior. 35. 179–188. 10.1016/j.chb.2014.03.007.

18: Aydin, G. (2018). *"Effect of Demographics on Use Intention of Gamified Systems".* International Journal of Technology and Human Interaction. 14. 1-21. 10.4018/IJTHI.2018010101.

19: Miaskiewicz, T., & Kozar, K. A. (2011). "*Personas and user-centered design: How can personas benefit product design processes?*" Design Studies, 32(5), 417–430. doi:10.1016/j.destud.2011.03.003

20: Waykar, Yashwant. (2015). "*role of use case diagram in software development*". International Journal of Management and Economics.

21: Udemy Affiliate API Documentation (v2.0)[online] accessed on 03-07-2022, from: https://www.udemy.com/developers/affiliate/

22: Catalog APIs [online] accessed on 03-07-2022, from: https://build.coursera.org/app-platform/catalog/

23: Serrat, O. (2017). Wearing Six Thinking Hats. Knowledge Solutions, 615–618. doi:10.1007/978-981-10-0983-9_67

24: Lichtenberg, Sascha & Brendel, Alfred. (2020). "*Arrr you a Pirate? Towards the Gamification Element "Lootbox"."* [online] available: https://www.researchgate.net/publication/341380073_Arrr_you_a_Pirate_Towards_the_Gamification_Element_Lootbox

25: Subhan I. (2022) "*18 European countries call for better regulation of loot boxes following new report"* [online] available: https://www.eurogamer.net/18-european-countries-call-for-better-regulation-of-loot-boxes-following-new-report

26: Oinas-Kukkonen H, Harjumaa M. *"Persuasive systems design: Key issues, process model, and system features."* Communications of the Association for Information Systems 2009;24(1, Article 28).

27: A. Mader and W. Egginik, "A DESIGN PROCESS FOR CREATIVE TECHNOLOGY," 84 Enschede (the Netherlands), vol. 16, Accessed: Jul. 8, 2022. [Online]. Available: https://ris.utwente.nl/ws/portalfiles/portal/5362932/140304_ADesignProcesForCreaTe_EPDE14Authors.pdf.

28: Dai Clegg and R. Barker, Fast-track : a RAD approach. Wokingham, England ; Reading, Mass.: Addison-Wesley Pub. Co. ; Berkshire, Uk ; Redwood Shores, Ca, Usa, 1994.

29: J. McLeod Colour, 2016 "*Psychology Today*". O-Books.

30: Unity TextMeshPro [online] Available at: https://docs.unity3d.com/Manual/com.unity.textmeshpro.html

31: Brooke, J. (1996). "SUS: A *"quick and dirty" usability scale."* In P. W. Jordan, B. Thomas, B. A. Weerdmeester, & I. L. McClelland (Eds.), Usability evaluation in industry (pp. 189–194). London: Taylor & Francis.

32: Bangor, A., Kortum, P. T., & Miller, J. T. (2008). *"An Empirical Evaluation of the System Usability Scale".* International Journal of Human-Computer Interaction, 24(6), 574–594. doi:10.1080/10447310802205776

33: Jesse Schell. 2008. "*The Art of Game Design: A book of lenses*". Second Edition. CRC press.

34: Högberg, J., Hamari, J., & Wästlund, E. (2019). *"Gameful Experience Questionnaire (GAMEFULQUEST): an instrument for measuring the perceived gamefulness of system use".* User Modeling and User-Adapted Interaction. doi:10.1007/s11257-019-09223-w

35: Mader, A. H., & Dertien, E. C. (2016). Tinkering as Method in Academic Teaching. In E. Bohemia (Ed.), DS 83: Proceedings of the 18th International Conference on Engineering and Product Design Education (pp. 240-245) https://www.designsociety.org/publication/39073/tinkering_as_method_in_academic_teaching

36: Oinas-Kukkonen, Harri & Oinas-Kukkonen@oulu, Harri & Fi,. (2022). Behavior change support systems: The next frontier for web science.

# Appendix A: personas

These personas are mainly intended to sketch a picture of the users. Once a good picture has been sketched, it can be determined how the services can better suit the user. The idea is also to make the name typical for this type of person. A person feels like a Niek or Eva. Thinking in terms of characters is easier than thinking in terms of abstract properties, so characters would make it easier to understand what some users would think of ideas.

The first 4 personas are mainly for searching the boundaries of the target group. These boundaries are viewed from different angles. The last two are mainly to sketch a picture of what the typical personas of potential users are.

## 1. Persona's current job disappears

**Name:** Hendrik Jan

**Who and what is he/she:** Hendrik Jan is a man of 33 years old. He currently works as an administrative assistant (senior bookkeeper or senior controller). He has studied for this job. After he finished his studies, he immediately started working. Because he is an administrative assistant, he knows a lot of standard things about working with computers, but he has no technical training. He could learn technical things with some time and retraining. He can speak Dutch and English well and a little French. He is middle class. He has a wife and a 6-year-old child. In his spare time, he watches Netflix relax and likes cooking and playing tennis.

**Demographic:** To get to his office job, he travels +/- an hour by car. He lives in Nijkerk (a small town around the periphery) and works in Utrecht. He was born in Haarlem and also studied there. He and his wife moved to Nijkerk to live in a fairly large terraced house. In the neighbourhood where he lives, there are many terraced houses and there is quite a lot of green. It is a neighbourhood where mostly middle-class people live. His house is quite modern. But not super modern and there are a few small defects.

**Wishes and goals:** He hopes to retrain for a job that will not disappear any time soon and that will earn enough for his family. It must also be a job that challenges him and offers him the opportunity to grow. The job should also bring new challenges as he progresses in his career.

He chose data analyst as his retraining because it was close to his original training. He found Cumlaude because through colleagues who were looking for alternatives in job markets. Cumlaude was advertised there.

**Concerns and annoyances**: His concern is that the retraining/job may not exist in the future for the same reasons that his old job is disappearing. He is also reluctant because he does not know how much room there is for growth in this new career. He thinks he could find a challenge here, even if he has been doing it for a few years.

He does need some guidance, so a contact person would help him retrain.

**Quote and tone of voice:** Tone is direct, sometimes comes across as a bit blunt, just direct and fairly formal. "I want to have certainty for my future, where I can always look for challenges myself to expand my career. "

**Appearance:** A broadly built (not fat) man of 170 cm. It has lenses and a buzzcut.

## 2. Persona wants to make a career switch

**Name:** Margriet Scholten

**Who and what is he/she:** Margriet is a 23-24-year-old girl who has just finished her studies in History teaching. She was born in Winterswijk and is of Dutch origin. After she finished her study, she found out that this was not for her. She is a woman who is smart and can learn very well. She has only just started her job. During her studies, she did not think she could change. She understands things related to technology and data very quickly and is interested in learning new things that she can become proficient in using computers. This also became apparent during her history studies: she always tried to use different programmes for writing reports and once even made an installation with interactive components. e is good at Dutch and has an excellent command of French, German and English. She has no children but does have a boyfriend of 25 years. Her character is gentle and kind, but not very outspoken.

**Demographic:** She has a driving licence but a car, which his friend uses to come to work. She, therefore, has to take public transport, but occasionally she can use the car to get to work. She lives in Doetinchem and has to travel one and a half hours by public transport. By car, it is just under an hour. She lives with her boyfriend in an apartment/flat which is fairly large (for an apartment). The neighbourhood has quite a lot of green and it is a nice neighbourhood, but here and some houses are not well maintained. Furthermore, it is almost always clean, although sometimes there is a fallen sofa or chair that someone has dumped there. Most of the people living there are middle-class people, but there are also a few people living on welfare.

**Wishes and goals:** History has long been one of Margriet's passions. However, the jobs for which she is currently lined up (e.g. teacher, researcher) do not fit her profile and ambitions as well. At the same time, Margriet notes that the field of data has made enormous strides. She now has the feeling that she has missed an opportunity. During her history studies, data proved to be of increasing interest to her. In assignments, Margriet was occupied with the data aspects of research questions and paid a lot of attention to data visualisation.

She saw Cumlaude University in an online advertisement. She got through the recruitment phase and hopes to complete the training programme. She is quite sure that she will like this job because she is good with numbers.

**Concerns and annoyances**: She has concerns about being tied to a job that is not for her. She is not sure if data management is for her but thinks with her interests and background she would like to retrain. (Does she know enough to make the choice?) She also thinks it will earn her enough to support a future family and move to a bigger house in the future. She does not necessarily need guidance but a contact person can help her on her way.

**Quote and tone of voice:** The tone is formal and detailed and logically easy to follow. "I want a job that suits my interests and I can go to with pleasure. Moreover, I must earn enough to support my future. "

**Appearance:** A slender woman of 165 cm. She has a slender face with dark straight hair. She also has glasses.

## 3. Persona has no advanced education but is competent

**Name:** Amal

**Who and what is he/she:** Amal was born in the Netherlands but has an Indian background: His parents moved from India to the Netherlands because they thought there would be better opportunities for life here. Amal has done high school: He is technically gifted and can handle it well. He can study well, but especially financially it is difficult for him. His parents are lower class and earn relatively little. He thinks progressively and especially about how he can improve the future for himself and his parents. His Dutch is quite good because he grew up here, and his parents' is less so because they had to integrate. He has a good command of English and quite a bit of Indian. He has not completed his studies because he had difficulty at the time in completing them due to his home situation. He is mainly interested in geeky things and therefore spends a lot of time indoors.

**Demographic data**: Amal lives in Rotterdam in a neighbourhood where mainly low-class people live. He hopes to find an affordable education that will enable him to support himself and even offer his parents a better living environment. He currently works a small job in ICT, but that does not earn him enough. His home is a small terraced house in a social housing estate. He travels by public transport mostly when he has to be outside Amsterdam, otherwise, he takes the bicycle because it is cheaper.

**Wishes and goals**: Amal hopes to find an affordable education that will teach him technical skills for a job he can live off. He hopes that the job will make it easier for employees to accept him, as he feels that his name and background put him at a disadvantage when applying for jobs.

He hopes to use his technical qualities in his career and sees this education as an opportunity for a future with a good job.

He found Cumlaude's offer through flyers while travelling for small jobs in ICT. He wanted to seize the opportunity so he did everything he could to get through the recruitment phase. Against his expectations, he was hired and now he wants to do everything he can to complete the training programme. Because the training programme is also paid for, this is the perfect solution.

**Concerns and annoyances**: Amal has concerns about the accessibility of the training. Will he be accepted here? He is also not sure whether he will be able to complete it because of financial reasons. He should also receive guidance, especially in the earlier stages when he cannot quite get into the flow of the training. If he can prove himself through training, he thinks employees will hire him despite his background.

**Quote and tone of voice:** His tone is very precise, and many things he says could be left out. He is highly motivated but finds it difficult to articulate this to employers. "I want to have done an

education that gives me a chance of a job that gives me a future. A job that is technical because I can use computers well. There's a lot of jobs in this too."

**Appearance:** He is 23 and radiates where he comes from. He also exudes that he is technically inclined through his glasses and clothes.

## 4. Working persona wants promotion in a company and new challenges

**Name:** Leander

**Who and what is he/she:** He is a man of 29 years old. He has studied Business Administration and has been working at ING for about 4 years. He is ready for a new challenge and thinks that by retraining, he will be able to receive a promotion by being able to do more in the workplace. He does a good job because he is motivated, but in the meantime, he is looking for new challenges and opportunities in his work environment. He thinks progressively and carefully about the future before making a move. A person who dares to do things, especially after thinking out the choices. He is excellent in Dutch and English but does not like other languages. He has a lot of technical knowledge because he grew up with computers. He is middle class (but quite high); his parents are quite rich, so financially he has never had any problems. His hobbies and interests are mostly Games and Netflix in his spare time, but he also thinks cars are pretty cool, so he likes car spotting.

**Demographic data:** He lives in a reasonably large (for Dutch standards) detached house. The surroundings are also neat with lots of green in a neighbourhood that is for the richer side of the middle class. He has his car to go to his job. From his home in Haarlem to Rotterdam is only half an hour's journey.

**Wishes and goals:** His goals are to broaden his horizons in his work environment. For promotion/status and so that he has more on his margin. This makes him better in the eyes of his employers.

Therefore, he wants an education that will guarantee him new challenges and opportunities. He had a meeting with his boss about this, who suggested Cumlaude University because other employees had also received training there. After looking at Cumlaude University's website for additional information, he is sure to follow the training programme alongside his current job.

**Concerns and annoyances:** He is not sure whether this direction offers him challenges. If it provides him with new skills that he thinks he can apply in his business, this concern will ease.

**Quote and tone of voice:** His tone of voice does radiate that he is of somewhat richer descent through self-assurance and character. "I am looking for retraining that will give me more opportunities and a challenge. Retraining that broadens my horizon."

**Appearance:** He has short/medium blond hair and a typical Dutch face (clean-shaven). He is almost always neatly dressed.

## 5. Typical persona with an HBO degree

**Name:** Sjoerd

**Who and what is he/she**: He is a 26-year-old guy who has just finished his studies at a higher vocational education level. He studied Finance Control in Amsterdam, but he can hardly find a job. He cannot find a job that matches his ambition level. Most jobs are WOs. When he started studying, there was a lot of demand for this full-time job but this demand has decreased. He has a good understanding of technical things like computers. Moreover, he has a good understanding of numbers and statistics. He has an excellent command of Dutch and English. In other languages (German and French) he has almost only a little command through high school. In terms of income, he is in the middle of the middle class. He has no girlfriend or children. In terms of leisure, he does running, Netflix and gaming. He especially likes tactical games where you have to think.

**Demographic data**: He lives on his own in a small flat in Zoetermeer. He has a car to go to his future job. There are many starter homes and flats in the area. It is a modern and green neighbourhood.

**Wishes and goals**: His wish is to find a job because he cannot find work with his current studies. He hopes to find a job that will allow him to earn enough to live well and, if possible, a bigger house than the starter's house he is living in now.

He found Cumlaude at a job market. Because of the job guarantee and because it suits his interests and strengths, he is sure to follow the training course. He wants to work here because it suits him. He expects it to be quite a lot of work, but with enough perseverance, he expects to get through it without any major problems.

**Concerns and annoyances:** He is very worried that he will not be able to find a job with his current studies, and therefore wants to train for something that will guarantee him a job.

**Quote and tone of voice:** His tone exudes that of a typical young person who is only just making the step into the world of work. He is independent but has yet to find his footing. "I'm looking to find a job that can give me a good future, only it's hard for me to determine that."

**Appearance:** He has short blond hair and blue eyes. He has contact lenses and a well-tended beard. He dresses in business casual and sometimes with a blouse. He is 180 and slim.

## 6. Typical persona without an HBO degree

**Name**: Kyle

**Who and what is he/she**: He is a 22-year-old man who fell back from HAVO to MAVO. He finished secondary school but he could have done secondary school. Due to personal circumstances, he could not study properly and did not want to put much effort into his school career. Now that he is older and more mature, he regrets it. He does have the HBO level of thinking, but no proof to show it. He is also quite technically capable because he has put together his PC after doing a bit of research online. He plays a lot of games in his spare time. He likes technical games like Factorio. (A game where you have to automate aspects of a factory. You maintain many inflows and outflows of components of the factory. ) He does not have a girlfriend but he has had one.

**Demographic data**: He lives with his parents in a terraced house in Amsterdam. For his part-time job at the paper factory, he uses his parents' car or public transport. He does not do this job for fun, but

because he needs some income. The neighbourhood he lives in is mainly for the middle and upper classes. It is not a green and clean neighbourhood.

**Wishes and goals:** His wish is to be able to do extra training for a better future. With the training, he can find a job where he can live on his own because he is tired of living with his parents. He did a lot of searching online and through social media (LinkedIn) he was recommended to Cumlaude because of his interests. He had received a whole list of different training options from people and this interested him the most because of the management of data flows (just like in Factorio which he plays a lot). At Cumlaude, he wants to learn to identify data flows and manage them. After that, he wants to continue working in a (tech) company.

**Concerns and annoyances:** He is very worried that he will not be able to find a job with his current studies, so he wants to retrain for something that will guarantee him a job with enough income.

He is particularly concerned about the fact that he does not have a college education and finds it difficult to deal with this during job interviews. He does not have much to advertise himself.

**Quote and tone of voice:** His tone is typical of a young person who has a strong character and is technical, but still lacks skills. He is quite direct and may therefore sometimes come across as blunt or a bit silly. Rash "We will fix that right up. It's not a problem."

**Appearance:** He has short dark blond hair and brown eyes. He has a stubble beard. He dresses in very casual/street clothes (with a blouse at job interviews). He is 170 and a bit stout.

## Appendix B: Interview Questions and calculating SUS score

In this appendix are the questions for the interview.

If the user is asked to rate from 1 to 5. 5 means that the participant strongly agrees, 3 means they are indifferent, and 1 means they strongly disagree. In the non-SUS questions, they are also asked to elaborate on these types of questions to get deeper insights.

1. What were your first impressions of the prototype?
2. How many videos did you do and how many days did you study?
3. Were you motivated to keep up the daily streak? (please rate 1 to 5 and give a description)
4. Were you motivated to get gems as rewards? (please rate 1 to 5 and give a description)
5. Were you motivated to get a high multiplier by doing multiple lessons in a row? (please rate 1 to 5 and give a description)
6. Where are you motivated to get the skins? (please rate 1 to 5 and give a description)
7. Were you motivated to explore the galaxy while you were doing lessons?
8. What do you think of the program flow for someone who is motivated to learn?
9. Do you think the aesthetics of the system influenced your learning? Did the colours and art style?
10. Are there learning concepts that appeal to you? Some options are lecture slides, pre-recorded lectures, a guided learning plan, competitive quizzes, and reward systems.
11. Would you like to see these added to the lesson system? In this prototype, it is only pre-recorded lectures.
12. Do you think a reward system such as the gems motivates users in general to learn more?
13. Do you think a reward system such as the streaks motivates users in general to learn more?
14. Do you think a customization system such as the space rocket motivates users in general to learn more?
15. Do you think a reward system such as the multiplier motivates users in general to learn more?
16. What motivates you while learning?
17. Do deadlines motivate you while learning?
18. If yes, would missing these deadlines demotivate you to keep studying afterwards?
19. Do you have any opinions on Peer to peer feedback?
20. What aspects of the game in particular motivated you short-term?
21. What aspects of the game in particular motivated you long-term?

22. Keeping in mind that it is a prototype, would you change anything? Is there anything missing?

Below are the 10 questions of the SUS score:

01. I think that I would like to use this system frequently.

02. I found the system unnecessarily complex.

03. I thought the system was easy to use.

04. I think that I would need the support of a technical person to be able to use this system.

05. I found the various functions in this system were well integrated.

06. I thought there was too much inconsistency in this system.

07. I would imagine that most people would learn to use this system very quickly.

08. I found the system very cumbersome to use.

09. I felt very confident using the system.

10. I needed to learn a lot of things before I could get going with this system.

For each question, the user is asked to answer with 1 to 5 with similar reasoning to some of the questions above. From each uneven numbered question the score is subtracted by one. For each even numbered question, the score is subtracted from 5 since these questions are negatively loaded questions. Combining these new scores and multiplying the sum by 2.5 gives the System usability score on a scale of 0 to 100 [31].