Graduation Project [July 2022]

Making Learning Fun: How to take charge of your own learning experience.

By Maria Voicu (s2259532). Supervisor: Robby van Delden, Critical Observer: Dees Postma

University of Twente Drienerlolaan 57522 NB Enschede, Netherlands

Abstract

This paper describes the research process of my graduation project. The initial task was to find a solution for Creative Technology students that struggle with the Research and Design for User Experience class from Module 6: Intelligent Interaction Design. The initial research question referred to finding ways of facilitating academic learning, which as the project went on, evolved into the hypothesis that personalized learning styles can have a beneficial effect on the students' learning experience. As the project went on and more research was conducted, the chosen solution was to create a learning application which would encapsulate the content of the class and would provide the student with quizzes which would test their knowledge. The aim was for the app to be a tool for the student to feel more in charge of their own learning experience and create a healthy studying habit. During the creation of the app, one of the most notable aspects was the integration of the data base element, which would allow for the app to be used in any class, not just ResDesUX. Furthermore, this element sparked the inspiration for the core element of the app, namely the personalized variations of it, made to fit students, all unique individuals. Other than that, the learning app includes a reading element, which takes the content of the class and compartmentalizes it into interactive sections, that facilitate the reading and comprehension of the content.

   As for the research aspect, the focus was on the statement that all students are unique individuals when it comes to learning. The project included user testing sessions, which had the participants complete 2 quizzes, both with different learning styles applied to them, and then a questionnaire in which they would state their preference. The user testing sessions done through the course of the project uncovered useful insights and have shed some light on the effects of personalized learning.

Acknowledgements

List of figures

List of tables

Table of Contents

Chapter 1 – Introduction

University students are tasked with many distinct types of assignments that require the development of a plethora of academic skills. From proper time management to becoming proficient in different software tools, being enrolled in university will often push one's limits in terms of workload, no matter the field of study. This project will focus on a skill that all students aim to attain, namely academic learning. According to Kaowiwattanakul (2021), academic learning implies reading research papers, journals, and scientific articles, and more importantly, retaining the information from said sources. This skill proves to be practical in STEM-related studies, as well as subjects that are focused on humanities. This is relevant to Module 6: Intelligent Interaction Design from the Creative Technology Bachelor's, as well as BIT/TCS. Individual reading and study play a critical role in this quartile and many students face difficulties with this. The subject of Research and Design for User Experience is extremely vast, and Module 6 encapsulates many complex concepts that the students must comprehend in a brief period of time. With only ten weeks per quartile, the amount of information that one must retain can be quite intimidating and oftentimes, it can drive people away from subjects that otherwise might prove to be captivating. The main research question that will shape the research described in this report is: *how can academic learning and reading be facilitated through interactive methods, through a HCI focused framework*? Additionally, another question that that has to be answered for this is (in the extent possible): *what are the most efficient and effective methods to comprehend information from academic texts that are particularly complex?* It is important to examine what the root of the issues are, as well as how the problem impacts the students' lives, in order to be able to identify the possible solutions.

The effects of having an unbalanced studying schedule are oftentimes negative and force the student to build a disdain for their work. As Busse et al (2015) outline, one such effect is the 'too-much-of-a-good-thing effect' (TMGT) which refers to the threshold that the act of studying has, and how its efficiency declines after a certain amount of studying is done. Moreover, students experience sleep deprivation, headaches, and mental health issues due to a chaotic studying style (Busse, 2015). Maintaining such a lifestyle for a considerable amount of time can have serious long-term effects on one's health (Busse, 2015). This topic holds a considerable amount of importance since students often tend to not prioritize their health (physical or mental) and that highly reflects on their grades (Busse, 2015). The main challenge of this project consists of the fact that not every student has the same approach to learning, as well as the fact that not every approach is fitting for every student (Cairncross et al, 2001). The aim of the project will be to create a tool that facilitates academic learning in an interactive way, so that as many students as possible can use it in order to go through Module 6 in a less stressful way.

Another challenge that will come up will be the fact that the content that the students have to learn is quite complex. The challenge lies in taking that content and breaking it down to its essentials so that the students have a framework that they can work with during their individual study. Overall, the students should be able to comprehend the broad subjects of the module as well as enjoy studying it. With the proper support structure and the right approach, students can overcome seemingly insurmountable obstacles. Every student is different and it is clear that there is no 'one-size-fits-all' approach to studying. Abykanova et al (2016) point out that through interactive means, the student can retain information easier and is more engaged with the content of the class. What this implies is that by allowing the student to take part in interactive activities at their own pace, through their own preferred methods, they develop a stronger memory and start creating their own connections to help them remember crucial information. Therefore, it is important to use proper research techniques before deciding what would be an ideal solution. For this project, the initial research phase was used to gather as much information as possible about the students' approaches and perspectives and the teachers' insights. The students that have agreed to participate in the research have been divided into two focus groups. The aim of the research is to gather more qualitative data rather than quantitative, which is why the focus group approach was taken. The incipit part of the project will require the researcher to conduct two discussions through two separate focus groups (both of which will consist of Creative Technology and TCS/BIT students). The second part of the project required user testing or prototype testing, again with participants from the Creative Technology and TCS/BIT Bachelors.

The user testing was done by having the users complete 2 sets of questions, in order to identify whether or not the students perform better when faced with different learning styles (in this case it would be either a fitting style or a contradicting style). These methods will allow for the project to have effective results and facilitate the learning process of the students.

After the research has been completed, the project itself will consist of an application targeted towards students. The learning application will be focused on helping students with Module 6, specifically the Research and Design for User Experience class. The application will consist of the lessons from that class (summarized in a way that highlights the most crucial aspects of the subject), and through gamification, the app will aid students in forming healthy studying habits. The gamification aspect will include adding 'quests', 'experience points,' and daily goals, as well as the subtle use of visual feedback that will encourage the user to open the app as often as possible, without making them feel 'pressured' to study. The lessons will be structured in missions/quests, with the user having to complete a certain number of units (that will be determined by the material covered in exams). After a unit is completed, the user can test their knowledge with unit tests, in order to prepare for the actual exams. The tests will be structured in a way that the user will have to understand the concepts rather than memorize phrases. At the start of using the app, the user can choose a certain amount of time they wish to spend on the app daily, ranging from 5 minutes to over an hour. This goal will encourage them to form a daily habit of studying, which will ultimately lead to having a better understanding of the subject. The ideation process description can be found in Chapter 4.

Overall, the aim of this report is to shed light on the learning process of university students and provide an in-depth description of the studying application that aims to find a solution to the issue of disordered studying. The research done throughout the project will help future students in their learning journey and will increase their overall motivation when it comes to academic classes.

Chapter 2 – Background research

The background research found in Chapter 2 has provided a broader perspective on the issue, from possible roots for the problem, to already existing solutions that can be adapted into the project. The chapter has been divided into three main sections, namely 'Academic research' (which has been adapted from the 'Academic Writing Literature Review' course), 'Real-life examples', which will offer examples of related projects/products, and 'Autoethnography', which will be a section in which I will describe their own experience with Module 6. The research done in this chapter will allow the researcher to have a better understanding of the issue in order to find a suitable solution.

It is important to mention that the COVID-19 pandemic should also be considered, especially since online learning is vastly different from what students were used to before. Furthermore, this project will be mostly focused on the independent act of studying, outside of lectures. For a course like Research and Design for User Experience, independent reading is a crucial aspect, and the project will aim to aid this process by making the information more accessible and easier to comprehend for the students. As Cairncross et al (2010) mention, students and their style of learning should not be seen as a 'homogenous' and it is important to remember that some students prefer a more visual style, whereas some have their own unique habits that they use to retain information.

2.1. Academic research

The topic of interactive learning can take many shapes and forms, mostly since interactivity can be both physical and digital. The effects of this type of learning have been studied throughout the years and this learning style may be the answer to some issues that students struggle with, such as loss of focus or retaining information. This chapter contains four parts, discussing the possible methods of facilitating studying heavy material. The first part is dedicated to examining existing literature on interactive academic learning and the technology that accompanies this topic. The second part will be focused on effective methods to retain information (especially in the case of retaining information from academic papers). The third part will focus on the research done on complex academic papers, to have an overview of how the information needed for Module 6 could be structured in an analogous manner. The final part will be focused on gamification. Whilst this chapter will not focus necessarily on research directly related to Module 6, it will emphasize research papers that contain information about learning methods that will ultimately be used in Module 6.

2.1.1. Keywords

The keywords used in the search for related academic papers that have been mentioned in chapter 2 have been separated in categories, in order to identify the most relevant papers on the subject. Moreover, connector words have been used in order to identify the most relevant sources. Table 1 illustrates the process of choosing and using the keywords. For the topics of academic and interactive learning, the terms used were searched individually as well as using the 'AND' and 'OR' operators in order to collect a literature list that would be as comprehensive as possible, with theories rather than solutions.

Table 1 - Keywords

Table 1: Keywords related to academic and interactive learning

Terms related to academic learning	Terms related to interactive learning
'academic learning', 'academic writing', 'university-level', 'college-', 'complex reading', ''	Interactive learning ', 'interaction', 'school', 'pedagogical'

2.1.2. Interactive technology and academic learning

There are many facets to interactive learning. From visual learning to incorporating physical activity into the studying process or taking a collaborative approach to encourage students to maintain better focus, studying is a skill rather than an activity. It is useful to examine Bloom's taxonomy (see figure 1 below) and understand how the figure can help shape the learning process for a Creative Technology student. As can be observed below, the base of the pyramid consists of knowledge. According to Adams (2015), knowledge is the cognitive skill that is the easiest to assess. Throughout this graduation project, the skills of knowledge and comprehension will be studied in parallel in order to improve the learning strategies of Creative Technology students. After those skills are properly understood and an effective strategy has been developed, the learning process will continue with the application, analysis, synthesis, and ultimately the evaluation skill.

Figure 1 - Bloom's Taxonomy adapted by Adams (2015)
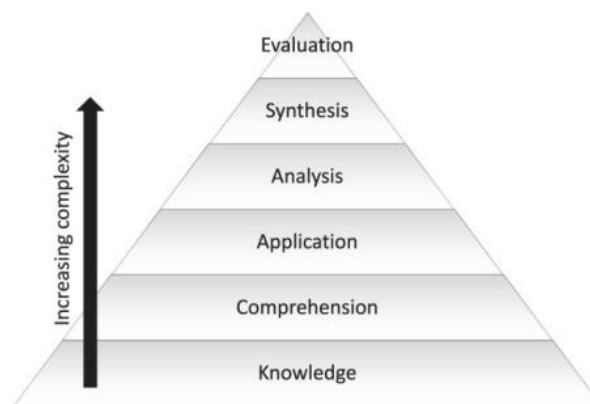
Efficient interactive learning relies on two main aspects: proper use of educational technology and the student's own learning approach. Abykanova et al (2016) established that interaction is related to having several participants engaging in a certain activity, whilst in the context of learning, interaction can become a tool to improve the efficiency of studying (especially when it comes to higher education). Furthermore, interactive learning is described as a crucial element in helping with self-development and building a personal learning strategy. Similarly, as Zufar et al (2021) point out, educational technology aims to solve studying issues that students face, and whilst the subject is still evolving, the definition can change but the main aspect of it is focused on facilitating education. Furthermore, pedagogical technology is often interactive in its nature and should be regarded as its own separate "scientific family" (Zufar et al, 2021). Some examples of interactive academic learning include lessons with interactive whiteboards, virtual reality classrooms, or the more commonly seen tablets. Overall, this type of technology proves to be quite effective when it comes to forming the proper studying techniques.

The second aspect of effective interactive learning is less reliant on technology and more focused on the individuality of each student. It is not sufficient to have only interactive learning technology available. As such, Wang (2021) states that having state-of-the-art technology is not enough to facilitate interactive learning. For example, countries such as the US have also invested in teacher training and supporting digital education, through the '*No Child Left Behind*' Act of 2001 (Wang, 2021). Whilst making learning technology more widely available, it is also important to remember that the teacher-student dynamic should focus on the encouragement of having the student develop their own studying strategy and use technology as a supporting tool rather than a stand-in for a teacher or a professor (Schell, 2019). There are many

different approaches that can be taken in order to facilitate this. One of the more effective approaches is described by Stansberry and Haselwood (2017), who look at pedagogical technology through a 'gamified' lens.

The gamification approach implies that education can be facilitated through video game elements, such as having learning quests, a reward system, and working in teams to complete certain tasks. The approach of Stansberry and Haselwood (2017) "empowers learners" through successes as well as failures, which is ultimately the goal of studying. By transforming the learning process into an 'adventure quest', the student becomes more immersed in studying and is encouraged to look at learning as a personal journey rather than a grueling activity. As such, there are three powerful distinctions between every student and their studying strategies. Nantschev et al (2020) state that students take three broad approaches, specifically, student-based approaches, teacher-based approaches, and mixed approaches. In this project, the approach will be mixed since they final product will be realized with the input of both students and teachers. The reason it is noteworthy to make this distinction is that each student is their own unique individual and, simply put, it is not reasonable to apply the same learning structure to every student. It is important to encourage these differences rather than try to find a solution that suits everyone. All in all, making studying a personal process will always have beneficial outcomes.

2.1.3. Complex reading

When being tasked with a hefty amount of reading, regardless of the subject, every student can feel quite intimidated and reluctant to start. However, the skill of retaining information can be trained and even mastered through various methods. This relates to Bloom's taxonomy, which is a framework that can help students build their own strategies. Bloom's taxonomy is a pyramid that exemplifies all the necessary educational goals that one should have when learning about any topic. At the bottom of the pyramid is the concept of knowledge (and thus the retention of said knowledge), which, despite being the most needed step, is something that many students struggle with. Then, the question remains: *how can remembering become easier?* Abykanova et al (2016) point out that through interactive means, the student can retain information easier and is more engaged with the content of the class. What this implies is that by allowing the student to take part in interactive activities at their own pace, through their own preferred methods, they develop a stronger memory and start creating their own connections to help them remember crucial information. On a similar level, according to Kaowiwattanakul et al (2021), retaining information is based on the student's reading comprehension skills and requires practice as well as focus. Reading comprehension can be improved by skimming through articles, journals, research papers, and trying to identify the main concepts described, whilst focus can be increased by removing all distractions from one's environment, as well as having reachable goals that can allow the student to feel accomplished throughout their learning journey. Overall, having an efficient memory requires patience and a clear structure when studying.

Nonetheless, whilst students are aware of what they should be doing to improve their learning skills, it is much more difficult to put everything into practice. These difficulties can prove to be large hurdles for inexperienced young people and knowing how to identify negative behavior is the first step towards a more worry-free approach to learning. Busse et al (2015) outline chaotic studying as reading for hours at a time without break, cramming, consuming substantial amounts of caffeine, not having a set schedule, etc. They state that the effect of these activities will most definitely result in an immediate decrease in information retention and ultimately in a poor learning experience. Furthermore, Grant and Schwartz (2011), as cited by Busse et al (2015), offer a more philosophical perspective on the effects of chaotic studying, namely that happiness comes from creating a balance between "deficiency and excess". Whilst Grant and Schwartz (2011) attribute these concepts to everyday life, Busse et al (2015) consider that this balance should be a framework for students in order to improve their academic performance. With the students shifting their priorities towards their mental and physical well-being, their learning process will also become easier.

To minimize the tendency of having a disorganized approach to studying, there are three main concepts that can aid in the process of learning. Firstly, Goulding et al (2017) establish that there is a correlation between the performance of a student and their capability to retain information, and their attendance of physical classes (regardless of the teacher's abilities). In other words, having a constant attendance rate will eventually lead to a better understanding of the class material. Whilst this is more of a step that the student is strictly responsible for, there are other concepts that the teachers can take into consideration, to facilitate the learning of their students. The second aspect is brought up by Senkova et al (2018), who describe the issue of exams, specifically the fact that when it comes to open book versus closed book exams, the most important aspect is not the type of exam but how the questions are formulated and if they facilitate the student's thinking and ability to recall information. Circling back to Bloom's taxonomy, recalling information proves to be the single most crucial step in learning. The third concept to encourage information retention is specified by Price et al (2012), who described the Peer Assisted Study Sessions (PASS) strategy. Whilst many classes do not facilitate group studying and instead encourage individual study (mostly due to time constraints), Price et al (2012) argue that having a study group with other peers can improve memory and will result in the students having a more positive outlook on their classes as well as studying itself. All in all, the three concepts discussed in this section have the potential to aid students in developing stronger retention of information.

2.1.4. Retaining information

One of the most common issues that students encounter is the fact that they are intimidated by lengthy pieces of text. Being tasked with reading a considerate number of pages can prove to be quite a challenge, even for the most studious. Whilst some may struggle with a loss of focus, the common denominator in these situations is the difficulty of retaining information. By analyzing existing literature on the subject, this issue will hopefully be ameliorated throughout the project. The most frequent practice for students that must memorize substantial amounts of information is the act of recall, rather than the recognition of information. However, it is important that in this context of the project, the focus should shift on which strategy is better since they both have their respective advantages and disadvantages. As Buehl (2017) mentions, the literacy model is split into four distinct categories: reading, writing, speaking and listening, and language. These four divisions can be seen as a base for the project and used to build an overview of what the students should practice recalling the information. Along with the literacy model and considering Bloom's taxonomy that was mentioned before, by taking these two concepts as guidelines, the outcome of the project will result in an efficient learning strategy for Creative Technology students.

Expanding on the topic of information retention, one topic that will inevitably come up is complex reading. No matter the academic path, all students find themselves facing the challenge of reading research papers, journals, or scientific articles. Whilst having a good memory is important, knowing how to approach complex reading is essential to the study process. Kaowiwattanakul et al (2021) state that reading skills and critical thinking skills are strongly connected and that reading implies more than skimming through text, it requires the understanding of the subject as well. Furthermore, they point out that complex reading can be tackled using methods such as sketching out learning schemas, interacting with the text, interpreting the text, discussing the text, and assessing said interpretations. Overall, having an in-depth grasp of the paper is based on how interactive and engaging the student's approach to studying is.

Whilst a deep understanding of the topic is necessary, it is easily possible to sway towards negative effects without the proper caution. Busse et al (2015) observe the 'Too Much of a Good Thing Effect' (TMGT), which suggests that there is a threshold to the amount of studying a student can do, after which their efficiency starts declining. The main takeaway from their statement is that students should be aware of their focus threshold and work around it, to maximize their efficiency, as well as avoid burnout. One such way to achieve a better understanding of one's capabilities is, according to Goulding et al (2017), to engage in as many in-class assignments as possible, which will improve reading comprehension during individual studying. This closely relates to the previously mentioned PASS strategy, outlined by Price et al

(2018), which allows students to develop their own personal studying strategy. In the end, it is important that students do not overwork themselves and that they look for support from their peers.

2.1.5. Gamification and persuasive design

Gamification represents the embedding of video game elements, such as achievements, experience points, leaderboards etc. in non-video game settings (Deterting et al, 2011). Gamification can be used in education in order to make learning more attractive for students. Stansberry and Haselwood (2017) describe each students' skills as ways to form strategies ("skills as strategies"), since people are more encouraged to learn if they recognize familiar skills as an efficient way to accomplish a goal, in this case learning. Moreover, learning is facilitated when the student has a clear overview of the subject, which gamification facilitates through "giving meaning" to the system thinking approach (Stansberry and Haselwood, 2017). Taking into consideration the individuality aspect that has been brought up in previous sections, Kim (2015) highlights how different personalities can be related to player archetypes, such as "socializers" (people who become motivated through feeling that they can relate to others/the subject they are studying) or "achievers" (those who become motivated through their wish to master a subject). These types of classifications can help students become more self-aware of their studying methods and allow them to create their own persona, in order to discover the most effective, personalized strategy. Ståhl et al (2017) quoted Gee (2004), who has discussed the concept of "real-life identity", "virtual identity", and "projective identity", which refer to the different behaviors that a person exhibits, depending on the medium in which they find themselves. The "projective identity" describes the way in which a person "projects" their morals and values in a virtual environment. This specific identity can be the pathway for students to discover who they wish to be and what behaviors they wish to exhibit through the graduation project's application.

Furthermore, there is a broad range of video game elements that can help improve the learning experience. Specific elements include progress bars (which allow the user to have a visualization of their progress), levels and quests or score points. These elements combined create an immersive experience for the user, and ultimately transform a mundane activity such as studying, into an engaging learning moment. Gee (2004) also stresses out the importance of "multimodal literacy" (referring to multimodal texts, which are both words and images), which gamification facilitates through its constant use of visual elements. By associating academic concepts with visual elements, the student can have a deeper understanding of the subject. Moreover, visual elements can also influence the user by using certain colors to signal different emotions. Martosenjoyo (2021) identifies red and green as being the colors that have a powerful impact on the user's emotions, specifically red symbolizing incompleteness or errors, whilst green symbolizes correctness and completeness. Using green when completing tasks can prove to be a subtle but efficient way to encourage the user to continue utilizing the application.

The topic of gamification also strongly relates to persuasive design. Persuasive design refers to the conscious decision that a designer makes when creating a product, with the aim of influencing the user's decisions. Oinas-Kukkonen and Harjumaa (2009) provide an in-depth description of 'Persuasive Systems Design' (PSD) by listing 28 design principles. Their framework description can be used in the context of the graduation project. One particular table from Oinas-Kukkonen and Harajumaa's highlights the dialogue support that is used in PSD (see Table 1). This table provides a great amount of insight that can be integrated into the project, in addition to the gamification element.

Table 2 - Dialogue support in PSD (Oinas-Kukkonen and Harajumaa, 2009)

Principle	Example requirement	Example implementation
Praise By offering praise, a system can make users more open to persuasion.	System should use praise via words, images, symbols, or sounds as a way to provide user feedback information based on his/her behaviors.	Mobile application that aims at motivating teenagers to exercise praises user by sending automated text-messages for reaching individual goals. [Toscos et al. 2006]
Rewards Systems that reward target behaviors may have great persuasive powers.	System should provide virtual rewards for users in order to give credit for performing the target behavior.	Heart rate monitor gives users a virtual trophy if they follow their fitness program. Game rewards users by altering media items, such as sounds, background skin, or a user's avatar according to user's performance. [Sohn and Lee 2007]
Reminders If a system reminds users of their target behavior, the users will more likely achieve their goals.	System should remind users of their target behavior during the use of the system.	Caloric balance monitoring application sends text-messages to its users as daily reminders. [Lee et al. 2006]
Suggestion Systems offering fitting suggestions will have greater persuasive powers.	System should suggest that users carry out behaviors during the system use process.	Application for healthier eating habits suggests that children eat fruits instead of candy at snack time.
Similarity People are more readily persuaded through systems that remind them of themselves in some meaningful way.	System should imitate its users in some specific way.	Slang names are used in an application which aims at motivating teenagers to exercise. [Toscos et al. 2006]
Liking A system that is visually attractive for its users is likely to be more persuasive.	System should have a look and feel that appeals to its users.	Web site that aims at encouraging children to take care of their pets properly has pictures of cute animals.

From Table 1, the praise, rewards and reminders elements will be the most predominant in the project. Praise and rewards elements will be quite similar, by combining visual feedback with virtual rewards, such as experience points or other virtual currency. Reminders will consist of notifications sent throughout the day to remind the user to keep using the app.

All in all, the uses of gamification are vast and there are many approaches to it. This project will use gamification and persuasive design to facilitate studying and ensure that the students build a more structured strategy when it comes to learning. Gamification is not necessarily the answer to receiving high grades, but it is an effective tool that can be used to create more motivation for the students and make studying more engaging and less of a chore.

2.1.6. Conclusion from existing literature

Most students struggle with finding motivation, as well as forming healthy studying habits. This struggle can often lead to negative behaviors that can affect one's health (both physical and mental), and ultimately result in a decrease in the quality of education, a lacking understanding of academic subjects and a detrimental learning experience. Another hurdle that the students must overcome is finding a studying strategy that is fitting for their needs, which oftentimes is not similar to 'traditional' methods of learning. Finding a fitting strategy is beneficial not only for the academic life of a student, but also for their future career since these concepts can be applied in other aspects of one's life.

The research presented provides meaningful insights into discovering a possible solution for this issue. It seems evident that the technological tools available can build a great learning environment, however, the research brought up highlights the importance of encouraging students to find their own strategies. Gamification has been described as a viable solution to studying complex material, since it allows

students to create their own learning journey and take charge of the self-discovery process. Other than gamification, 'Peer Assisted Study Sessions' have also proven that the feeling of belonging to a group create a learning environment where students can thrive. Overall, students should be encouraged to explore multiple approaches to learning, in order to discover the one that suits them the best. Whilst some students can find the presence of other peers motivating, there are others that find inspiration from being on their own but using different learning tools.

The conclusion that can be drawn is that whilst it is not possible to come up with a solution that would result in every student drastically improving their academic performance, there are ways in which education can be facilitated and made more approachable. Traditional studying methods might not resonate with many students, which is why it is important to explore all these different possibilities that can prove to be more effective when it comes to information retention and complex reading. With methods such as gamification or 'Peer Assisted Study Sessions', students can embrace the learning process and thus find better motivation to study and improve their education.

In terms of limitations, academic learning is mostly hindered by the vastness of the topic, as well as the individual perspective and skill set that each student possesses. This chapter covers extensive topics that can be advantageous for many students, however, it is important to consider the fact that a student's capability is not determined by their ability to pick up certain learning methods, and it is rather based on their willingness to adapt and search for suitable learning options. Moreover, the approaches brought up are not perfect solutions to the issue, but can serve as steppingstones, or tools that can aid students in their learning process, thus improving their quality of education. In the context of the graduation project, the background research has uncovered useful insights into the root of the problem, as well as possible approaches to improving the studying situation of most students, which is the goal of the project. The methods presented are extremely versatile and can be implemented using interactive technology. The findings from the research consist of the key elements for facilitating studying are memory and focus improvement, engaging in-class activities, as well as studying alongside other peers in a group setting. As for future research, these elements can be tested out in a classroom setting or can be discussed with students through focus group sessions. It is important that these elements are discussed with both students and teachers in the context of the Creative Technology Bachelor's, in order to apply these methods in a fitting manner for this specific course.

2.2. State of the art

Interactive learning has taken many shapes in real life settings. From phone applications to classroom gadgets, technology is a tool that makes education more accessible for many students. This section is meant to highlight the existing technologies/projects that have facilitated education through different means. These approaches will be examined in order to discover why they are effective and how they guide the student through the learning process.

Figure 2 - Screenshots from Duolingo
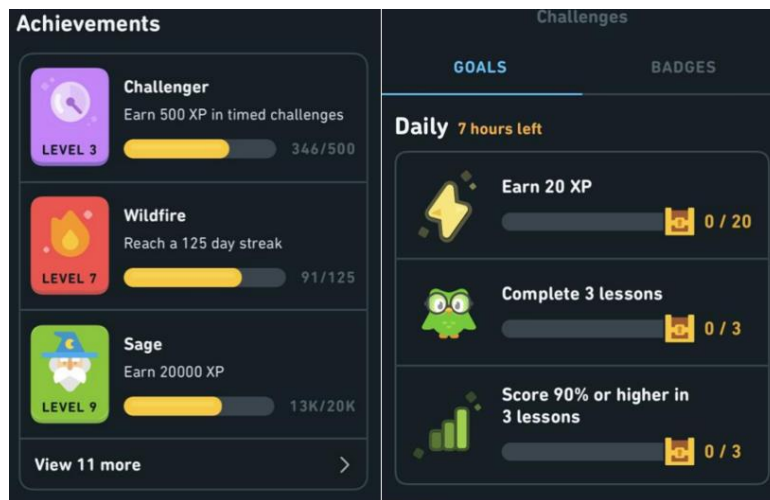
The first example is Duolingo. Duolingo is an application (that has a website version as well) that allows the user to start learning a language by setting a daily goal of experience points to reach. The user can choose from up to 37 languages to learn. The way Duolingo works is by having different sets of exercises that allow the user to practice their chosen language (Blanco, 2021). The lessons might seem repetitive and outright simple at first glance, but that is the application's main strategy to ensure that the user properly retains the information, to become more accustomed to how the language works, and eventually, the user will start to fill in the blanks and predict how a sentence should be structured or how a verb will be conjugated. However, this is not the main reason as to why Duolingo is effective. There are certain subtleties with which Duolingo ensures that subconsciously, the user is encouraged to keep using the app and maintain their motivation. The app uses gamification to increase the user's ability to retain information, and as Smiderle et al (2020) establish through their experiment that gamification has a drastic positive effect on students' grades. One of the possible reasons as to why Duolingo's gamification is efficient is because it uses elements that reward the user constantly (see figure 2). From experience points to coins and gems, every learning action that the user completes, unlocks rewards or additional learning tasks, making the user feel like they are progressing through a storyline with quests. Additionally, Cao (2015) states that the visual, audio and haptic feedback given by the app are also a great contributor to the user's motivation. According to Cao (2015), visual feedback is seen to have received up to six times more powerful reactions from users, compared to textual information. The "picture superiority effect" (Cao, 2015) is the reason why Duolingo has invested so much effort into their visuals, from making recognizable characters, to giving them unique animations that make the user feel rewarded. As such, this project will use visual feedback elements in order to achieve its goal.

Another example of interactive education technology is the learning platform Highbrow. Highbrow is meant to be used as a learning tool for a wide variety of topics (over 300) and it tasks the user with spending only 5 minutes of their day learning something new. The appeal of Highbrow stems from its positive reinforcement, such as the wording used on their platform as well as the calming illustrations (figure below) that make the user feel at ease. Furthermore, the appeal of only using 5 minutes of the day is very convincing for many people, since it is not a huge commitment. Highbrow's success is proof of the fact that it is more important to make small consistent changes rather than try to make a great amount of progress in one day and then give up the next. Van der Weiden et al (2020) agree that positive habits can only be formed with realistic goals and that if a person sets goals that are too ambitious, it will ultimately lead to failure. It is important that this project encourages students to form healthy learning habits that will substitute their dysfunctional studying tendencies.

Figure 3 - Highbrow courses screenshot

MASTERING YOUR CONVERSATIONS

Our lives are built around conversations. Our friendships, our acquaintances—all our relationships, including how we...

A DAILY JOURNAL PRACTICE TO BECOME A BETTER PERSON EVERY DAY

There are many daily journal methods out there. Most people find that they don't stick....

INTRODUCTION TO PERSONALITY PSYCHOLOGY: THE BIG 5 TRAITS

This course is designed to introduce you to the world of personality psychology. Specifically, the...

Figure 4 - Microsoft's Language Quality Game

On the topic of gamification, one of the most effective examples is the "Language Quality Game", created by Microsoft. Since Microsoft is one of the largest companies in the world, their products are available in hundreds of different languages. In order to ensure that there would be no grammatical mistakes or typos, Microsoft decided to create the "Language Quality Game", where employees from all over the world, with different nationalities, would 'compete' against each other in finding as many linguistic mistakes as possible in Microsoft products. One of the strategies created by Microsoft was to intentionally add mistakes in certain translations, in order to test the users' attention and focus. Ultimately, this proved to be an effective strategy since at the end of this game, over 500 000 screens of text were analyzed. The person who created the game and is researching gamification, is Microsoft's Director of Testing, Ross Smith. He states that the concept of work should be redefined and reimagined in a way that is more fitting to newer generations. Smith also puts an emphasis on collaborative 'play' activities in the workplace. The success of the Language Quality Game is proof of how efficient gamification can be.

One of the elements that will be included in the learning app will be a calendar/schedule for the students to have an overview of their tasks, exams and other activities. One example of an app targeted towards students that has such a function is Canvas (see below). This function is connected to all the classes from a module, allowing the student to be aware of their upcoming assignments and classes. It even allows the student to create their own 'events' and customize it accordingly. The project will take inspiration from this function by providing similar assets, except it will be customized for the Research and Design for User Experience class. Moreover, the learning app will include not only assignments and exams but reading and quiz prompts as well.

Figure 5 - Screenshot of the Canvas calendar

29	30	1	2	3	4	5
	08:45 [AI&T] Lecture 3	[AI & Prog] Pong (Formative)		10:45 [AI&T] Tutorial 3		[STAT] HWA 2
	[ResDesUX] D2.0 Table of Personal Responsibilities	[ResDesUX] D2.1 Initial Interview Plan				
6	7	8	9	10	11	12
	08:45 [AI&T] Lecture 4		08:45 [ResDesUX-T] Exam 2	10:45 [AI&T] Tutorial 4		[ResDesUX] D2.2 Extended/Updated Contextual Analysis and Project Concept chapter
	[AI & Prog] Project: Search Algorithms (Summative)		[ResDesUX-T] Exam 2 - Cognitive Walkthrough			[ResDesUX] D2.3 Lo-fi prototyping and User Testing chapter
			[ResDesUX-T] Exam 2 - Heuristics			[STAT] HWA 3
13	14	15	16	17	18	19
	08:45 [AI&T] Lecture 5	[ResDesUX] D3.2 DRAFT Initial Plans for Research Experiment		10:45 [AI&T] Tutorial 5		[STAT] HWA 4
	[ResDesUX] D3.1 Table of personal responsibilities			[ResDesUX] D3.3 Peer review of research plans of 2 other groups		[STAT] SPSS HWA 4
20	21	22	23	24	25	26
[AI & Prog] Project: Tic-Tac-Toe (Summative)	08:45 [AI&T] Lecture 6	[ResDesUX] D3.2 (FINAL) Plans for Research Experiment	08:45 [AI&T] Tutorial 6			

'The River of Grass' (below), is an interactive learning installation that is meant to be an immersive experience through the Evergaldes National Park in Florida. The project combines visual and audio elements that are responsive to the people going through the installation. It provides a better understanding of the animal and plant species habiting the Everglades and it proves to be an efficient learning experience due to its interactivity. It consists of motion sensors, adaptive music and lighting and 3D animations. Whilst the final solution for the graduation project will not consist of any physical elements, searching for different learning methods (digital or physical) has been beneficial in understanding one's learning needs.

Figure 6 - The River of Grass of the Everglades

Chapter 3 – Methods and techniques

The overall approach used in this Graduation Project follow the guidelines provided by the Creative Technology GP manual, specifically the CreaTe Design Process depicted bellow, by Mader and Eggink. The four-step process covers all the necessary aspects that should be included in a project. These four steps are: Ideation, Specification, Realisation and Evaluation. As the arrows in the figure indicate, every step can be re-visited and re-done, in order to achieve a better result. After each phase, there are certain evaluations that must be done, in order to move forward with the next stage. In the diagram, the evaluation criteria can be seen in the white boxes in between the phases (e.g., 'experience idea', 'experience specification', 'experience prototype', 'evaluation' and so on). Moreover, as stated in the reader for Research and Design for User Experience, the design process can be seen as a "spiral process", since it is iterative. Since the application's design will be centered around the user's needs, it is important to adhere to general rules of the HCI field. These rules generally revolve around ethics, user needs, human factors etc. This chapter illustrates an overview of how the design process based on the Mader and Eggink diagram has been implemented in this project.

Figure 7 - The CreaTe design process by Mader & Eggink
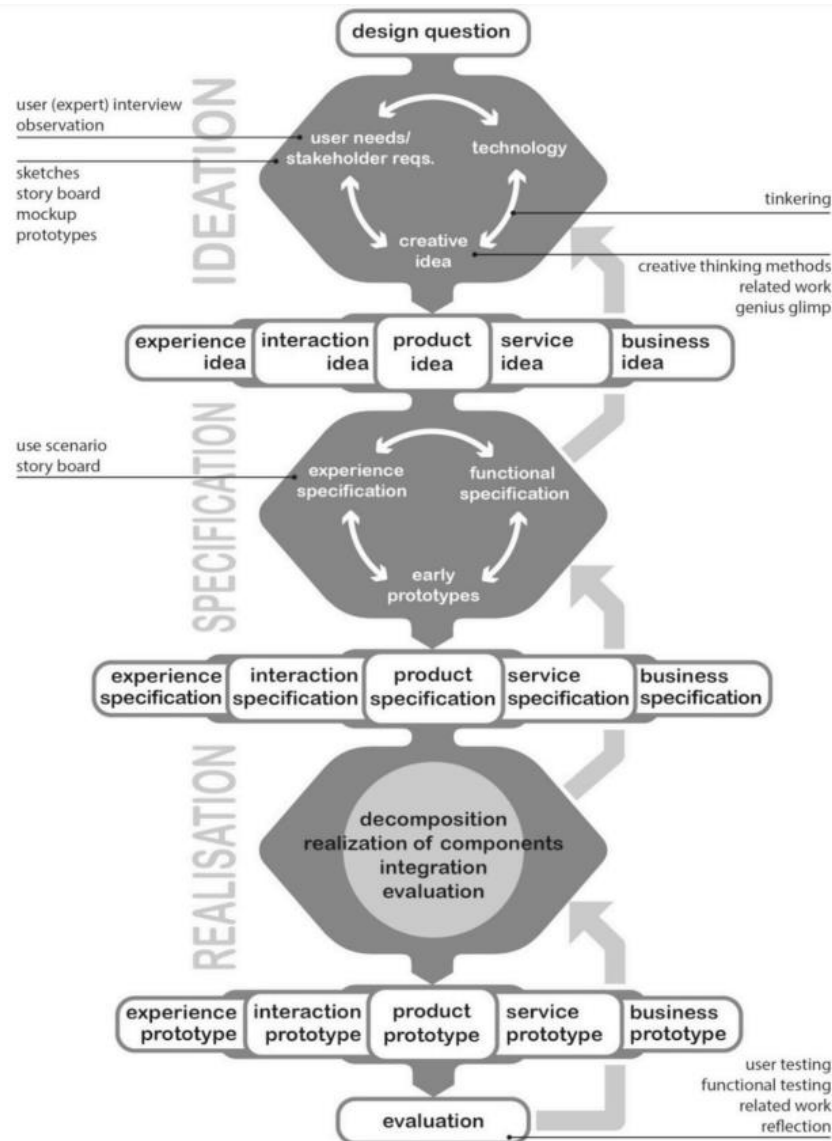
3.1. Ideation

The initial phase of the project is the Ideation process. This can be described as the process through which the researcher comes up with solutions to the design question, by taking into consideration the user needs and requirements. As the diagram implies, the ideation process considers three main aspects: a creative idea/concept, the available technology to put said concept into practice and the user needs. These aspects are determined by actions such as observations, interviews, focus groups, as well as sketches, prototypes and so on. In this project, the first step taken was reaching a clear understanding of the stakeholders and their requirements. In this case, the main stakeholders are the students (with a focus on CreaTe/BIT students). In order to gain more insight into the perspective of the students, two focus groups sessions have been conducted (as described in section 3.1.1). As mentioned in the background research chapter, every student has a different learning approach, since they are unique individuals. Moreover, teachers can also be considered stakeholders in this context, since their goal is to ensure that every student has a positive learning experience. Several discussions with the teachers took place during this phase of the project, in order to identify the most important elements of the project. During these discussions, one topic that was brought up was the SEQ feedback of students throughout the years, which provided a With this project, both types of stakeholders benefit from positive learning experiences and that will ultimately lead to an improvement to the quality of education of the students. Since the ideation process puts great emphasis on user needs and user-centered design, the focus was put identifying those needs as early as possible. Thus, the ethical approval for the focus group sessions was received in the 7th week of the project.

The next step was mind-mapping ideas for different learning approaches. Mind-mapping is an explorative approach to gathering as many ideas as possible, whilst also being time effective. Coming up with as many ideas as possible has proven to be an efficient method of gathering a significant amount of insight in order to be able to proceed to the next step. The mind-mapping has been centered around finding different learning approaches, as well as existing examples that could be used as inspiration for certain elements of the project. In order to search for the proper background research and the current state of the art on the topic, several keywords were used. The strategy behind the keywords is explained in section 2.1.1. This has both covered the creative idea and the technology aspects of the diagram. Moreover, after the stakeholders have been identified and several creative concepts have been analyzed, some sketches have been created.

3.2. Specification
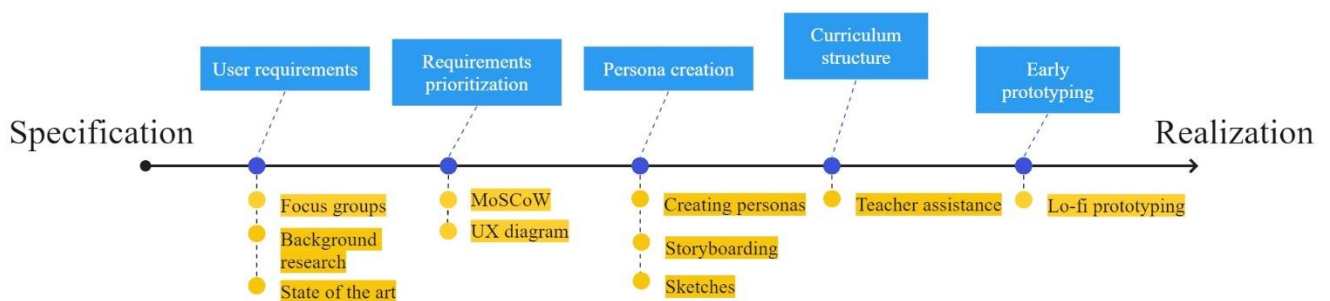
Figure 8 - Roadmap of the specification phase

Specification is the second phase of the design process. The ideation process has provided a solid framework to work with, from the user needs identified in the focus group sessions, to the sketches and concept generation methods used. The first step (as seen in the figure below), was to have a proper overview of the user requirements. Moreover, in this step of the design process, it was important to distinguish between the most important user needs, as well as what is the most realistic plan in regard to the graduation project. This was done using the MoSCoW method, which, according to 'ProductPlan', is an approach that

focuses on prioritizing user requirements in an adequate and manageable way. The CreaTe design process diagram also highlights user scenarios and storyboarding in this stage, as well as early prototyping. Following the user requirements gathering phase, the next step is to create a more concrete overview of the project. This stage includes building a user experience diagram that will serve as a guideline for the creation of the actual project. It will be a step-by-step plan that will highlight how the user will feel/accomplish through every step of using the learning app. Furthermore, after the user experience diagram is complete, the next step is the creation of different user personas. As mentioned before, students are unique individuals that have unique needs. This will be the most important aspect to `keep in mind in this stage of the project. The next step is finding an efficient way to structure the curriculum. This will be done through communication with the teacher, in order to ensure that the app does not omit any important elements and that the learning content is up to par for the students. After all these stages are complete, it is time to start prototyping.

3.3. Realization

The specification stage is followed by the realization phase. Realization consists of the creation and building of the final result of the project. This, according to the CreaTe design process diagram, includes a decomposition of the concept into sub-systems (in this case we split the project into the gamification elements, lessons + other elements). Following that is the actual realization of the elements, including the visual/audio aspect of the project. Lastly is the integration, which means embedding all the elements into one big project, thus reaching the final result. Below is a figure of a roadmap describing this process. The final stage is the evaluation.

Figure 9 - Roadmap of the realization phase
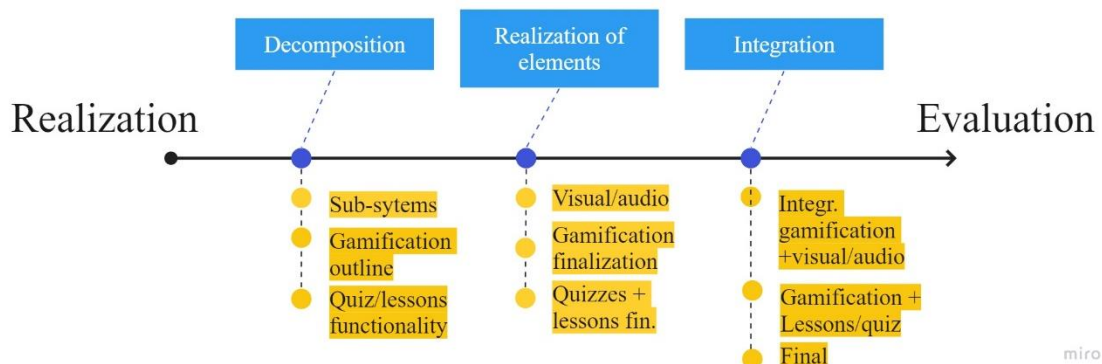
3.4. Evaluation

The evaluation phase consisted of user testing as well as checking if the requirements established in the realization phase have been accomplished. Moreover, this is when the research question receives its final answer. The results of the project as well as feedback from users will be discussed in this chapter. Based on the conclusion of this chapter it can be determined if the project has been successful and impactful. The most important aspect of this phase has been the user testing sessions in which the hypothesis that personalized learning is beneficial was tested.

Chapter 4 – Ideation

The ideation process consists of generating ideas by sketching out different concepts, finding different ideas through mind maps or prototype testing. Initially, there was a wide variety of different ideas that could constitute possible solutions; however, it was necessary to come up with one idea that would prove the most efficient. This chapter illustrates the entire ideation process, from the mind-mapping sessions and the design sketches to the final design choice, as well as the reasoning behind it. Moreover, in this stage it is important to identify and understand the stakeholders.

Identifying the stakeholders

One of the most essential steps in the design process is understanding (and identifying) the stakeholders of the project. This section will focus on two types of stakeholders, both equally important: the students and the teachers. The table below illustrates the Power/Interest grid for Stakeholder Analysis (the template has been provided by the default Microsoft Office Suite options). The stakeholders are identified based on their power level (how much influence they have on the project) and their interest in the project. It is important to note that the students that will go through Module 6 have the highest priority since the graduation project is meant to be a solution for them. The issue would be that, since they have not gone through Module 6 yet, they do not know what to expect. That is why the project will also focus on students that have gone through Module 6 and must redo it. They can provide valuable insight and should also be prioritized. The teachers are another stakeholder category that require a substantial amount of communication and focus. Since they are the experts when it comes to how a class should be organized and what should be included in the curriculum, they rank quite high on the 'power' axis. Throughout this project, teachers will be consulted to ensure that the quality of the content of the app is up to par. Lastly, there are the students from the focus group sessions, who, despite having finished Module 6, have the right (and most likely will want) to be informed about the results of the project. These sections will give an in-depth explanation of two of the stakeholder categories (future students and teachers).

Figure 10 - Stakeholder analysis

Power / Interest Grid for Stakeholder Analysis

	High	Teachers Students that will go through M6 + Students that are redoing M6
		Keep Satisfied — **Manage Closely**
Power		
		Students from focus groups **Keep Informed**
		Monitor (Minimum Effort)
	Lo	
	Low	Interest — High

4.1.1 Future M6 students

The final project is aimed towards future second year Creative Technology students. Whilst it is not possible to ask them for feedback on what they think about Module 6, it is possible to use the information provided by the focus group participants in order to create the most efficient learning experience. Furthermore, due to the time constraints, it would not be possible to test the app with actual M6 students (unless the project deadline becomes extended to October 2022). In order to ensure that the needs of the students are met, the app will be created with the help of older CreaTe students, as well as the teachers of the course. They have the highest priority in the Stakeholder Analysis, meaning that the project will impact them the most.

4.1.2. Creative Technology teachers

The second most important type of stakeholders of the project are the Creative Technology teachers. The teachers, being the experts in this case, will assist the project by providing the guidance and the knowledge necessary to create a solid structure for the learning content that will be included in the app. With their help, the app will include all the necessary information for a thorough learning experience.

4.1.3. Autoethnography

Autoethnography represents the act of using subjective experiences and self-reflection to conduct research of the qualitative type (Wikipedia contributors). This approach is appropriate for this project since I had personal experience with the tasks of Module 6 twice (due to failing the module the first time around). The experience has been beneficial overall (despite the inconvenience that comes with having to retake a module) because it has allowed me to not only have a deeper insight into the topics of the classes, but also a broader understanding of the process of academic learning, which is the focus of this project. This autoethnographic research will be conducted as follows: the thoughts and feelings of the researcher will be analyzed, as well as the studying process during both module attempts. The two attempts will be compared in order to identify the root of the difficulties of the tasks.

Firstly, from the perspective of a Creative Technology student, coming out of Module 5 and going directly into Module 6 was quite difficult. Both modules, whilst remarkably interesting and thought-provoking, both are quite challenging. Additionally, having to follow all classes online was an impediment for most students. The fact that Module 6 introduces many new concepts that take time to be fully grasped has been the main factor that influences the difficulty of the module. Another element that characterizes this quartile is the amount of individual study needed to comprehend the basics of each class. Participating in the lectures is not enough for a passing grade. By self-reflecting on the experience of this quartile, the principal elements that should be researched have been identified as academic learning, time management, and maintaining focus. When it came to classes that required a vast amount of reading, I found it exceedingly difficult to maintain focus. This was mostly caused by the fact that the entirety of my learning time was spent in one room, in front of my laptop, with only my housemates to socialize with. This caused a lot of disdain for my work and led to burnout symptoms where I found it awfully hard to find any motivation. Alas, this was caused by the Covid-19 pandemic and not much could have been done about that, which brings me to my next point. Another cause for the stress caused by having so much to read was the fact that I would find myself reading an entire page and by the end of the reading, it would dawn on me that I had not retained a single piece of information. This would be very frustrating, and everything would have just spiraled into being very unproductive. This was during my first encounter with Module 6, which completely overwhelmed me.

During my third year, I retook all the classes in Module 6. Having the experience of the previous year, I knew what to expect and how to prepare more, both in an academic way and a psychological way. This was the first step towards achieving passing grades. Furthermore, this time around I have asked one of my peers to study with me, either at the library or a cafe. Doing this before every exam has helped me stay on track and be more motivated, which ultimately ´ helped me pass my classes. Moreover, I noticed that talking to someone (in this case, my peer) and having a conversation about the topic of the exam has helped me grasp the concepts much more easily compared to just reading through the books. This can be related to the PASS method mentioned in chapter 2, which demonstrates how being in a group of peers can facilitate studying through mutual encouragement. Another great change I made in my studying routine was the fact that I would skim through the required reading, try to remember the key aspects, and then explain those concepts to a peer and try to go as much into detail as possible. These changes can help me understand better how I can build my final project, and what strategies I can apply in order to achieve the desired outcome.

4.1.4 Focus groups

The aim of the project is to improve the ease of learning for Module 6 Creative Technology students. In order to achieve an encompassing overview of the students' situation, the most appropriate method would be to conduct research through focus groups. The focus group sessions have received ethical approval from the EEMCS Ethics Committee, under the reference number "RP 2022-44". In this part of the project, students that have agreed to participate in the focus group will be divided into two groups: the first group will consist of students who have passed module 6 in one try, while the second group will consist of students who have gone through module 6 more than once. The reason for this division is due to the fact that the two groups would have vastly different perspectives on the structure of the module. Moreover, students from the second group might feel uncomfortable talking about this subject with people who passed the module in their first try. By putting them together with students with similar experiences, they might feel more comfortable and open up more in detail about their thoughts and feelings about module 6. Furthermore, focus groups have an exploratory element to them, which will facilitate the ideation process when making design choices. In this case, it is much more important to collect qualitative data compared to quantitative data since the primary aim of the research is to identify what allows students to study better or what are their likes and complaints and not necessarily how many students have passed certain classes.

The focus group sessions went as follows: the participants have been recruited through mutual friends and WhatsApp group chats. Four people have been selected for each group. They have been given an information brochure and a consent form to sign beforehand. The have been informed about what will be discussed during the sessions, that the session will be audio recorded and then transcribed (with the audio file being deleted afterwards), and that they can choose to end/leave the session at any point if they feel uncomfortable. They have also been given the contact information of the researcher, the supervisors, as well as the Ethics Committee. The consent form and the information brochure can be found in the Appendix. After the participants have been selected and they have given written and verbal consent, the sessions begin. They have taken place at the University of Twente, in a project room.

The first focus group session has uncovered useful information about the students' wants and needs. The transcript of the discussion can be found in the Appendix section. The start of the conversation consisted of the participants discussing their overall opinion of the module, then their opinion on the Research and Design for User Experience class. This subject proved to be quite the controversial topic, since the opinions varied from student to student. Some students claimed that the course is too unstructured, whilst others stated that they did not attend the lectures or read the material. The consensus was that the class, in combination with the rest of the subjects from Module 6, is extremely challenging. The most discussed reasons for failing this class were as follows:

1. *The content should have been structured differently.*
2. *The content was too theoretical.*
3. *The theory and practical aspects were not connected enough.*
4. *The students did not attend the lectures or do the reading.*

Thus, the focus of this project should be on improving the following: content structure, combining theory and practice, and increasing motivation. Moreover, the students have also discussed what could be improved for them to achieve a better understanding of the subject. The students of the first group have identified the following possible improvements: encouraging social studying activities with fellow peers, having a better selection of information that they should study, making the content separation clearer. When asked about the possibility of having a learning app, most were enthusiastic. The majority stressed that they feel like the app should have a social aspect to it, through which the students can interact with each other (and possibly the teacher as well). This way, the students can ask and respond to questions, creating a 'group feeling', by helping each other. To expand on the gamification aspect, students who help others can also be rewarded through points, badges or achievements.

The second focus group session consisted of participants that have passed the class in one try. The transcript for the session can be found in the Appendix. One topic that was brought up by several students was the quantity of learning that had to be done. Whilst this seems to be a common theme, one student brought up the fact that they used an audio software which took the text and transformed it into an audio file. The student listened to the audio in their free time (whilst doing chores as well) and managed to retain the information just by listening to the material being read out loud. This could be a potential solution to the reading issue that most students seem to have. However, the only downside to this is the fact that since the software reads every single word of the book, it becomes extremely time consuming to go through the entire material. The figure on the left illustrates the most popular studying methods described during the focus group sessions. One particular aspect that was interesting was brought up by a student who said that after finishing an exam, they felt rewarded, or accomplished. The others nodded in agreement, which means that implementing quizzes in the learning app could be an efficient way of motivating students to practice their knowledge. Furthermore, the students from the focus group came to the agreement that a learning app aimed towards the ResDesUX should send out daily reminders, such as prompting the student to answer a question, or reminders to do some daily reading. This option could be controlled by the user, who can decide on the frequency and the content of the reminders, thus personalizing the learning experience, according to the users wants and needs. One aspect that was mentioned in both focus group sessions was the fact that students feel the need to have a stronger communication with the teacher. The second group suggested that the app could allow teachers to monitor how much time students spend on a certain topic. For example, if the teacher considers that a chapter would take the average student 4 hours to learn, it could be very easy to discover discrepancies between the expected time and the real learning time. That way, the teacher gains insight on how the students are managing the study load and can make certain adjustments or offer additional support. On the other hand, this could bring up some ethical issues regarding the students' privacy.

Figure 11 - Most popular studying methods mentioned during the sessions

All in all, the focus group sessions uncovered many useful insights. The main issues that students face have been identified, possible solutions were discussed, and most importantly, the sessions have helped to steer the project in the right direction. The most discussed issue was the structure of the content, and the most liked elements of a possible learning app are daily reminders, as well as quizzes and interactive lessons. The discoveries from the focus group sessions will be used in the next phases of the project in order to come up with the best possible solutions for all the stakeholders.

4.2. Preliminary requirements

Based on the analysis of the stakeholders and the background research done (including the focus groups, autoethnography and state of the art), it was possible to build a preliminary requirements table (see below). The requirements are based on the information gathered in the first part of the project, and will be used in the further stages, when coming up with concepts, ideas and the design of the finished product. These

requirements will determine what elements will be included, as well as the prioritization of user needs, in the context of the time frame given for the project.

Table 3 - Preliminary requirements

No.	Requirement	Source
1.	Should contain improved structure.	Focus groups, autoethnography
2.	Should contain accurate information.	Focus groups, teachers (stakeholders)
3.	Should be accessible to all students.	Students (stakeholders)
4.	Should include learning mechanisms aimed at university students.	Background research
5.	Should help with information retention.	Background research
6.	Should include gamification elements.	Background research, state-of-the-art
7.	Should provide support for the ResDesUX class.	Students, teachers

4.3. Idea generation

The process behind generating ideas for the graduation project was primarily focused on finding as many ways as possible to facilitate studying. This was done through mind-mapping, writing down everything that came to mind, as well as separating all these ideas into different categories, based on concept, difficulty and effectiveness. Moreover, the background research done in chapter 2 has provided a solid framework for identifying the most feasible and effective elements that should be included in the project. The figure highlights the mind-mapping process. The main topic that is being researched, which is learning approaches, can be seen in the center. There are seven categories/approaches, each with some examples. The examples are color coded based on their feasibility (how realistic it would be for these elements/concepts to be part of the graduation project). Green signifies realistic goals/elements that can be included, yellow symbolizes elements that would be nice to include but are not a high priority, and red signifies elements that, whilst related to the topic, are not very realistic in terms of time management. After these concepts were categorized, the next step was to identify the most effective elements that should be incorporated.
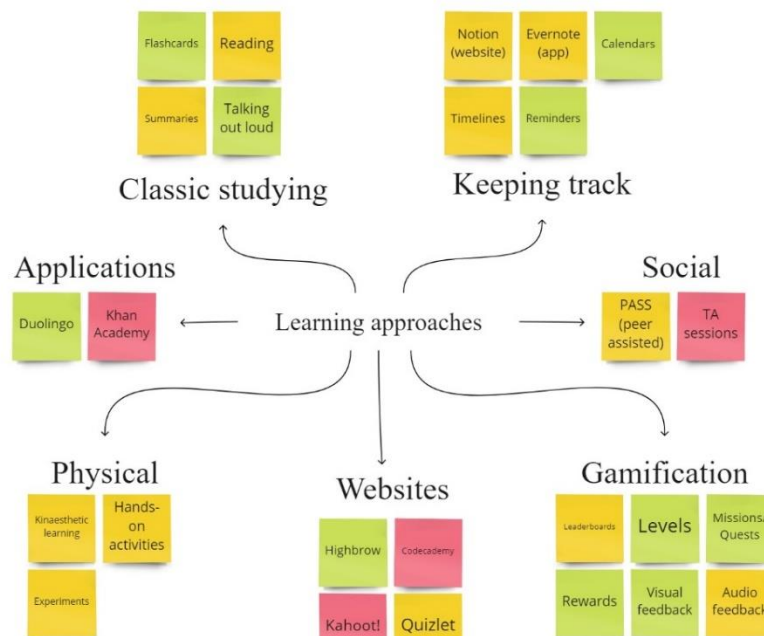
Figure 12 - Miro board for mind-mapping

The final selection of concepts can be seen in the figure below. The final idea was to create a learning application, with gamification elements similar to Duolingo, that still encourages a social approach, where peers can assist each other with questions, doubts, sample exams and so on. The social aspect was selected due to the large number of students that, during the focus group sessions, have expressed a need for a tool that makes it easier to interact with fellow peers. The application would take the lessons for the Research and Design for User Experience class and structure them in levels, with tasks and missions. Every time the user would learn something new, or complete a task, the app would give visual (and possibly audio) feedback. A reward system would also be incorporated into the application. Furthermore, the concepts of flashcards and 'talking out loud' would also be included, since keeping 'traditional' studying elements would help the student feel more grounded in the learning process. Lastly, reminders would be sent occasionally (with a higher frequency in the beginning of using the app), in order to ensure that the students create a daily habit of using the app.

Figure 13 - Final concepts

Figure 14 – Mood board

4.3.1 Inspiration board

Following the mind-mapping session, it became clearer what the final concept would be. To have a clearer overview of the goal, a inspiration board (see figure 14) was created with existing concepts from other learning applications that could possibly be embedded into the graduation project. Apps such as Duolingo, Khan Academy or Quizlet were used as main inspiration. All these examples have embedded gamification into their system in one way or another. What all these apps have in common is the fact that they put a very big emphasis on positive feedback and rewards.

4.3.2 Sketches and concepts

Sketching is a crucial step in the ideation phase. It allows for many different iterations of the project without putting too much commitment into only one idea. Sketching is an exploratory method that was used in this project to identify possible variations for different elements of the final version of the learning app. Kas (2021) describes the following elements of an efficient sketching approach: the classic pen and paper (in this case, drawing tablet), adding basic shapes (for clarity and quickness), text and annotations (adding more detail to the sketch), and UI pattern conventions (such as menus, buttons, radio or check boxes etc.). All these elements are present in the sketches used in the project, based on the inspiration chosen from the project, such as Duolingo, and the desired elements that would be included in the app.

Dashboard

The dashboard is the default screen that the user will see when opening the app. It will include navigation elements that allow the user to switch between tabs, from their profile to a lesson, or maybe a discussion page. Below you can see sketches of possible concepts for a dashboard screen. The dashboard's main functionality will be providing quick access to lessons and quizzes (see below, 2 concepts). It will combine vertical and horizontal scrolling, and will include subtle animations, to make the app livelier. In the top right corner, the app will display the current level of the user and their progress bar based on their experience level.

Figure 15 - Dashboard concepts
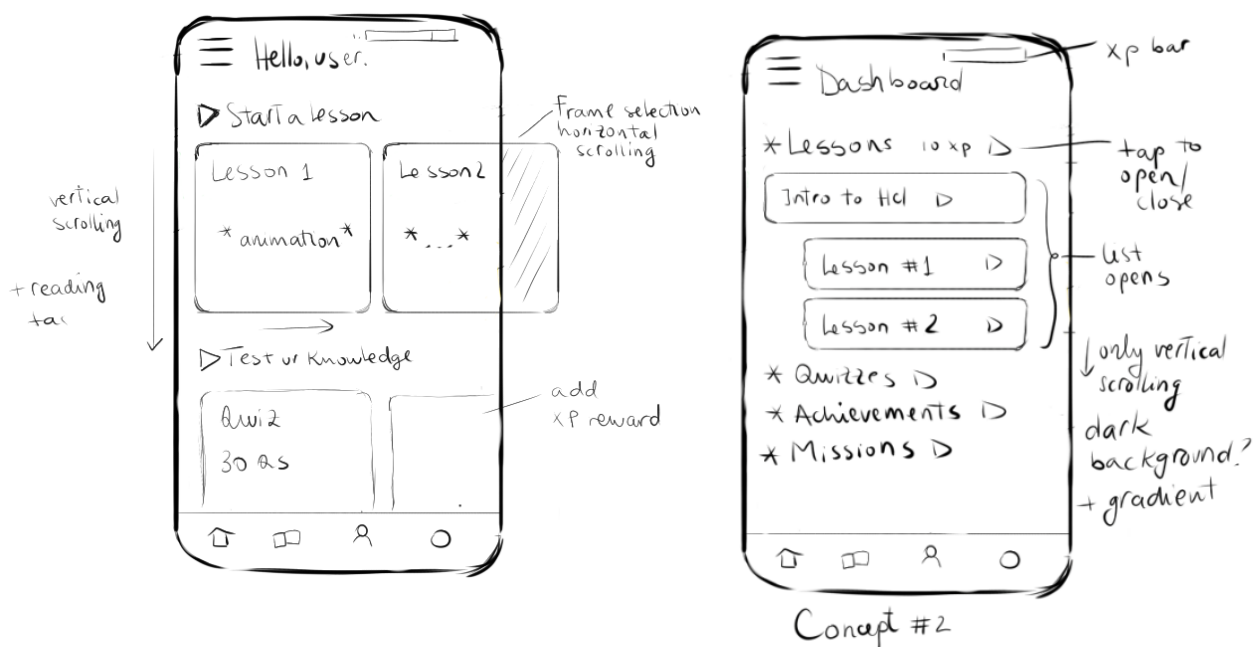
Calendar element

One of the most requested elements for the learning app was a calendar/schedule option. The Canvas plaform already has such an option, however it lacks many elements. In this project, the calendar element will include two main variants: a monthly view and a weekly view, which can be toggled through the click of a button (see below). The monthly view will use vertical scrolling , whereas the weekly view will use horizontal scrolling for navigation, to improve user experience. The calendar highlight four color-coded events: exams marked in red, quiz prompts marked in yellow, reading prompts marked in blue and completed tasks marked in green. When clicking on an event, the student can see positive reinforcement messages such as "Good job!" for a completed task, or "You can do it!" for an upcoming exam. Moreover,

the student can add their own events/tasks if they wish to complete additional actions. The user can go back to other tabs by accessing either the side menu (top left corner) or the bottom menu tabs.

Figure 16 - Sketches of the calendar element
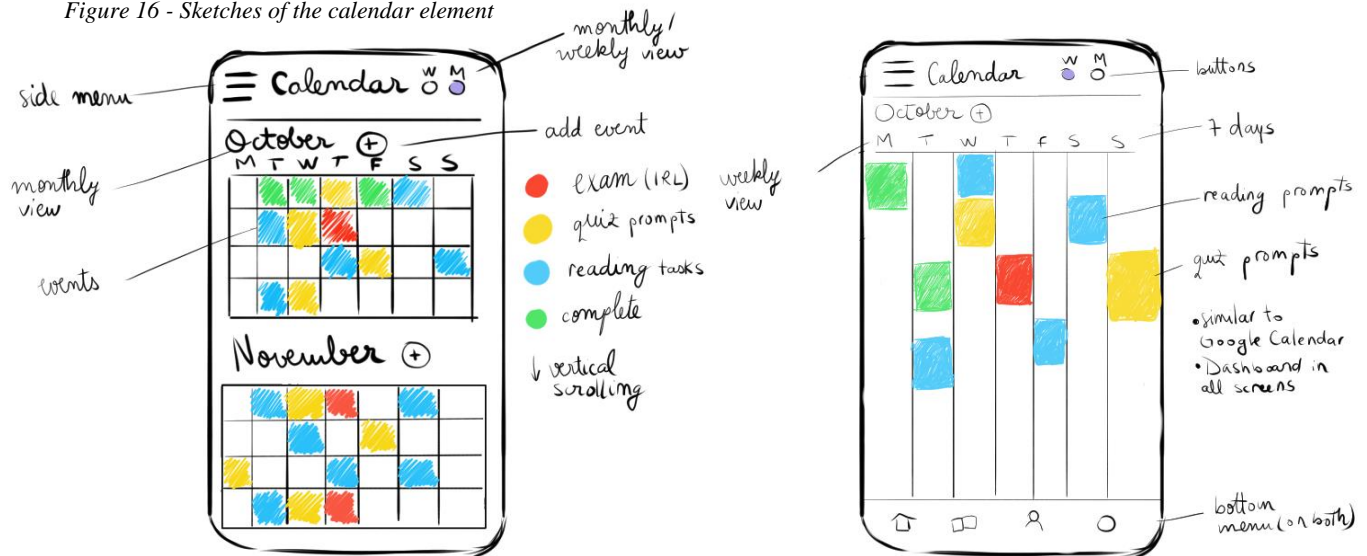
Quizzes

The quizzes were designed in such a way that they test out the student's knowledge and encourage them to use recall skills in order to answer the questions. Moreover, the quizzes contain different types of questions and exercises, such as multiple-choice questions, fill in the blank exercises, or word association exercises. By diversifying the exercises, students keep their focus more efficiently and can complete more questions without being fatigued. The sketches below illustrate possible iterations of some quiz exercises that will be available in the learning app.

Figure 17 - Quiz question concepts
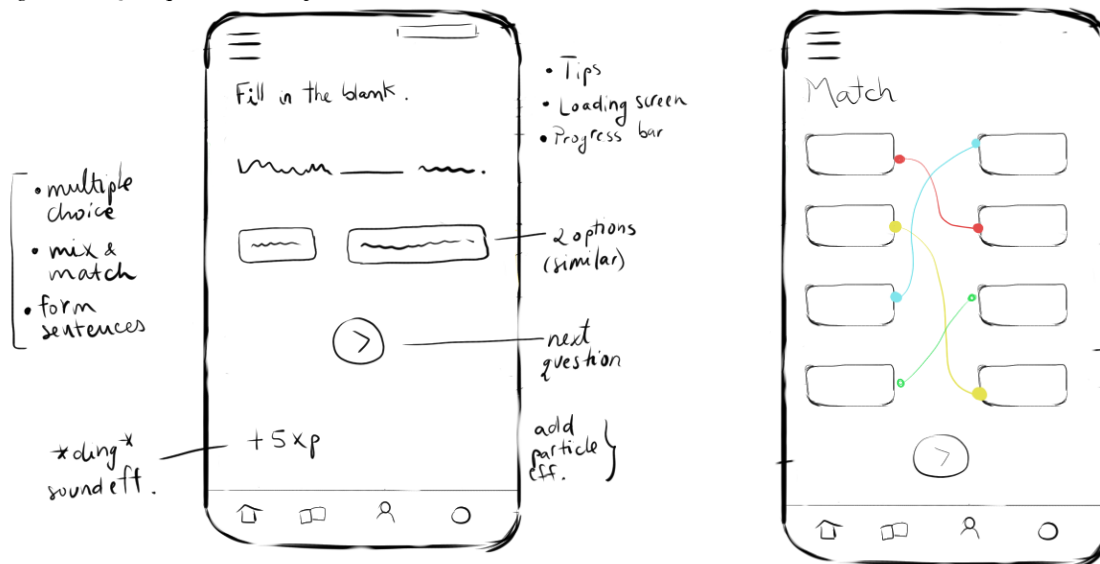
Lessons

The initial idea for the 'lessons' element was to first have the option to have an overview of all the chapters available with a completion bar, that would show the user how far along they are in each lesson (see figure below). The completion bars would show a percentage as well as have a color associated with the amount of completion. As seen on the right, green, yellow, orange and red would each indicate a certain percentage of completion. Below is a lo-fi Figma example of how the sketch on the right might look like. The figure below is only indicative and not the final design.
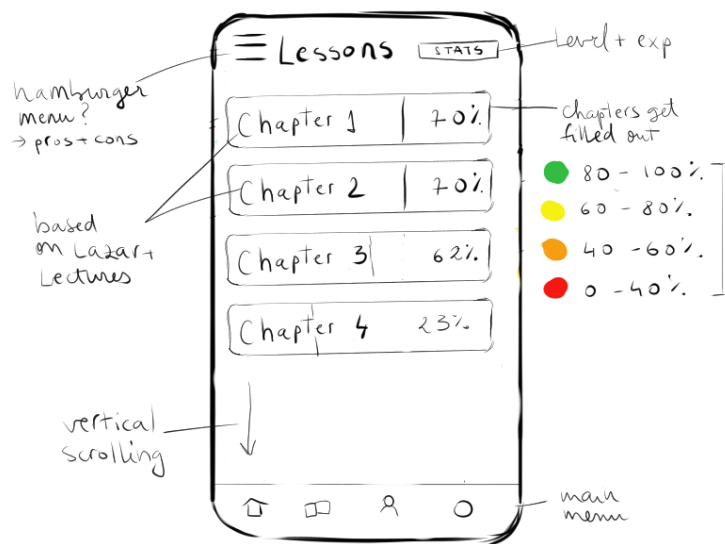
Figure 18 - Lo-fi 'Lessons' prototype   .
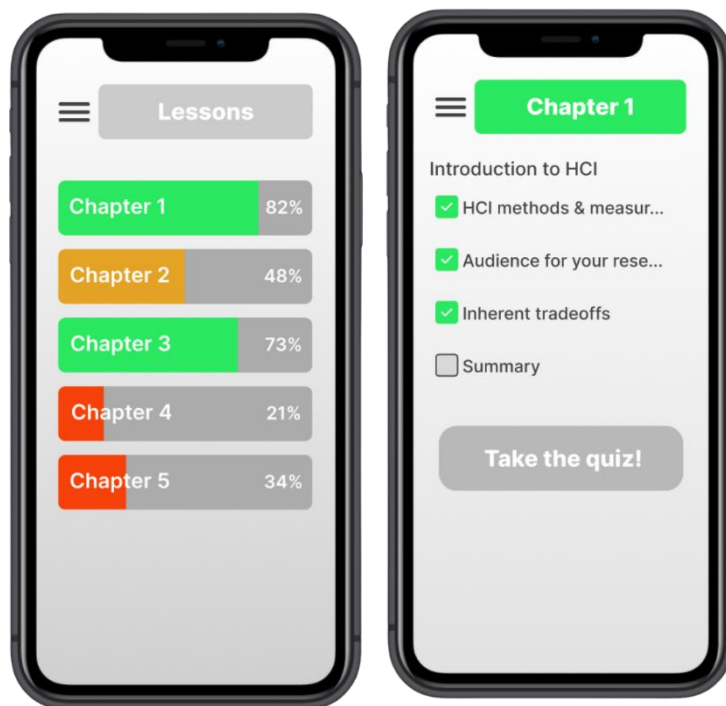
The lessons in the learning app will be structured in the specification phase. This will most likely influence the current strucutre of the concept. Moreover, having a clearer strucucture of the content will help solidify the design choices made throughout the process.

Profile

The user's profile will allow the student to track their progress, manage their goals and see their achievements. The most important aspect of this screen is the progress tracking element, which can be visualized through bar charts, diagrams etc. Using the knowledge gathered during Module 8: From the Source to the Senses, data visualization is an efficient method of visualizing information. Using the appropriate visualizations is very important and can be done using several 'conventions' when creating data charts. In this case, in order to track a timeline of the user's progress, the best option would be having a line

chart to track how many exercises the user has completed, as well as a pie chart or circular chart, to track the types of exercises the user has completed.

4.3.3 Final concept

Based on the sketches illustrated above, the final concept becomes more tangible, in anticipation to the Realization phase. The final result will consist of a learning app that will have a dashboard, interactive lessons, quizzes with diverse exercises and a profile tab to track progress. The gamification elements will be finalized in the specification phase, after the curriculum structuring is finished (this is due to the fact that the aim of the gamification elements goes beyond visual aesthetics and are meant to encourage the user to study). The figures below illustrate the chosen color scheme, as well as the font choices. When envisioning this application, the most important aspect to keep in mind was that this is an app meant for Creative Technology students. One of the most unifying opinions of the focus group CreaTe students is their attachment to setting every app, window, tab etc. to *dark mode*. That is why the learning app will have a dark background. Moreover, it is a known UX rule that using pure black is not indicated in any design (Okail, 2020), which is why a dark grey was chosen for the main color. Furthermore, there will be 3 main highlight colors (the app will use a triadic color palette approach, to create a good balance between contrast and harmony) to make the UI more friendly in appearance, as well as actually highlight the most important elements of the app. In terms of fonts, 'Nunito' was chosen as the font meant for headings and other important textual elements, whilst 'Inter' was chosen for subheadings, as well as other text details. Nunito was chosen as the main font because it has an approachable feeling, with the rounded corners, whilst also not being too distracting. It gives the app a more polished appearance whilst also maintaining a 'personal' and recognizable look.

Figure 19 - Color scheme and font choices

Chapter 5 – Specification

The specification phase followed the timeline described in chapter 3. It started with a proper definition of the user requirements, based on the focus group findings, state of the art, and background research, followed by requirements prioritization using the MoSCoW method. Following that was the persona creation phase, combined with more sketches and storyboarding. The last two phases were coming up with an adequate curriculum structure and early prototyping. After that came the realization stage. The reason why this phase is important is because having a clear overview of all the user/functional/non-functional requirements is the basis on which the project will be built on. Without having an established base, the project built on top of it will not hold up.

Figure 20 - Most requested app elements
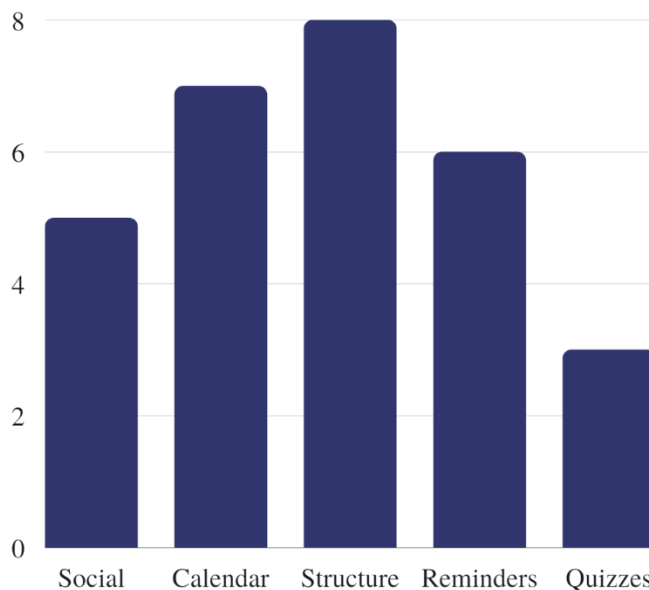
5.1. User requirements

Based on the background research and the focus group sessions (where students have shared their most desired functions in a learning app), the following elements have been identified:

1. A social aspect, which allows students and teachers to communicate openly about any topic relevant to the class.

2. The calendar element, which aids students in having a clear overview of their progress and schedule.

3. Better content structure, to help students have a better grasp of the subject.

4. Reminders and prompts to study, read or do a sample quiz.

5. Quizzes, to test one's knowledge.

The social aspect implies that the app provides a way for students and teachers to communicate. This can help students with any questions they might have about the content of the class and can also help teachers understand what part of the curriculum proves to be the most difficult. The social aspect could mean that the students can leave comments on lessons, quizzes etc. in the app, and have other peers or teachers respond to them. Another option would be to have a section of the app like a forum, where students and teachers can have open discussions. This option would provide more freedom for expression compared to the comment version. The social element was seen as quite popular, since most students agreed that studying with others is beneficial. However, despite being a very requested element, the social aspect is not the most important element that should be included in the app. Not only that but finding the right approach to this would be very time consuming and might not fit within the time frame of the graduation project.

The calendar element consists of a schedule overview, which the student can edit. As it was mentioned in the ideation phase, the calendar could have two versions, a weekly and a monthly one. The tasks/events would be color coded, ensuring that the student has a proper overview of their progress within the class. From a technical point of view, a calendar element is feasible within the context of the graduation project.

The structural element will be a core aspect of the project. Since this element was the most discussed and every focus group participant seemed to agree that they would like to see improvement in that area. The content structure will be discussed with the teachers, and it will mostly follow the lecture slide's structure.

Reminders will work similar to the Duolingo reminders, in the sense that they will be daily and will contain messages that will encourage the user to open the app and use it for at least a few minutes every day. The content of the reminders will mostly consist of reading and question prompts (e.g.: "How would you define triangulation?") or quiz prompts ("A sample quiz is awaiting you!" or "It's time to prepare for your exam on Tuesday!").

Quizzes will also be an integral part of the project. They will be designed in such a way that the students want to practice as often as possible, and that the information is retained quite fast and efficiently. They will also be created with the assistance of the teachers. The exercises will be diverse (not just simple multiple-choice questions) and will encourage the student to make connections and recall information from the content of the class. This will lead to a better understanding of the subject and ultimately, less worry for the students when it comes to passing exams.

Other than the elements identified through the focus group sessions, the rest of the background research has also provided useful insights when it came to requirements gathering. These elements include gamification concepts, visual/audio/haptic feedback, flashcards, and peer-assisted study sessions.

Figure 21 - MoSCoW diagram for user requirements

5.2. Requirement prioritization

The figure on the left illustrates the prioritization of the requirements in section 5.1., using the MoSCoW method. The requirements that are necessary to be present by the end of the project are the following:

- *Improved content structure for the class.*
- *Gamification elements.*
- *Sample quizzes.*

These requirements were chosen based on the preliminary requirements list, as well as the additional research done afterwards. Another criterion that was a deciding factor for the "must-have" requirements was how feasible they are considering the time frame of the project. It is important to have a realistic plan.

For the "should-have" section, calendars, reminders and visual feedback are elements that are also high on the priority list. They will make the experience more effective and are still somewhat doable within the time frame. The "could-have" section includes a flashcards option, as well as a social element. An audio feature, which would include sound effects for the app, would bring complexity to the project, however, it is lower on the priority list. The app will not have haptic feedback.

After the final requirements list has been finalized, it is important to form an idea of the final result of the project. Based on the figure above, the final project will consist of a learning application that will re-structure the ResDesUX class content, will use gamification elements and offer sample quizzes. The app will be constructed in Figma (using additional plugins for audio output, embedding code etc.). The app will also most likely include a calendar, reminders and visual feedback (animations etc.). The app could have a flashcard and social element, as well as audio output. The app will not have haptic feedback.

5.2.1. Functional requirements

After the requirements prioritization has been finished, it was possible to create 2 tables with the final functional and non-functional requirements. This was done using the information brought up in the previous

chapter 5 sections, as well as the background research and the preliminary requirements table. The functional requirements table can be seen below. The functional requirements strictly refer to the technical aspects of the projects, and how the final result must look like. The requirements have been divided based on their urgence and importance. The division has been made using the MoSCoW method.

Table 4 - Functional requirements

No.	Requirement	Importance
1.	The app COULD include levels, achievements and experience points.	Medium
2.	The app MUST divide the ResDesUX content into appropriate tasks.	High
3.	The app MUST provide diverse quizzes.	High
4.	The app COULD include visual feedback, such as custom-made animations.	Medium
5.	The app COULD include a calendar function.	Medium-high
6.	The app COULD have a reminder function.	Medium
7.	The app COULD have a flashcard function.	Low
8.	The app COULD have audio feedback.	Low
9.	The app COULD have a social/communication function.	Low
10.	The app SHOULD have different learning styles available.	High

5.2.2. Non-functional requirements

The non-functional requirements table (below) refers to the effects that the final product should have. It is based on the needs of the users that have been described during the background research and focus group sessions. The requirements are the goal of the project. During the evaluation stage, these requirements lists will be re-visited, in order to check whether or not the goals have been achieved.

Table 5 - Non-functional requirements

No.	Requirement	Importance
1.	Help students create better studying habits.	High
2.	Make students feel more in control of their learning experience.	High
3.	Make ResDesUX more approachable.	High
4.	Make an easy-to-use learning app.	Medium
5.	Make an aesthetically pleasing app.	Medium
6.	Should help students create a daily studying habit.	High
7.	Create an approachable structure for the class content.	High
8.	Create different learning styles fitting for students.	High

5.3. Persona creation

In order to create a better understanding of the user needs, 2 user personas were created. The personas (graphics made using HubSpot) were based on the perspectives of different students, specifically those who have participated in the focus group sessions. After the focus group sessions, it became clear that most students find themselves into two main categories: those who are not particularly interested in the subject (e.g., students who do not watch the lectures, who are not very enthusiastic about going through the reading material) and students who do show an interest in the field of Research for User Experience (though some still experience difficulty with the ResDesUX class). Below are two illustrated diagrams that represent two such personas.

5.3.1. Persona 1: the 'programmer' student

Creative Technology is a very broad bachelor's study. The students who choose this academic path have a very broad range of talents and passions. Some are more creatively inclined whilst some are more technical and prefer classes such as Artificial Intelligence and Programming or other similar topics. The 'technical' students usually more likely to face difficulties when going through the ResDesUX class. Take Lena (below), for example. Lena already knows that she wants to be a software engineer in the future, and in her opinion, the ResDesUX class is not that interesting. Her main goal is to just pass this class so she will not have to worry in the future about it. Her biggest challenges stem from her difficulty with focus, long text, as well as the fact that she chose to not attend the lectures and rather study before an exam, in hopes for a passing grade. Other than passing the class, her goals include understanding the basics of ResDesUX, as well as develop a more consistent studying strategy. She is reluctant at the idea of having a learning tool that would make going through all the reading material much easier but is willing to try it out.

Figure 22 - Persona 1 Lena Oxton

Name
Lena Oxton

Job Title
Student

Age
21

Biggest Challenges
- Focusing on the class
- Has trouble with long text
- Doesn't follow the lectures
- Isn't too passionate about the subject

Goals or Objectives
- Pass 'Research and Design for User Experience'
- Understand the basics of the class
- Be more consistent with studying

Bio
I'm in my second year of Creative Technology and the ResDesUX class is so difficult! I gave up on watching the lectures, so I hope that I can just read the book by the time the exams come. I'm not too keen on the subject, since I like programming way more. My biggest issue is that I can't focus for too long, and we have so much to read! I wish there was a way to make this class easier :(

5.3.2. Persona 2: the UX-oriented student

The second persona relevant to the project is Ana (below), who is a student that is passionate about Research and Design for User Experience. Though she finds the subject interesting, she still has difficulty with understanding the subject to the degree that she would want to reach. This stems from her challenge of applying concepts from the class into real life context, as well as not being able to manage her time properly. It is also important to take into consideration that Ana is redoing Module 6, which means that this is her second time going through this class. In fact, going through ResDesUX twice has made her realize that this is a subject that interests her. She feels confident that she will pass, so she is not too worried about it, but this time around she wants to feel like she has a deep understanding of the subject. She also wants to create a daily studying habit. She also says that she wishes for a more practical and interactive way to study this subject.

Figure 23 - Persona 2, Ana Amari

5.3.3. Scenario 1: Persona 1 uses the learning app

The creation of the two personas is very insightful when it comes to determining how the app should work/look, especially since they were based on actual Creative Technology students. The persona creation process helps the researcher have a deeper understanding of the user's challenges, wants and needs. In order to understand how the user will interact with the final product, it is necessary to create different user scenarios. In this scenario, the first persona, Lena, decides to use the learning app. Lena only wishes to get a passing grade for ResDesUX and downloaded the learning app in hopes that this will help her understand the basics of the class. She sets her learning goal to 5-10 minutes a day, since she does not think that realistically she would spend more time than that. In her perspective, other classes should require more attention from her.

After downloading the app and setting a learning goal of 5-10 minutes of practice a day, Lena is excited, thinking that she will be able to pass ResDesUX. The first week, she keeps up with the learning goal, finishing a reading task and a short quiz. By the second week, things become more difficult, and she has less and less time. She starts skipping some daily goals in favor of studying for other classes. After a month, Lena's daily goal of 5-10 minutes a day turned into maybe 20-30 minutes a week. Soon enough she realizes that she must change something. Increasing the daily goal might not be the most effective and realistic method. It seems evident that a daily goal would not work in Lena's case. She needs motivation that is based on her goals, which are to be more consistent withs studying and most importantly, pass the class. This could be done by having a 'weekly goal'. Instead of spending a short amount of time every day, Lena could spend around half an hour every 2 or 3 days and do some high-intensity exercises.

Lena's new goal has been set. Before, she was feeling discouraged that she gave up on her daily goal, but now she feels better about it. She found that the new style of learning suits her better. Now she feels less anxious about the exams and is eager to prove her knowledge. Her studying habits have improved, and she is more confident that she will pass the class. However, she does feel some pressure since last time she took an exam, it did not result in a passing grade. Now she wants to prove herself.

5.3.4. Scenario 2: Persona 2 uses the learning app

In the second scenario, the second persona, Ana, will use the learning app. When she first opens the app, she sets her daily goal to 15-20 minutes a day. She is eager to use to app. Since she is passionate about the subject, Ana keeps up with her daily goal without a problem. In fact, she wants to prove herself and wants to test everything that she has learned. She even started doing sample tests in the app more often! She finally created a daily studying habit, like her initial goal stated. As time passes, by using the app more and more,

Ana feels less anxious and realizes that this subject might be what she wants to pursue as a future career. That makes her feel happy, which is ultimately the aim of the learning app. She feels like the app helped her discover her learning style. By the time the exams come, Ana got an 8.7 on average! Compared to last year, when she failed the course, she feels much more accomplished.
Below is a user journey diagram that showcases the experience of the two personas in these scenarios.

Figure 24 - User Journey Diagram for 2 Personas

5.4. Curriculum structure

The curriculum structure can be seen in the Appendix. It has been separated in three main study units, to match the content of the exams. Each section will include information from J. Lazar's book, 'Research methods in human-computer interaction', the class Reader, as well as the video materials needed for the exams. The videos will be embedded in the learning app, in order to have all the materials in one place. The reason why it is important to have all the materials in one centralized place (the app) is because the students in the focus group have expressed that they feel like they lose their focus every time they have to open a different tab to find and access all the needed materials, and that having one place where they could find everything would be beneficial to their motivation. The way the content will be structured will be as follows: the three units are separated in chapters based on the content of J. Lazar's book. After each chapter, the student will be able to take a quiz to test their knowledge. After each unit, the student will unlock a more comprehensive quiz that encapsulates information from every chapter, in order to simulate the feeling of a real exam.

The table below illustrates possible question types for the quizzes, based on their difficulty to implement. Having a diverse set of questions can improve the student's information retention and increase their motivation (Kirschner et al, 2018). The sets of questions (table 6) will help when creating the gamification element. After the curriculum structure was finalized, the next step was to figure out how to integrate gamification into it.

Table 6 - Possible question examples

No.	Question/exercise type	Difficulty to implement
1.	Multiple choice questions	Easy
2.	Fill in the blank	Easy/Medium
3.	Mix and match	Easy
4.	True/False	Easy
5.	Open questions	Hard
6.	Form sentences	Medium
7.	Embedded answers	Medium

5.4.1. Gamification elements in relation to the structure

The chosen approach to make the learning app more engaging was to add gamification elements based on the content of the application. The primary gamification element that will be used will be achievements/badges that the student can unlock by accomplishing learning tasks (see table below). The achievements will be based on the number of reading tasks completed and the number of quizzes completed. For example, every 5-10 reading tasks will result in an achievement, every quiz will result in an achievement and so on. Finishing a unit will also result in achievements.

Table 7 - Achievements and their description

No.	Achievement description	Achievement name
1.	Finish your first quiz.	Quiz Whiz I
2.	Finish 5 quizzes.	Quiz Whiz II
3.	Finish 10 quizzes.	Quiz Whiz III
4.	Finish your first reading task.	Knowledge gatherer I
5.	Finish 5 reading tasks.	Knowledge gatherer II
6.	Finish 10 reading tasks	Knowledge gatherer III
7.	Finish the first learning unit.	ResDesUX Part 1
8.	Finish the second learning unit	ResDesUX Part II
9.	Finish the third learning unit	ResDesUX Final part
10.	Finish a unit quiz.	Quiz master I
11.	Finish 2 unit quizzes.	Quiz master II
12.	Finish 3 unit quizzes.	Quiz master III

5.5. Lo-fi prototyping

The lo-fi prototyping was done after the requirements were set. The plan was to create a snippet of the app in the form of a reading task, as well as a short quiz. The testing process has been as follows: the participants are given a consent form and an information brochure (which have been added to the Appendix) describing the testing phase. After the participant has given their consent, the researcher joins an online call with the participant (using Discord, Microsoft Teams, or any other application the participant feels most comfortable using). The researcher will be muted and will have their camera off, whilst the participant screenshares the prototype link that has been sent to them. It is important to take into consideration the Hawthorne effect which refers to the participants reactions being different once they know that they are being watched. Unfortunately, the only way to minimize them is to remain completely muted throughout the testing, despite the participant knowing that they are being watched. With that link they will complete the reading task as well as the short quiz, whilst the researcher watches and takes notes. It is important to note that the screenshare will not be recorded, in order to protect the participant's privacy, in case they receive any notifications throughout the completion of the tasks, or if they accidentally minimize the tab. After the participant completes the tasks, they will be invited to answer a series of questions regarding their experience with the prototype. Afterwards, they will be sent a link with a survey with more general questions about their thoughts and feelings. By taking notes and observations throughout the testing, having a short question session with the participant as well as sending out surveys, the researcher made sure to try to uncover as many insights as possible. This testing session has received ethical approval from the EEMCS Ethics Committee, under the reference number RP 2022-83.

Figure 25 -Quiz prototype screenshots
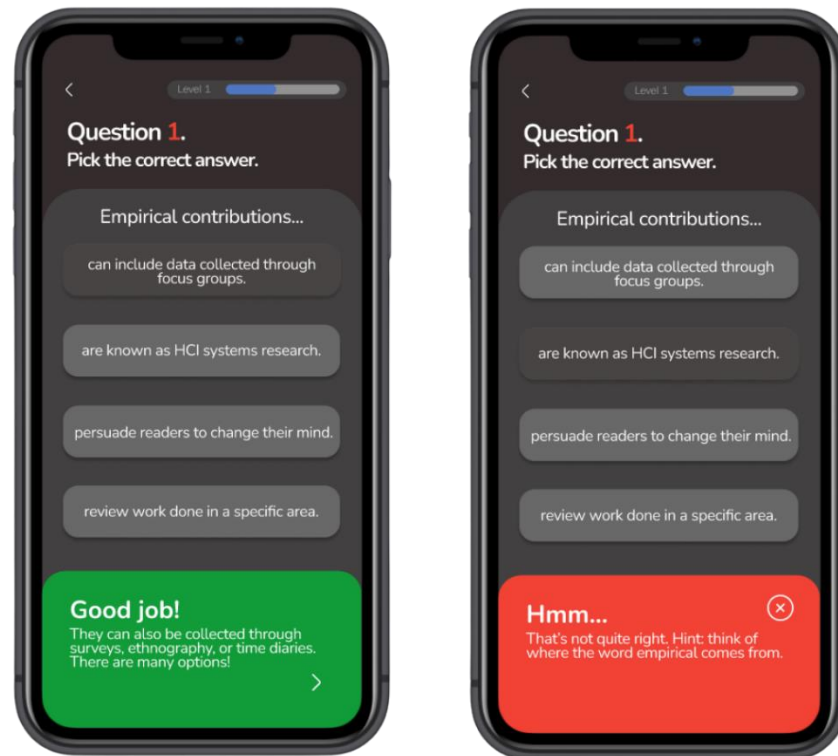
The prototype consisted of four different types of quiz exercises, namely multiple-choice questions, true/false questions, fill-in-the-blank, and exercises with embedded answers. The questions also included feedback for the user's answers (see above). The reading material consisted of four subsections of the 'Introduction to HCI' chapter, namely HCI methods and contributions, research audiences, inherent tradeoffs and a summary of the chapter. The results from the user testing have provided useful insights into the learning application's final design and will be discussed below. Initially, during the first week of prototype research, 4 participants have gone through the prototype testing.

5.5.1. The reading element

The results seemed to have a common characteristic, namely that the reading element of the app was not what they had expected. The desired reading element would have been more dynamic and interactive. The first iteration of the prototype had some interactive elements, but they seemed to have not been enough for the possible users. At the end of the first week, it was time to reevaluate the strategy and try a different approach. Instead of a simple prototype testing, the participants would be involved in A/B testing, in which they will also use a second version of the prototype, in order to see if there has been a positive change in the design of the app. In order to create the second version of the prototype, there had to be some more research done. When coming up with ideas that could make reading easier, one concept stood out. Comic books and graphic novels are easier to read than regular books, and according to Decker and Castro (2012), they discuss how their approach of using a comic book to teach students about a historical event helped them be more connected to the students and encouraged them to become more engaged with the content of the class. One aspect that is important to mention is that the comic book comparison that was made was not meant to be taken in a literal sense. The learning app, visually, will not look like a comic book and will not have comic book characters that use speech bubbles. That approach would be very time consuming and

would require a completely different approach to learning. Instead, the concept of comic books has been used in the 'background' of the app. The fast-paced reading, the skimming through text and the visual and stimulating elements are all concepts that make comic books easy to go through for mostly everyone. The surprising outcome was the fact that even students who were not very keen on reading became interested in the subject. This is exactly the desired outcome of the project. The next step was to figure out how to incorporate this concept into the existing framework. *How can comic books be used in the context of a learning app?*

The second concept consisted of separating the existing prototype into smaller chunks. That way, the information that the user needs to understand is smaller. In order to compensate for that, the navigation should be faster. The navigation button size was increased and there were transition animations added to make the user feel like they are skimming through a lot of text at once. Adding visual cues like that would increase the attention span of the user, thus improving the quality of the experience and the user's retention of information. Making the screen shake or having certain buttons react when being tapped will add to the interactivity level of the app. Whilst all that sounds effective and the obvious solution, it was important to test it out with real users and see if the assumptions being made were accurate. Thus, the testing began once again.

The second testing session had been more successful compared to the first one. This time, the focus was on the reading element of the app, in order to determine which version was better. The reaction of the participants was much more positive, with many claiming that, compared to the first version, this one felt more fluid and interactive, and the interaction provided felt more seamless rather than forced. The speed at which they went through the information was faster as well, reducing the time in which they read through the entire chapter. All participants considered that chapter 1 was readable in a 10-minute time frame, which proves hopeful that the other chapters (which are much lengthier) will also have a shorter readability time frame (though 10 minutes is a bit unrealistic). These concepts were used in the second round of testing to see if they are appropriate for this project and if it is a good idea to apply it to the rest of the app. The results of the testing have concluded so.

5.5.2 Quiz profiles

Other than the reading element, the project still needed that 'novelty' element, to make it stand out. This was quite the challenge since education is a highly researched field and at times it felt like everything had already been discovered or built already. After several discussions with my supervisor and critical observer, as well as a lot of individual turmoil, I decided that the quiz element could benefit from some improvement. In the evaluation stage I conducted more user testing sessions in order to prove that the final version of the quiz element brings a novelty aspect and proves that having different variations of the app catered towards different learning styles is beneficial and improves the student's learning experience.

Chapter 6 – Realization

The realization part consists of the actual creation of the product. According to the diagram presented in chapter 3, which illustrates the timeline of the realization phase, the first step should be the decomposition of the project into sub-systems. After those sub-systems have been identified and properly defined, each individual element needs to be created. The final phase consists of the integration of all elements, after which it is possible to transition to the evaluation stage.

6.1. Sub-systems

The division of the sub-systems can be seen in the table below. It consists of four main sub-systems (which can also be divided into their own respective sub-systems). The separation of the sub-systems provides an ample view of the tasks that need to be accomplished, as well as providing a framework to work with when creating each individual element.

Table 8 - Sub-system identification

No.	Sub-system	Function
1.	Gamification elements	Rewards the user for learning.
2.	Lessons + quizzes	Teach the user ResDesUX concepts + test knowledge
3.	Visual + audio elements	Provide visual feedback + aesthetic + complexity

6.2. Sub-system building

Each of the sub-systems mentioned in the table above have their own elements. Each element required different tools and software to create them, as well as their own individual planning. This section will highlight the process of creating each element and how each tool was used. Section 6.3 will highlight the integration of all these elements into one cohesive project.

Figure 26 - Onboarding quiz
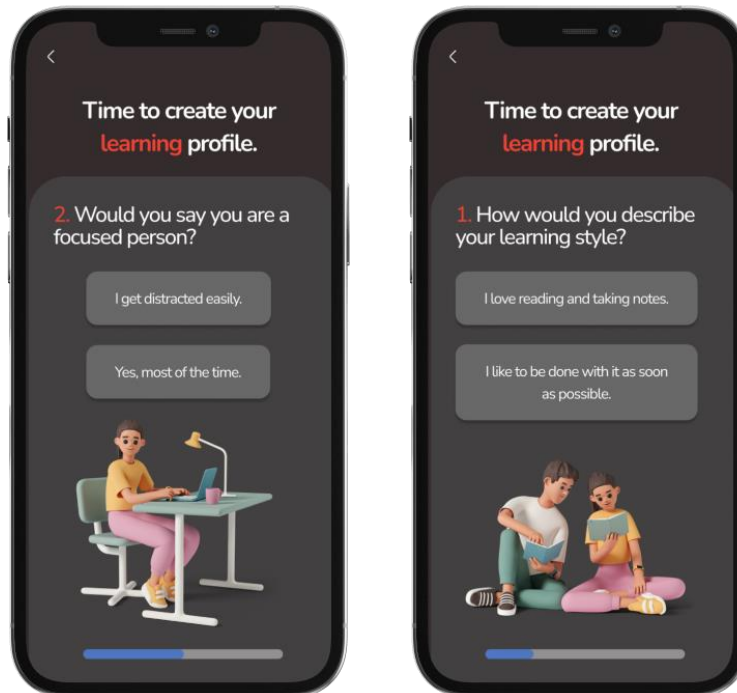
6.2.1. Gamification elements
Profiles

During onboarding, after creating a profile, the user must answer a series of questions in order for their app to become personalized. This could be considered a gamification element since video games usually attribute certain characteristics to 'classes.' In this case, a 'class' could be considered a learning style. Part of the quiz can be observed in the figure on the left. Based on the users' answers, the learning app creates questions that are most suitable for the user.

Badges & achievements

The implementation of all the chapters from the class content would allow for the addition of achievements (below). These achievements would make the user feel more rewarded when completing learning tasks and would incentivize them to be more consistent with learning. The figure below illustrates different types and tiers of possible achievements, for completing reading tasks, quizzes and study units.

Figure 27 - Achievements

6.2.2. Lessons & quizzes

Lessons and quizzes are two of the most important elements of the application. Both are meant to be interactive, as well as effective in terms of teaching and testing the user's knowledge. Moreover, these elements are also the key towards making the final product innovative and new. By creating the base for a learning tool that can easily be adapted for the content of any class regardless of subject, it is one step forward towards making higher education more accessible for everyone and facilitating learning for many students.

6.2.2.1. Lessons

The reading element of the application was finalized after the first user testing sessions, in which the participants indicated that they felt that the content should be more interactive and structured differently. In order to achieve this, the content was divided into smaller chunks to make it easier to go through. Moreover, the reading section includes several interactive elements that have the user tap the screen once every few seconds to maintain their attention. This would be similar to how Duolingo and Highbrow manage to keep their users' attention, with fast paced, bite-sized exercises, that do not overwhelm the user.

6.2.2.2. Quizzes

The quizzes are based on the lessons and test the knowledge presented in each respective unit, to ensure that the student keeps up with the class material and becomes more prepared for the actual real-life exam. In order to make the quizzes more interactive and entertaining, the questions had different formats. Every time the user would give an answer, they would get some sort of feedback. Correct answers would yield a positive message, whilst a wrong answer would encourage the user to try again (and give them a small hint as well).

What is important to note about the quiz element is that it brings a novelty aspect to it. The way it was implemented shows that the project can be used as a template for other institutions that wish to create personalized learning applications for their students. The quiz questions have all been put into an Excel sheet. The sheet contains questions separated into chapters and categories, as well as their respective wrong/correct answers. Before the embedding of the Excel sheet into the Figma file, the only way to display the questions was to manually create each screen with its question, number answers and feedback. For one chapter that is alright, however, most university classes are quite extensive and in order to go through all the content of a class, each chapter would need many more questions (over 100 for some chapters). With the Excel Sync plugin (see below) for Figma, the project is now much more efficient since one Figma screen can contain an unlimited number of questions and answers. This is done by syncing an Excel sheet with the Figma file (or any database for that matter) and by naming the text boxes appropriately, each cell from the file can be brought into the file and manipulated accordingly.

Figure 28 - Excel sheet syncing with Figma

	Question	CHPT	Type	Answer
1	What are empirical contributions?	1	Short	can include data collected througl
2	_____ are the type of audience which are concer...	1	Medium	Policymakers
3	True or False: According to Schneiderman, micro-HC...	1	Medium	False.
4	_____ contributions provide a corpus for the ben...	1	Medium	Dataset.
5	True or False: Combining big data approaches with r...	1	Long	True.
6	True or False: It is considered a standard in the HCI fi...	1	Medium	False.
7	_____ contributions focus on the design and devel...	1	Long	Artifact.
8	Triangulation is...	1	Short	when all efforts come up with the
9	_____ are the 2 most common types of research c...	1	Medium	Empirical & Artifact.
10	True or False: Longitudinal studies in HCI are rare.	1	Short	True.
11	Opinion contributions...	1	Short	are writings which seek to persua

It is important to note that requirement 10 from table 4 has been added later on than the Specification phase and that after the implementation of the data base syncing, it was decided to turn the 'different learning styles' requirement into a must-have. This was due to the fact that it had potential to become the novelty aspect and it was an interesting research topic that fit well within the context of the project.

Feedback overlays
When answering a question, in order to make the application more responsive, the user receives feedback. A correct answer results in positive reinforcement, whilst an incorrect answer would result in the app trying to steer the student in the right direction. This makes the user create a stronger connection with the app and feels rewarded when completing a question. Whilst making individual feedback overlays for every question might be not very time efficient, it is important that at least for the current version of the project, it is included, in order to have an overview of all the functionalities that can be added in a real app.

Figure 29 - Feedback overlays
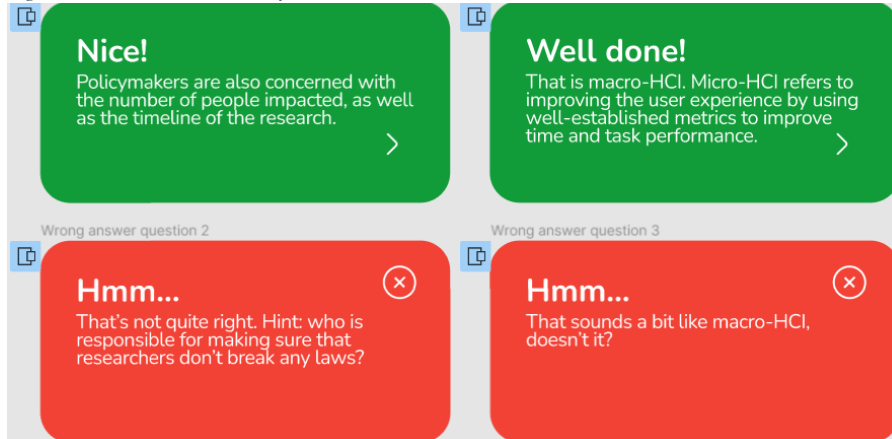
6.2.3. Visual elements

The visual elements, whilst mostly cosmetical and not necessarily functional, add a layer of complexity to the project and the overall user experience, making the app more realistic in order to improve the user testing results. The visual elements were implemented using the available functions provided by the Figma software, as well as embedded using Figma plugins that facilitate HTML and CSS code (Anima). One of the most powerful functions of the Anima plugin is that it can take the Figma prototype and can transform it into HTML & CSS code with 100% accuracy. What this implies is that the project can more easily be made into a fully-fledged product and can be made into a web version as well, with slight modifications.

Figure 30 - Snippet of HTML & CSS from Anima plugin
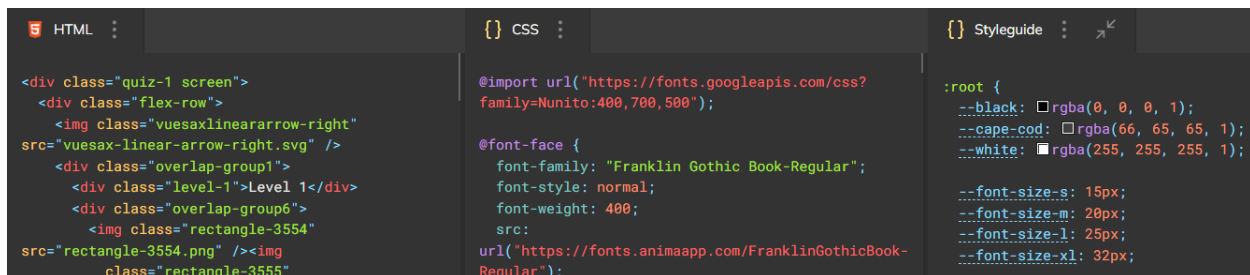
Visual elements provide the user with necessary feedback when performing an action. The learning app uses subtle visual elements (from animating buttons when clicking them) to more complex animations (such as having a confetti effect when completing a task). By incorporating these elements into the lessons and quizzes, along with the gamification aspect, the learning app becomes a much more interesting experience for the user.

Button effects

The hovering effect for when the user taps over a button was created using the Smart Animate function in Figma. Below is an example of such a button. The first rectangle on top is the Default state. The Default state means that the user is not hovering over the button, hence Click = False. In the middle is an ellipse with the color of the second rectangle, but its opacity has been turned to 0%. In the second rectangle, the ellipse increases in size and turns its opacity to 100%, thus changing the color of the first rectangle completely. By connecting the first two rectangles in the Prototype tab and choosing the Smart Animate

Figure 31 - Figma button hover effect
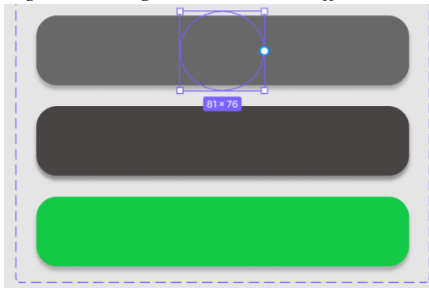
option, the interaction between them creates a smooth effect. The last rectangle is activated when the user clicks on it and changes it to green, thus symbolizing a correct answer.

Animated background gradients

One of the approaches taken in order to have a more visually appealing app was the addition of gradient backgrounds. In order to add more complexity to this element, the gradients were animated so that they would subtly move, making the app seem more dynamic. Below are two examples of such backgrounds, used for the dashboard tab, specifically the thumbnails for the lessons. The way the gradient is animated is by creating different polygons with a blur effect added on top, making a frame element, pasting the first element a few times then taking the polygons and rotating them slightly in each frame. Using the Prototype tab, the frame elements were connected and Smart Animated, thus creating the effect.

Figure 32 - Gradient background elements

Chapter 7 – Evaluation

The final step of the design process is the evaluation. This will uncover whether the set requirements were met and if the final product has made an impact. The evaluation stage of the project included several user testing sessions, in which the researcher wanted to prove that having different version of the app accompany different learning styles is beneficial to the user base. Below is an overview of how the user testing process was conducted.

7.1. Quiz profile testing

The importance of students having individual learning styles has been highlighted throughout the entire project and incorporating this into the quiz element was the perfect situation to explore something that is still new. The concept is to take Marosan et al's (2022) approach of classifying learning styles into categories ('the Protus system'), each with their own respective threshold. The system represents an approach which encapsulates most students, which is what makes it so efficient. The table results are based on questionnaire answers from participants.

Table 9 - Example from Marosan et al (2022) on how to determine learning styles

Active/Reflexive			Sensitive/Intuitive			Visual/Verbal			Global/Sequential		
Question	A	B	Question	A	B	Question	A	B	Question	A	B
1	1		2	1		3		1	4	1	
5		1	6		1	7	1		8	1	
9		1	10		1	11		1	12	1	
13		1	14		1	15	1		16	1	
17	1		18		1	19	1		20	1	
21	1		22		1	23		1	24		1
25		1	26	1		27	1		28	1	
29	1		30		1	31		1	32	1	
33	1		34	1		35		1	36	1	
37	1		38		1	39	1		40	1	
41	1		42		1	43	1		44	1	
Overall (sum of marks within one column)											
Active/Reflexive			Sensitive/Intuitive			Visual/Verbal			Global/Sequential		
	A	B		A	B		A	B		A	B
Sum	7	4	Sum	3	8	Sum	6	5	Sum	10	1
Index of the particular style											
−2			3			−1			−5		
Learning style type											
Fairly well balanced			Moderate preference for Intuitive			Fairly well balanced			Strong preference for Global		

Above is an example of Marosan et al's system. The learning style is determined based on whether the resulting index and whether it fits into a certain threshold. The learning styles highlighted are either 'moderate/intuitive' or 'global', or well-balanced with a slight preference for either. The same approach will be used to create the learning styles for the users of the app. To test whether taking this approach will yield positive results, it is necessary to do more rounds of user testing. The user testing will aim to prove the main hypothesis.

> *H0: There is not a significant difference in opinion when it comes to the different quiz variations.*

against:

> *H1: There is a significant difference in opinion when it comes to the different quiz variations.*

Thus, the testing began. The participants were given two sets of questions, one tailored to the global style and one to the sequential style. To prove the hypothesis, it would be necessary that the participant scores significantly lower on one of the versions of the tests. The two versions (sequential and global, since the

goal of the app is to achieve better information understanding) of the prototype were finalized, this time only with the quiz element present. In order to gather as many responses as possible (to make the research more relevant), the prototypes and a short questionnaire were sent out to students. Here is how the prototypes were built:

1. For the sequential style of learning, the quiz was built in a linear manner, that follows the class content in a straight line without any deviations. Marosan et al (2022) describe sequential learning styles as a process that follows a logical pre-determined course. In the context of the project, this type of quiz would follow the information structure from Lazar's book, along with the chunking of information and the fast scrolling.
2. Global style learning, as described by Marosan et al (2022), is a style of learning in which the focus is not on the basics and simple concepts, but rather on more complex subjects, skipping over introductory elements. Moreover, this style of learning allows students to have a very broad overview on the subject, which to some may prove more beneficial than starting with the basics. In the context of the prototype, this learning style meant that the questions were more complex and would not follow a 'start-end' structure.

The questionnaire that accompanied the prototypes had 10 questions. The questions had a similar structure, in which the participant was meant to choose between the 2 quizzes (questions like, 'what quiz made you more focused', 'what quiz made you understand the information better' etc.). The questionnaire was inspired by the model used by Marosan et al (2022). The questions used a slider format (from 1 to 100). 10 participants responded to the questionnaire. After all the results were collected, the questionnaire responses were put in a table. Each set of answers was categorized and analyzed as in the table below.

Table 10 - Results for question 1

Question 1	
Mean	42.9
Standard Error	11.99856
Median	43.5
Mode	1
Standard Deviation	37.94279
Sample Variance	1439.656
Kurtosis	-2.00409
Skewness	0.071514
Range	91
Minimum	1
Maximum	92
Sum	429
Count	10
Confidence Level (95.0%)	27.14264
Lower bound	15.75736
Upper bound	70.04264

The calculations resulted in the t-value being 1.848. 1.848 is greater than 1.330 (significance level of 20%) but less than 2.160 (significance level of 5%). This is most likely since the number of the participants in the sample is quite small, which means that the results are not necessarily accurate. However, in the context of this research, they can serve as an indicator as to whether the different learning style variations are

beneficial and have an observable effect. In this case, we can say that, at a significance level of 10%, there is a significant difference between the means of the samples and that we can reject the null hypothesis and conclude that the alternative hypothesis can be correct.

7.2. Requirements

In order to deem the project successful, it is crucial to look back at the requirements set out in the Specification stage and analyze each requirement in terms of completeness. Below is the non-functional requirements table. For the first requirement, it is difficult to say whether the app actually improves one's studying habits, since that would require lengthy testing. Whilst only future CreaTe students can answer this question, I do want to keep a positive attitude and imagine that my project could help others.The requirements will be considered complete based on the user testing evaluations and the final version of the app. Requirements 2-3 are not yet determined if they are complete: by making a personalized learning app and structuring the content in an appropriate manner, students are in control of their own learning experience, whilst simultaneously going through the class content in an easier way. However, in order to confirm this, it would be necessary to conduct user testing specifically aimed at analyzing this requirement. Requirements 4-5 are also complete (the app has a polished look, and its functionalities are straight forward and easy to use, since none of the participants encountered difficulty when using it, though future testing would be needed to fully confirm this). Due to time constraints, the calendar function has not been implemented into the full version of the app, thus marking the sixth requirement incomplete. Requirement 7 has been completed since the content has been structured based on student needs. Requirement 8 has been completed since the app can be catered towards multiple learning styles.

No.	Requirement	Complete?
1.	Help students create better studying habits.	To be determined
2.	Make students feel more in control of their learning experience.	Not determined
3.	Make ResDesUX more approachable.	Not determined
4.	Make an easy-to-use learning app.	Yes
5.	Make an aesthetically pleasing app.	Yes
6.	Should help students create a daily studying habit.	No
7.	Create an approachable structure for the class content.	Yes
8.	Create different learning styles fitting for students.	Yes

7.3. Evaluation conclusion

Based on the results of the user testing and the analysis of the requirements, the final version of the project looks quite different from its beginnings. Some functionalities have been added as the project progressed along (such as the database implementation), whilst others have been dropped along the way, mostly due to time constraints. Whilst not everything that has been discussed in the beginning of the project has been implemented, the current version is something that can serve as a learning tool and does fulfill its aim of making learning more interactive and most importantly, a personal journey.

Chapter 8 – Future work

As mentioned before, not all functionalities could be implemented into the learning app. Moreover, certain limitations did not allow for the exploration of all the possibilities within the project. Firstly, it would be interesting to conduct proper research on the topic of the different learning styles and quizzes, since throughout this project only 10 participants could be examined. The sample is not large enough to fully come up with a decisive conclusion regarding the effect of having different app variations. Perhaps, in the future, it would be possible to gather more participants and prove (or disprove) the theory that catering to the different learning styles of students will result in a better experience.

Furthermore, with more research being done, the 'personalized' aspect of the app can be fully explored and perfected so that the app encapsulated all possible learning styles. As of now, the system of choosing a learning style consists of basic concepts, however, with more research it is possible to create something truly personalized for every student, which would be quite novel. This would mean that the quiz element would encapsulate more learning styles. For that to be feasible, it would mean that a larger set of questions should be researched and tested with more users. If the participants sample is large enough and enough data is collected, then every user can find themselves in the established learning style spectrum, which then can be translated into the learning app. That way, the database implementation could be improved to the point where it is possible to apply it to learning styles such as active/reflective, visual/verbal and more.

Secondly, the learning application can have more functions implemented. For example, the progress tracking could be an extremely beneficial element for the students and teachers alike. Not only would it motivate students to be more mindful of their learning journey but for the teacher it would provide an insightful image of what their students are most struggling with and thus would help them have a better understanding of their class. Moreover, the calendar function would tap into the aspect of having the user create a daily studying habit, having reading tasks and quiz tasks spread throughout the week at a pace that is manageable. This would greatly improve the learning effect of the app and would help the student create a healthy studying habit.

Another possible addition to the research could be expanding to different courses or even different universities. Having the insight of multiple professors could prove to be beneficial and would make the learning app more comprehensive. With additional teacher interviews, the content of the app could be restructured even further and adapted into different class topics.

As for the future of the learning app, I believe that it can be used further than one class in the Creative Technology Bachelors. With its current functionalities, it can be adapted into any type of content, with as many variations as possible. With this number of unlimited variations, other courses can make use of it. Furthermore, students would feel like they have more learning resources if they know that the class that they are attending provides a personalized app for that specific curriculum, as well as for their specific learning style.

Chapter 9 – Conclusion

9.1. Discussion

The initial research questions were the following: *how can academic learning and reading be facilitated through interactive methods, through a HCI focused framework* and *what are the most efficient and effective methods to comprehend information from academic texts that are particularly complex?* The answer to the first question has been answered by the implementation of the personalized quiz element. The user testing shown in the evaluation proves that having different variations for different learning profiles results in better learning and makes the student feel better about their experience. Having the quiz element also provides the novelty aspect to set apart the project from other products, like having different variations in combination with the data base system embedded into the app creates a multitude of opportunities for the app to be used in different fields, classes, institutions and so on. It is important to note that whilst the app can prove to be effective, there is an inherent trade-off when it comes to the reading of the material and developing the needed skills to acquire knowledge. When focusing mostly on the knowledge gathering skill, there is a possibility that it could be detrimental when it comes to the time spent on learning activities. As for the second question, the answer lies in the reading element, which provides an alternative to the traditional book reading, which to some, is not the most ideal option.

However, getting to the final version of the product was not a linear process. Through the user testing sessions, it became apparent that the version I had in mind was not necessarily the most effective in terms of achieving the original goal of creating an app meant to help students. Whilst at first, I became pretty stumped and had no idea how to get out of the rut of not knowing how to continue the project, eventually, after many tribulations, I had reached a point where I was satisfied with the concept. After making the necessary changes and taking the time to understand what my potential users need, I had made the breakthrough with the database/Excel integration, which would solve many of the issues I had up until that point with the project. I have learned that sometimes it is important to take a step back and visualize everything from a broader perspective rather than tunnel vision through a task to be as time efficient as possible. One of the most important aspects of this project was the research. Research is a broad topic since it includes so many procedures and concepts that take years to master and understand. More importantly, research is necessary almost everywhere, no matter the field of work. Throughout this project I have tried out several research methods and have observed how others (professionals) conduct their research and how they interpret their results.

Moreover, having design thinking skills is another essential aspect of being a Creative Technology student, which I have further established throughout my graduation project. However, I think that from a personal perspective, what mattered the most to me was discovering what I want to build as a future career. Whilst working on the learning app, I uncovered a hidden passion for design and suddenly I had a clear idea of what I wanted my future to look like. The more I worked on this project, the more sense of individuality I discovered. Soon after, my graduation project became a passion project rather than an obligation I needed to fulfill. I would look up tutorials and save design and UX resources that seemed interesting, and I would constantly be reading more and more about what it means to be a good designer. The more I read the more I realized how all these concepts were covered by the Creative Technology curriculum, and that I already had the theoretical base, I just needed to apply it into the project. And for that, I am very grateful for having chosen this topic.

Some of the topics brought up when discussing the project with my supervisor were in regard to the platform chosen to support the app. I chose to create a mobile phone app, rather than a website based one. Moreover, in the focus group sessions, some students mentioned that they would like to see a website version as well. The reason why I chose a phone app is because would offer the option to use the app even without an internet connection, whereas a website would always need to be connected. This could mean that the student can go through the reading or finish a quiz whilst in the train or waiting for the bus, without having to worry about being connected to the internet. Moreover, people spend the most time on their phones rather than their laptops, and usually associate laptops with work and phones with leisure. That way,

the user does not associate the app with a chore, but rather a pastime. Similar to Canvas, the student would have all their material needed for the class in one app. However, the learning app goes beyond what Canvas does, since it solely focuses on learning, whereas Canvas has a myriad of different functions, that can sometimes get overwhelming. Personally, as a student, I see Canvas more as a management application, since it is clear what assignments and exams are upcoming, but it is a bit lackluster in the learning aspect. My learning app prioritizes the studying element.

As for the app itself, in its current form, it has the most important functionalities that were discussed in the beginning. The reading element has gone through different iterations, until a preferrable solution had been found, and the quiz element (the most important aspect) provides that novelty element that can take the project from a hi-fi prototype (with plenty of functionalities) to a fully-fledged product that can be used by other institutions to make learning more accessible and easier for their students. Furthermore, the app consists of more than the typical prototype characteristics and is similar to a finished product. Overall, the finished product has accomplished its purpose. On the other hand, I would have liked to be able to do more User Centered Design-related research, especially regarding the visual elements of the application. I had different iterations of the app that could have been used, but in the end, I had to pick one. The color and font choices have been casually discussed with friends, but if the project time frame had been larger I would have considered doing more research about what font styles and color palettes would have been better for the app. In my opinion, the current font could be interpreted as a bit too 'creative' for the context of the project and the 'Inter' font is not dyslexia-friendly, which could pose accessibility issues. On that topic, the spacing of the lettering has also not been carefully chosen due to lack of time.

9.2. Limitations

One of the limitations of the project was the time constraint. Whilst 10 weeks for research and 10 weeks for the actual implementation was sufficient to create a finished product, having more time would have allowed for more features to be implemented, as well as more content, such as different chapters or embedding videos and so on. One of the features that would have been interesting to implement was the progress tracking. Apart from the fact that it would have been useful for many, it would have also allowed me to showcase the skills I had gained from Module 8, specifically the Data Visualization class. To track the progress of the user, I would have created visualizations (in the form of bar charts, pie charts etc.) in the Flourish or Tableau software and embedded them in the prototype. Moreover, the visualizations would have been interactive and dynamic, allowing the user to see their progress in real time, as well as possible predictions or insights of their future progress. Another feature that had not been implemented due to time constraints is the calendar function. In the sketching process I had made some concepts for a calendar function which would have included a weekly and a monthly view. In order to track the progress, the charts would have been connected to certain Figma screens, and using Figma plugins, would have stored the progress of the user.

Another limitation was the software used. Whilst Figma is the best available software for prototyping apps (because of its base functionalities and community plugins), it is not very flexible when it comes to elements that go beyond visuals. That it why it was more difficult to implement the Excel sheet embedding, and it would have taken a very long time to add a progress tracking feature. However, Figma is a very powerful tool, and it has allowed me to convey my ideas in the short time frame that was available. Moreover, using the plugins available, it could be quite easy (though time consuming) to transform the prototype into an actual product.

9.3. Overall conclusion

Overall, the project had a personal significance. Going from failing the subject to dedicating 20 weeks for my final graduation thesis on the same topic, I can proudly say that I am proud of what I have accomplished and of the things I have learned along the way. The goal of the project was to conduct research and find a solution for students who might feel discouraged by certain classes and provide them with a tool that can help them in their learning journey. This project has laid down the foundation for something that can

become bigger and can impact the lives of many other students. The two most important aspects of the final result are the fact that it can allow teachers from any class to add their own material to it, thus creating different versions of the app which can help students understand the curriculum better, and secondly, that the students are in charge of their own learning journey and that the app becomes personalized based on their individual learning styles.

References

Adams, N. E. (2015). Bloom's taxonomy of cognitive learning objectives. *Journal of the Medical Library Association : JMLA*, *103*(3), 152–153. https://doi.org/10.3163/1536-5050.103.3.010

Abykanova B., Nugumanova S., Yelezhanova S., Kabylkhamit Z., Sabirova Z. (2016). *The Use of Interactive Learning Technology in Institutions of Higher Learning*, Atyrau State University, Kazakhstan.

Blanco, C. (2021). *Duolingo 101: How to learn a language on Duolingo*. Duolingo Blog. https://blog.duolingo.com/duolingo-101-how-to-learn-a-language-on-duolingo/

Buehl, D. (2017). *Classroom Strategies for Interactive Learning, 4th edition* (4th ed.). Stenhouse Publishers.

Busse, C., Mahlendorf, M. D., & Bode, C. (2015). The ABC for Studying the Too-Much-of-a-Good-Thing Effect. *Organizational Research Methods*, *19*(1), 131–153. https://doi.org/10.1177/1094428115579699

Cairncross, S., & Mannion, M. (2001). Interactive Multimedia and Learning: Realizing the Benefits. *Innovations in Education and Teaching International*, *38*(2), 156–164. https://doi.org/10.1080/14703290110035428

Cao, J. (2015). *The psychology of visual UX*. TNW | Dd. https://thenextweb.com/news/the-psychology-of-visual-ux

Decker, A.C., & Castro, M. (2012). *Teaching History with Comic Books: A Case Study of Violence, War, and the Graphic Novel. The History Teacher, 45(2), 169-187.* http://www.jstor.org/stable/23265918.

Gee, J. P. (2004). *What Video Games Have to Teach Us About Learning and Literacy*. Palgrave Macmillan.

Goulding R. R. J. et al (2017). "*Impact of the quick-response code based in-class assignments on student engagement and retention*," Papers on Postsecondary Learning and Teaching: Proceedings of the University of Calgary Conference on Learning and Teaching, 2, 42-50.

Grant, A. M., & Schwartz, B. (2011). Too Much of a Good Thing. *Perspectives on Psychological Science*, *6*(1), 61–76. https://doi.org/10.1177/1745691610393523

Gundumogula, M. (2020). Importance of Focus Groups in Qualitative Research. *The International Journal of Humanities & Social Studies*, *8*(11), 299-302. https://doi.org/10.24940/theijhss/2020/v8/i11/hs2011-082

Kaowiwattanakul, S. (2021, October 20). *CEFR Based Learning Approach: Using Literature to Enhance EFL Students' Reading Skills and Critical Thinking Skills | Kaowiwattanakul | English Language Teaching | CCSE*. CCSNET. https://ccsenet.org/journal/index.php/elt/article/view/0/46143

Kim, B. (2015). Designing gamification in the right way. Library Technology Reports, 51(2), 29-35.

Mader A.H. and Eggink W., "*A Design Process For Creative Technology*", Proceedings of the 16th International conference on engineering and product design education, Enschede, The Netherlands, 2014, pp. 568-573

Martosenjoyo, T. (2021). Higher Education Color Design Based on Organizational Vision. *Education Quarterly Reviews*, *4*(2). https://doi.org/10.31014/aior.1993.04.02.216

Microsoft. (2012, December 12). *TechNet Wiki*. Language Quality Game. Retrieved April 10, 2022, from https://social.technet.microsoft.com/wiki/contents/articles/9299.language-quality-game.aspx

Nantschev, R., Feuerstein, E., González, R. T., Alonso, I. G., Hackl, W. O., Petridis, K., Triantafyllou, E., & Ammenwerth, E. (2020). Teaching Approaches and Educational Technologies in Teaching Mathematics in Higher Education. *Education Sciences*, *10*(12), 354. https://doi.org/10.3390/educsci10120354

Patrick, Y., Lee, A., Raha, O., Pillai, K., Gupta, S., Sethi, S., Mukeshimana, F., Gerard, L., Moghal, M. U., Saleh, S. N., Smith, S. F., Morrell, M. J., & Moss, J. (2017). Effects of sleep deprivation on

cognitive and physical performance in university students. *Sleep and Biological Rhythms*, *15*(3), 217–225. https://doi.org/10.1007/s41105-017-0099-5

Price, J., Lumpkin, A. G., Seemann, E. A., & Bell, D. C. (2012). Evaluating the Impact of Supplemental Instruction on Short- and Long-Term Retention of Course Content. *Journal of College Reading and Learning*, *42*(2), 8–26. https://doi.org/10.1080/10790195.2012.10850352

Senkova, O., Otani, H., Skeel, R. L., & Babcock, R. L. (2018). Testing Effect. *Journal of Effective Teaching in Higher Education*, *1*(1), 20–36. https://doi.org/10.36021/jethe.v1i1.15

Smiderle, R., Rigo, S. J., Marques, L. B., Peçanha De Miranda Coelho, J. A., & Jaques, P. A. (2020). The impact of gamification on students' learning, engagement and behavior based on their personality traits. *Smart Learning Environments*, *7*(1). https://doi.org/10.1186/s40561-019-0098-x

Stansberry, S. L., & Haselwood, S. M. (2017). Gamifying a Course to Teach Games and Simulations for Learning. *International Journal of Designs for Learning*, *8*(2). https://doi.org/10.14434/ijdl.v8i2.20897

Ståhl, M. & Kaihovirta, H. & Rimpilä, M. (2017). *Visual Learning and Identity Construction through Gamification in Visual Art Education.*

Thaariq, Z. Z. A., & Surahman, E. (2021). How does educational technology answer challenges? Empirical theoretical studies and public perspectives. *Journal of Education and Learning (EduLearn)*, *15*(3), 474–482. https://doi.org/10.11591/edulearn.v15i3.19598

van der Weiden, A., Benjamins, J., Gillebaart, M., Ybema, J. F., & de Ridder, D. (2020). How to Form Good Habits? A Longitudinal Field Study on the Role of Self-Control in Habit Formation. *Frontiers in Psychology*, *11*. https://doi.org/10.3389/fpsyg.2020.00560

Wang, J. (2021). A Review of the Development of the Integration Strategy of Information Technology and Education in the Four Countries of the United States, Britain, China, and Singapore. *Science Insights Education Frontiers*, *9*(2), 1283–1303. https://doi.org/10.15354/sief.21.re042

Appendix

Information Brochure for 'Discussing Module 6 Studying Strategies'
(THIS IS NOT A CONSENT FORM)

Institution: University of Twente (053 489 9111)

Researcher information: Maria Voicu, m.voicu@student.utwente.nl (0721952893), supervisors: Dees Postma, d.b.w.postma@utwente.nl, Robby van Delden, r.w.vandelden@utwente.nl .

Title: Easy to express hard to understand - Using Games OR Game, Play, Sports-ification to teach elements of HCI

Purpose: For a vast majority of students, Module 6 represents quite an academic challenge. The issue stems from the hefty reading materials given in all the classes, as well as the demanding assignments. Moreover, since the subjects are quite complex, the students must grasp completely new and elaborate concepts in a brief period of time. The primary reason students are discouraged when first tasked with the assignments of Module 6 is the copious amount of reading that must be done. The main challenge of this project consists of the fact that not every student has the same approach to learning, as well as the fact that not every approach is fitting for every student. The aim of the project will be to create a tool that facilitates academic learning in an interactive way so that as many students as possible can use it to go through module 6 in a less stressful way.

Procedures: You will be asked to participate in a focus group with other UT students. You will be asked to discuss Module 6, specifically your studying strategy and how you felt throughout the Module regarding the studying material. The discussion will be AUDIO RECORDED and TRANSCRIBED into text afterward. The transcribed text will be completely anonymous. If you wish, you can contact the researcher after the session and say that you do not want your data to be used or made available for teachers or anyone else (this can be done no longer than 48 hours since the focus group session has ended). After the audio recording has been transcribed, the audio file will be deleted. There will be no personal information used in the research. The transcripts will be deleted after the project is finished (July 2022). The researcher will also take additional notes during the discussion. If you wish to stop the session at any point, please let the moderator know. If you are uncomfortable discussing the subject of Module 6 for any reason (failing a class, having difficulties studying, etc.), you are advised to refrain from participating. IMPORTANT: the audio files will be deleted after the sessions have been transcribed anonymously.

Duration: Approximately 20 minutes.

Risks: The participants will be required to be present at university. Covid-19 regulations will be implemented, as well as additional precautions to ensure the health and safety of the participants.

Benefits: The participants will make an impact on future generations of students.

Alternatives to participation: The participants can request to have a one-on-one conversation with the researcher if they are not comfortable with the focus group setting. Furthermore, the participants can withdraw from the study at any moment.

Confidentiality: The participants will not be required to disclose any personal information. The findings from the research will be anonymized and the study will not process any personal data. You can ask at any point in the research for your data to not be used. The contact information to do so has been given in this brochure as well as the consent form.

Consent Form for 'Discussing Module 6 Studying Strategies'
YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FORM

Please tick the appropriate boxes   **Yes**   **No**

Taking part in the study

I have read and understood the study information dated [22/03/2022], or it has been read   ☐   ☐
to me. I have been able to ask questions about the study and my questions have been
answered to my satisfaction.

I consent voluntarily to be a participant in this study and understand that I can refuse to   ☐   ☐
answer questions and I can withdraw from the study at any time, without having to give a
reason.

I understand that taking part in the study involves being part of a focus group that will be ☐   ☐
audio-recorded, which will be transcribed as anonymous text afterward, and that the audio
recording will be deleted after the transcription has been completed.   ☐   ☐

I understand that if I am uncomfortable at any point of the session, I can ask the moderator
to end the session.

Use of information in the study

I understand that the information I provide will be used by the researcher to properly   ☐   ☐
understand a student's perspective on Module 6 (Intelligent Interaction Design).

I understand that there will be no personal information collected about me (such as my name, ☐   ☐
address etc.) and any other information I provide will not be shared beyond the study team.

I agree that my information can be quoted anonymously in research outputs.   ☐   ☐

I agree to be audio recorded.   ☐   ☐

I understand that the information (ONLY in the form of the text transcripts) I give   ☐   ☐
will be available to the teachers of Module 6: Intelligent Interaction Design.

Future use and reuse of the information by others

[OPTIONAL NOT REQUIRED FOR PARTICIPATION] I give permission for the anonymized   ☐   ☐
transcripts that I provide to be used for future research and learning.

[OPTIONAL NOT REQUIRED FOR PARTICIPATION] I give permission to the researcher to   ☐   ☐
archive the information I have given in UT (Universiteit Twente) servers widely accessible by
UT   employees,   students,   and   any   of   their   future   project   partners.

Signatures

_____   _____   _____
Name of participant   Signature   Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____   _____   _____
Researcher name   Signature   Date

Study contact details for further information: Voicu Maria, m.voicu@student.utwente.nl
Contact Information for Questions about Your Rights as a Research Participant
If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee Information & Computer Science: ethicscommittee-CIS@utwente.nl

Information Brochure for 'Prototype Testing for a Learning App'

(THIS IS NOT A CONSENT FORM)

Institution: University of Twente

Researcher information: Maria Voicu, m.voicu@student.utwente.nl, supervisors: Robby van Delden, r.w.vandelden@utwente.nl , Dees Postma, d.b.w.postma@utwente.nl,.

Title: Interactive Learning through Gamification

Purpose: For a vast majority of students, Module 6 represents quite an academic challenge. The issue stems from the hefty reading materials given in all the classes, as well as the demanding assignments. Moreover, since the subjects are quite complex, the students must grasp completely new and elaborate concepts in a brief period of time. The primary reason students are discouraged when first tasked with the assignments of Module 6 is the copious amount of reading that must be done. The main challenge of this project consists of the fact that not every student has the same approach to learning, as well as the fact that not every approach is fitting for every student. The aim of the project will be to create a tool that facilitates academic learning in an interactive way so that as many students as possible can use it to go through module 6 in a less stressful way.

Procedures: You will be asked to access a Figma prototype on your laptop or phone. The prototype will be of a learning app based on the Research and Design for User Experience class. You will be tasked with reading through the prototype and complete a short quiz, based on what you read. Throughout the testing, you will be screensharing your screen to the researcher, who will be taking notes (about how easy/difficult you access and navigate the app, how your mouse cursor moves on the screen and how long it takes you to go through the tasks), whilst muted and having the camera off. After you finish your task, the researcher will ask you some follow-up questions (which you can refuse to answer if you wish) and you will be linked to an anonymous survey to fill out. The follow-up questions will be related to your experience, how you would improve it, as well as what you liked/did not like. The survey will have closed questions (such as 'rate your experience on a scale from 1-5', yes/no questions) about the experience and app prototype itself. Please note that the only inclusion criteria for this study is that participants are required to have gone through Module 6 at least once.

Duration: Approximately 30-40 minutes.

Risks: You will be screensharing your application window whilst completing a task. There is a possibility that the researcher will be able to see personal information. For your privacy, it is recommended you open the prototype link in an empty tab without any bookmarks and put your device on 'Do not disturb' or just turn notifications off. No matter what information is shared through the screenshare, the researcher will not report on it, since it is not relevant to the project. Please note that the screenshare will <u>not</u> be recorded.

Alternatives to participation: The participants can request to only fill out a survey if they do not wish to answer the follow up questions, or if they can request that the researcher is not present when completing the task. Furthermore, the participants can withdraw from the study at any moment. Please note that your participation is completely voluntary and refusing to participate, withdrawing during or after the study have <u>no</u> repercussions.

Confidentiality: The participants will not be required to disclose any personal information. The findings from the research will be anonymized and the study will not process any personal data. You can ask at any point in the research for your data to not be used. The contact information to do so has been given in this brochure as well as the consent form. Furthermore, please not that teachers/lecturers will <u>not</u> have access to any personally identifiable information. Additionally, this research has been assessed by the Ethics Committee.

Consent Form for 'Prototype Testing for Learning App'

YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FORM

Please tick the appropriate boxes   **Yes**   **No**

Taking part in the study

I have read and understood the study information dated [03/05/2022], or it has been read   □   □
to me. I have been able to ask questions about the study and my questions have been
answered to my satisfaction.

I consent voluntarily to be a participant in this study and understand that I can refuse to   □   □
answer questions or complete tasks, and I can withdraw from the study at any time,
without having to give a reason.

I understand that taking part in the study involves testing an app prototype (whilst   □   □
screensharing my screen to the researcher), answering follow-up questions, and filling out
an anonymous online survey.
                                                                                             □   □
I understand that I can end the session at any point, without having to give a reason.

Use of information in the study

I understand that the information I provide will be used by the researcher to create a   □   □
learning application that will be used by future students.

I understand that there will be no personal information collected about me (such as my   □   □
name, address etc.) and any other information I provide will not be shared beyond the study
team.

I agree that my information can be quoted anonymously in research outputs.   □   □

I agree to be screenshare my device screen during the prototype testing and I   □   □
understand that there may be personal information shown throughout the
screensharing process.

I understand the researcher will be watching me screenshare during the testing   □   □
and will be taking notes throughout the process, and that I will be asked follow-
up questions after the testing session.

Future use and reuse of the information by others

[OPTIONAL NOT REQUIRED FOR PARTICIPATION] I give permission to the researcher to   □   □
archive the *anonymous* information I have given in UT (Universiteit Twente) servers widely
accessible by UT employees, students, and any of their future project partners. The
information might be used for improving future courses, as well as reporting purposes.

Signatures

_____   _____ _____
Name of participant   Signature   Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____   _____ _____
Researcher name   Signature   Date

Study contact details for further information: Voicu Maria, m.voicu@student.utwente.nl

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee Information & Computer Science: ethicscommittee-CIS@utwente.nl

Transcript Focus Group Session 1

[Asking for verbal consent]

Researcher: "So basically, the goal of my project is to make a product that will help students like you go through module six more easily, specifically the research and design class. Who wants to start talking about their experience with module six?"

Person 1: "Module 6 in general, or just the class? The class of research and design? Yeah, so my experience is, I look on Canvas to see the books. I read the books. I skipped the first test the second and the third one. Then I got enough points for that to not have to do the first one. So, I just showed up what's out reading anything and worked out."

Researcher: "What about the others?"

Person 2: "Yeah, I failed it. Okay, in my second year, so I had to redo it. And I found the books to be very helpful. They were easy to read. They were nice. But there was just a lot of text and a lot of examples. And it was annoying to filter through the stuff that you actually need, because they gave them three points, but that explained over like five pages. And that's annoying. So, I just made a lot of summaries in the first year and that didn't work out, since I failed. And the second year, I thought, whoa, maybe let's go watch the lectures. Again, it might help, but for me it didn't help at all, it was just a repetition of what the books already explained, but then less accurately and less informative. And it was just also a lot of examples, and just not really any information that I would like to know. So that was not helpful. I started the books again, and this time, spent four full days per test, studying from about nine to five in one big chunk. Basically, memorizing everything. And that seemed to work."

Person 3: "I also just look at the books. When the first two lectures, I realized that I don't understand anything the teacher says, and I continued on reading the books and the materials and I passed. I also like it since I want to do a masters in this."

Researcher: "And you?"

Person 4: "I failed the first time, but I also didn't go to the lectures, and I didn't read the books. So, in my experience it was probably handy to read the books."

Person 2: "So personally, in my experience I felt, I would say that the tests really didn't help passing the tests, honestly, because they were just really tricky with words. The questions will sometimes be like, hey, what would not fit in the list? Just really small, like small differences in wording that would, you know, give one answer the correct list and one answer being wrong. And that made it really annoying for me to (..)"

Person 1: "Especially the ones that were like an entire paragraph of text where I had to read like three to five times, because there was a certain nuance in the text that made the situation entirely different than from the first time I read it."

Person 2: "Exactly. And I noticed that in that second year, I did all of the tests, again, that the teacher did change the questions a bit by highlighting some words, but it still was just a block of text and four options that sound exactly the same. And then you had to pick one of those."

Person 3: "And also the numerous typos in the paragraphs of text in the exam and typos in the possible answers, which are not helping with thinking and comprehending what he's asking for."

Researcher: "And what do you think helped you the most when studying for it?"

Person 2: "Honestly, working together with a peer helped a lot, just discussing this subject. Really, you know, just ranting about it. And also, just summarizing it, just having the book and making it cohesive, and making it like in bullet points instead of just blocks of text explaining one little, tiny thing Okay, mostly working with peers."

Researcher: "Okay, did you guys also work with other people? Or did you just study on your own?"

Person 4: "Yeah, definitely. I think it's just… because it's just text, text, text, text, text, text, text. So, I think like, summarizing the videos too."

Person 3: "It's, first of all difficult to work with a peer when you're just supposed to read and memorize."

Researcher: "What about the sample tests? Did those help?"

Person 3: "I did look at the sample test. Last thing, they were unhelpful, because they're not complete the questions, were having typos, and they look very poorly made. So, I said, oh, this is not representative for the exam until I went to take the exam and I saw the same stuff."

Person 2: "Yeah, I would say the sample tests were helpful, because exactly the same questions were asked in the exam. So, if you make the sample question, exactly the same ones, whereas the exam worded it a little bit differently. But since you already made them, it was easy to recognize, you know?"

Researcher: "Okay, and what do you think would be like, the solution to all these blocks of text, like for you to learn them easier?"

Person 1: "I think a bit of structure would be nice to have. Maybe not just a list, but like, just a place where all, because now you just had to download all the sources to like maybe a zip file or some kind of website interface, where all the files are, and there's like, basically a burndown chart for the GP right now. Something like that. But then for all the readings, so you don't have to worry because very easily, you just forget about it. And then just before the text, you have to read everything. And then it's easier to learn how to know the pace that you have to read."

Person 4: "And also, as someone who doesn't really like the subject, just thinks it's pretty boring, the big text just doesn't help with your focus. It's just hard to read through, it's slow, it's kind of painful to read through the book, you just see text, and you're like, oh, I already know this is gonna be boring. And then you have three pages and pages of text. Doesn't help."

Person 2: "If it was just in pieces, so chapter one will just be chopped off in five pieces, or if chapter two will be chopped up in five pages, because one chapter was like 60 to 70 pages of boring, like plain text. And I mean, it wasn't that bad to read, for me personally, I'm not having a problem with big blocks of text. But if it was just a little bit more structured, chopped up."

Person 3: "And also more relevant because one of the prevalent books he recommends, Lazar was very much focused on what's happening in the USA and USA legislation. And while they are mentioning Yeah, maybe this is not the case for you, though, it's not concrete examples for what we are learning here in Europe."

Researcher: "So something you relate to more?"

Person 3: "I mean, great to know how parental consent for children was in the USA, but it's not relevant if I'm trying to do a project in the Netherlands."

Researcher: "Yeah, it doesn't help you. Okay, yeah, that's a good point. And you said that this is like a subject that you want to do in your master's? So, liking this subject, has that made it easier for you to study?"

Person 3: "Yes, because the subject is my passion. And it's quite cool, in my opinion, to try to figure out what people like and how you can adapt the product or the service or an experience to the users to enhance the theme itself. But the course itself did not teach me that. The course itself doesn't teach me how to lead an interview or how to lead the focus group. The only useful thing I remember from the course was learning how to write an ethical consent form. Like, yes, they recommended me some books and videos, and they found about the UX Foundation, which I also found on LinkedIn. Yeah, that was all they provided for me. So that was not exactly helpful in finding or highlights my interest."

Researcher: "Okay. And so, we also had lectures but also, we had some videos that we could watch. Which one did you guys prefer?"

Person 3: "I prefer the videos because they were well made. They introduced a lot of vital concepts, and they were very simply putting them quickly with everything you need to know about that."

Researcher: "Ans what do you think is missing from the lectures?"

Person 3: "Good information uhhh, information structure. They are giving a lot of background literature to date and then they are vaguely referring to it in the lectures. And then there's been a lot of examples, which is great, but it's not always explaining how the examples are relevant. Or if he's doing that, he's doing it too quickly. He's just sliding over the information. And it's hard to comprehend. And it doesn't help when he starts the first lecture, we're saying, yes, 60% of the people are failing this course."

Researcher: "Okay. And how did you feel like the workload for this class was compared to the rest of the classes in module six?"

Person 2: "Honestly, the workload wasn't too bad for me, because statistics was, for me a lot harder, and a lot more sadness. And honestly, for this subject I prepared in four days, and I passed the test with like an eight in the second time, because I knew how to study for it, actually, this time, and otherwise, not really that much. Because I didn't go to the lectures because I didn't feel they would help me. So that already took away a lot of time that was scheduled for it. But yeah, the preparation for the exam. So that took a lot of time, because I summarized every chapter, from the book we had read from the Lazar book, and that's an insane amount of pages. So that would be like a solid week or two, but the exam preparation is just a lot."

Person 1: "Also something that might help during the project, we also have to do the interviews and such. But I feel like the order that this course is given doesn't match the projects, because you learn about how to properly do interviews after you've done the interviews. Because if you have it during the same time or before, it's actually something that you need to apply and need to learn anyways, you might be more motivated to read."

Person 2: "And especially because they downgrade you if they do the interview is wrong. But you hadn't even learned how to do interviews before you did the interview. So, so, take that around, it wouldn't be (…)"

Person 4: "Like a lot of synergy between the two subjects even though they're really the same thing. They didn't really notice it, except it's about the same thing."

Person 1: "I think if you match that properly, it really helps."

Researcher: "Yeah, so you feel like you would actually learn better if you first learn the theoretical part, and then actually did the interviews and all of that?"

Person 3: "Yeah. Okay. I mean, the UX class and the project are in the same building blocks, so they should be better connected. I think that's the first structural change, that should happen."

Researcher: "Well, all these things being said... Now, my question is, how would you feel about having, let's say, an app, where lets you have all the Lazar information was structured, in a way that makes sense to you. And you can read it that way. But you also get maybe exercises to test your knowledge. And that way, you can use that every once in a while. And that way you can gain a better knowledge of the subject. Would that help?"

Person 2: "Like Duolingo?"

Researcher: "Yes, but for Research and Design."

Person 4: "Yeah it would be nice. I mean, it's what you mentioned before, but there's like some structure, more structure in place."

Person 1: "And more prompts to actually start working on. But what I think also will be nice if you have a basically you have all the information there, and everybody can have comments, and everybody can see the comments. So, like, you can kind of help each other. Yeah, you can make like subjects. And then when you click on that subject, like, I don't know what that subject is on the questions. You can see all the things that people related to that subject, all the things that content or references."

Person 2: "And the questions they ask you how people answer them, like the correct question answers, because I felt that would help me a little too, because I had a lot of questions, but no answers. Yeah. And if people had the same questions, I would help each other out. That's what I noticed when I did the peer study thing, that when I had questions, they could be answered, and we could discuss them together. And that was really, really helpful, especially for this course."

Researcher: "Okay. So is the helpfulness from the fact that it's like a group thing or that you talk to your classmates, or is the structure more important?"

Person 4: "I think first of all, structure and collaboration is nice."

Person 2: "I would think that I would need the structure to actively to work together with peers to do it. Because if there's no structure, you're just trying to figure out how to even start. And then you wouldn't even be able to properly work together with people because there's nothing that, you know?"

Researcher: "Okay, yeah, it makes sense. And let's say that you can also solve sample tests or exercises for each chapter, would you prefer, if it was like, straight up just questions that will be asked on the test, or questions that are more about you understanding the subject and then making those connections during the exam?"

Person 4: "I think, to have both options would be nice. Because, you know, as I said, for me, it's the boring bits but for Person 3, you were very interested in it. So, maybe for you would be better to be deeper. But for me, it's just about passing the test."

Researcher: "Alright, what about the others?"

Person 2: "I would honestly say both as well, because I think that test-like questions will be nice, like a full prep exam, with like, better questions. Because last time we had like 10 questions or something vaguely basically related, and attached itself was like, at least 25 to 40, with a lot of multiple choice and two big open questions. So it'd be nice if we had like a full set test to practice on, especially with a time limit, because you have to read very carefully. And I noticed that I myself got know, quite stressed out with time at some point, because I just read the questions too carefully. Because I was curious as last time. And I would think the dig deeper questions would be nice to just be released, when each topic is finished, after like a lecture that these questions would go open, you can make them and then you can use them for your project for actually putting theory to work."

Person 1: "Questions don't have to be really close to what's actually asked to the test just give the same kind of questioning and what kind of things are important to take away from the text that we read? Because it's like 60 pages. So, you don't know what is important to remember and what is not simple to determine what are like really precise, for example, years that something happens is important or more of a broader picture is what's asked on the desk."

Researcher: "So basically, I want to ask you, how would you feel if this app had gamification elements, so like, every time you would finish a chapter, just like experience points or achievements and all that, like, would that make the experience more like, interactive, and less like, just studying for an exam?"

Person 2: "It would definitely make it more interactive, especially if you can, you know, compete with peers or something like that. But I would also think that would be nice. If you prove the for example, if you finish all of it correctly on one try, and then everything that you would get, like a bonus or something on your grade, because that will motivate me the most like not even just if I would get points, but nothing would happen. I wouldn't necessarily want something, but I want something in return that could benefit me."

Person 3: "I mean, imitation without the price isn't gonna work out, does it? Yeah. No, yeah. Even on Duolingo. We can share it on Facebook and brag about it."

Person 1: "Yeah. It has to have value inside the game, but I think it's quite a difficult job to make reading papers."

Person 2: "Yeah, I think it would be nice if you could, like do you know the Quizlet? Yeah, like the asteroid game thing. Like something like that. I think it'd be okay."

Person 1: "Oh, maybe like students could if you're doing a collaboration thing actually make questions about learning materials and then during like a quiz."

Person 3: "And also, maybe more guest lectures, because like last day, they had like, they, they had one guest lecturers thing, and it was to UX workers, designers from the Dutch banks. And they had super cool presentation, actually, from that guest lecture. But because many of the attendants and one of the resits, they've added questions in the guest lecture that happened after the exam and in between the exam and like I said, for one of the exams, which is not fair."

Researcher: "Yeah, okay."

Person 3: "The guest lecture itself was more useful than that, let's be clear about it. They actually showed practically how you can do it, what you do it and what your software's actually used for UX, and what else other than theory, but I think what they said in this lecture is to visit of an exam where the information was not even available to begin with, is that fair?"

Researcher: "Okay. Well, that was all my question. So if you have anything else you would like to add that I should take into consideration …"

Person 1: "Maybe make the app also available on the website? Because I know quite some people who storage already full to the brim. And, you know, I'm a broke student, and I can't really afford a new phone on the top of my head. So, if I have no storage, I wouldn't be able to download the app."

Person 4: "I like to study more on my laptop."

Person 2: "So make it available on a laptop with exactly the same functions on your laptop, as on your phone will be nice. Because that way, you don't really have to necessarily download it."

Person 3: "Like website wise is also easy to use, if you want to have this functional community asking questions. It's a lot of information you want to structure so it's easier to see a laptop or monitor your phone. So, it's organized."

Person 2: "And it's easier to link to via the Canvas page because I think it's nice if it was just put immediately on top like you have the heading and then you've clicked downwards at the first bar would be to the webpage to motivate people to use it more making it visible."

Researcher: "Thank you for joining, I will stop the recording now."

[End session 1]

Transcript Focus Group Session 2

[Asking for verbal consent]

Researcher: "Okay, so first of all, thank you for joining. So, basically, my goal is to make the Research and Design for User Experience class a bit more approachable for everybody. So, my first question to you guys is, how was the class for you? Anyone can start."

Person 1: "I'll just start. It was sometimes confusing. But I think in the end, it was made clear, I looked at it, what we had to do to be reminded of it, and I remember not doing anything for it. I didn't do the reading after week two, just because I didn't feel like it."

Researcher: "What about the others?"

Person 2: "In my opinion, it was a bit too much material. I think it wasn't that complicated. In a way, it wasn't difficult to understand. But it was time consuming to read everything, and then study and learn everything, mostly by heart, because it was mostly theoretical. Also comparing to other subject because the module was quite heavy. So, I think, for me, I liked this field. And it was very interesting. So, I understand if somebody who is more technical is not that interested. But still, I found it difficult to have enough time to actually read and learn everything with the other subjects."

Person 3: "Yeah, I agree. It was a lot of material. And at some point, I just stopped watching lectures. And only for the reading, I went for the summary part, because it's what Person 2 said, it's not difficult. But yet you need to read it at least once to be able to talk about it in a better sense. So yeah, and I also remember that I was very discouraged, by the way the module started that we were prompted that half of us will not pass the test. So, then I was like, Okay, so what's the point?"

Person 2: "Yeah, especially because we had three exams for that subject, which made it easier in a way you could concentrate on one like third of it. But still, it was, it was kind of difficult to manage everything. What I did is that I did the audio of all the lectures, I found the software that can read it aloud. So I can do other things while I'm listening to the readings, which helped me, but it was definitely time consuming to just at least read everything was."

Person 4: "Yeah, I agree as well. I mean, the reading. Okay, for the lectures, I watched all of them. And I think that was pretty helpful. Because what he said, was also mostly part of the exam. So that was nice. But you had to read everything at least once to know how to remember the questions for the exam. So I agree to the others. That was pretty time consuming. Yeah."

Researcher: "Okay, and what do you think about the way the questions on the exam were formulated?"

Person 2: "But this one was that all three were mostly multiple choice. And then we had two or three open questions, if I remember correctly, which is good for having the results fast when it's multiple choice, but I found several questions to be quite like having double meanings to some extent, I would remember what I read about it. And then I would read the answers that are offered. And I would be like, Oh, well, that could be true. But then this other one is also kind of true. So I if you would allow me to write it down, like from the book, I wouldn't be able, but how it was formulated, sometimes, I wasn't so certain what the professor wanted us to choose, and then know if others had the same experience."

Person 4: "Yeah, I mean, yeah. When you read the book on chapters, and you got the exam question, it was, yeah, I remember something. It should be that and then you read the next answer. And you're like, maybe it could also be. So mostly you could, or you had a choice between two answers. So two were pretty similar.

And the other two were Yeah, okay. I'm pretty sure that's not the right answer. But yeah. But I also think if you wouldn't do in multiple choices, it would also be hard to rewrite parts from the book, because it was just too much to study. Yeah."

Person 3: "Yeah, I guess if we have multiple choice, it would depend how in detail, the questions are because they are a broad overview, I guess, then everybody could do it. But if the question went more into detail then yeah, then I would prefer that the multiple choice."

Person 1: "What, what I've noticed as well, was saying that in the questions, there were at least two answers that had overlap. And the thing that was changing was such a miniscule or like, miniscule detail that in the book wasn't explained in so much detail. And maybe it was basically Question one, the answer is like, oh, yeah, this is what was set in the book, but then (…) so in the, in the answers, there were parts that were similar or like, even the same, and then what changed was just a small detail that wasn't even emphasized in the book, or you may have you remembered if you've read the book five times."

Researcher: "Okay. Um, so how did you guys end up passing the class? Like, what was your strategy to pass this class?"

Person 4: "So for me, it was watching the lectures. And I read the book once."

Researcher: "Just going through the material then?"

Person 4: "Yeah, but yeah, like, more focused on the lectures, and just the first lectures. So I had a overview of the book, and then read the book, and then my understanding was better. It was my feeling that I understood the material from the book better."

Person 2: "Yeah, I didn't, I don't know if I watched the lectures, I was focused on the book. And then if something wasn't clear, then I would just watch a fragment of the lecture. But I mostly just reread, I think I've read the book 10 times, maybe even more. I also used this audio software, I would clean the house listening to it, I would shower listening to the lecture. And I think I was like hypnotized. And at the end, I even knew like some parts of the book by heart. So I don't know if that's a good strategy. It was definitely time consuming, but I was just, also I put it on like, two times faster. So reading it fast over and over again. And then for some concepts, if it's like some types of something, then I would take some notes so I can remind myself but for the general like examples and those parts that you don't have to actually learn it. I was just like, rereading it or re-listening to it."

Researcher: "What about you?"

Person 3: "Yeah, so I went for the first I think I remember reading the summary or at least parts of the book. Then going to the practice questions, checking if I can do them, and then reading the book kind of for the practice questions. And just hoping it works."

Researcher: "Okay. Yeah, that makes sense. And what do you guys think would be a way to improve the way the material is given to the students?"

Person 2: "Well, my opinion is that, okay, we don't have many theoretical subjects in general in a way that we didn't have to learn many, like much theory by heart, in Creative Technology in general. But I think that we don't have to go, like in detail with this in a way that we don't need so many, like a detailed subcategory, subcategories, and the ways it works, I think that just the lectures and like the, the chapters themselves are very interesting and clear. But if we can get have like one chapter, and then like, summarize it in a way in

which we will use it as professionals, like practically, so the most important concept, and then learn how to apply this concept in various situations, then to go in like the via a variety of concepts, if that makes sense."

Person 1: "And then also, not expect that level of detail in the exam. I mean, I get that multiple choice questions have to be like, tricky, because otherwise, they would be too easy. But I feel like you should not make a distinction, at least for me, and that would probably also help people studying. I wouldn't make that big of a deal out of if like the overlap of the answer segment, if two answers overlap by 90-95%, and that one thing that changes this like a word, or like a small detail, I would still count them, because that would just be infuriating on the first test, if you get the results on the first of three exams, and it basically tells you Well, that one question where you knew everything? And then you answered, you chose one answer out of two, because they were just overlapping so much, that kind of defeats the purpose everything and just makes you feel like, why should I even study? If it basically comes down to chance?"

Person 3: "I also feel like it like that topic is not the most intuitive one, but you get already a kind of understanding of the subject is not that the presented stuff is like completely new. So therefore, I think if we just have a good baseline, without exactly what it was, say the details, then we can also just if we need something we can go. But if we have a good foundation of that, that's enough, and we don't need all the details that are only relevant in few cases."

Person 4: "Yeah, I would agree with the others. So mostly to like what Person 1 said, like, I think it's the right way to use multiple choice, because that's just too broad topic. But yeah, it's a bit mean to make two answers pretty close are the same meaning but just a small part of it is different. And you can't really recall from the book, which one was correct. So let's just, yeah, then you have to guess and that's not the point of the multiple choice, right?"

Person 2: "Not everything should be an exam because right now we have three exams. Maybe it's better to like, have one exam, which will cover the most important topics of the three exams. And then for example, an assignment or something practical like show me or like document a brainstorming session or I don't know, because we have a project in that module as well. So maybe like the designing report for that project can be one part of the grade, and then one exam and not like three small theoretical exams."

Person 1: "Although I agree with that, but I would still keep it two exams, because I felt that having shorter exams on stuff that was taught in like two weeks or three weeks, rather than one big exam at the end helped. also helped me a lot with studying because you still have to keep track of all the stuff that you learned, and you had to like actively revise it at the time you were learning it, or it was being taught because then you didn't have an excuse to say like, I'm going to study it later. Because Oh, yeah, in one week, I have the example. I should study now."

Person 4: "I just wanted to say that it also was a good feeling when you finish one exam. And they said, Yeah, you pass. Okay, so this part is done. I guess. That was nice, but, yeah, of course, if you fail the first one, it's like, Oh, no. No, I have to study for both. Kind of pity."

Researcher: "And my last question. So basically I want to kind of make this class easier by making an app. And like, the best way I can describe it as like a Duolingo. But for the research and design class, specifically. So what are some features that you guys think should be included in an app like this?"

Person 4: "Maybe sample tests."

Person 2: "Maybe in the morning, you get a sample question to wake up with."

Person 1: "Maybe also feedback on what is being studied. So I don't know if it's possible to have like a two way street. So basically, that means you can see if students struggle with a certain topic, like I. But that's not just for this course. It's basically for every course, I would love to give the teacher feedback on certain topics. Like if I'm saying, Hey, I got this topic down like I understand it. And I can also apply it versus I still struggle with it. Because that way, yes, it may be more work on their part as well. But at least they can see how the class is doing and like, who to focus on or maybe they can like, tell someone Hey, check on check up on this guy, or the person is learning or Hey, have you asked, So and so they can help you. Maybe that also helps people study better."

Person 2: "Maybe it could also be some interesting YouTube videos or other resources on different topics, which doesn't have to be mandatory, but a fun way and like a visual way of explaining something. So if you're not very certain with a certain like this topic or concept, you can watch it or like some memes jokes, designed really to make us feel better."

Person 4: "And maybe also something like a timeline. But you know, how far you should be at that point? Something like that."

Person 3: "Yeah like Person 2 said it maybe to just be prompted when there's a certain question that you're not getting right several times, and maybe just didn't get prompted to like, Oh, this is an interesting YouTube video."

Person 1: "Maybe even have it as like a one stop shop that kind of says like, basically you have everything in that app. So you don't have to worry about downloading documents from Canvas because they're already in the app. Maybe you can, like combine it with like a Kindle, like with the Kindle app, where it basically has the documents you need to read as an E-paper kind of. And so, you can just take notes in there. I mean, a lot of apps already have those features. To me, it would just be nice to at least have the stuff all in one location. And then I can just not worry about finding the right one. And then, as Bill said, have a timeline, or maybe even just dedicate this week, this is the material you have to read. And here it is. So you don't have to worry about like looking for it. And then going through the document that shows you the overview, because the app is basically doing it for you."

Person 3: "Also another interesting. If the app is really a full package, then it could also track the amount of time the students spends on a certain topic. And then kind of to send the feedback to the teacher because if the teacher says okay, they're gonna spend four hours on the topic, but majority of students go for six, then it's also an indicator that is either too much material or too difficult."

Researcher: "Okay. Well, that was my last question. So if you guys have any other remarks that you would like to say, now is the time."

Person 1: "I would just say that it would help a lot. I imagine if teachers like in general, if teachers would also understand like, that students not always want to follow certain topics, and then also, not to make them feel bad about it. Because, yeah, I feel like just a lot that there's like, often the time where, in certain quarters answers like, I can't deal with this, well, then, when you talk about it to the teacher, they're like, Oh, you but you should make time for that. Instead of like, understanding that the topic may be either too difficult for you or you don't have like that your approach to learning is different. They give you shit for it, basically."

Researcher: "Okay, that makes sense. Okay, well, thank you guys for joining. It has been a lot of help. And hopefully, I can come up with a solution for future students."

[End session 2]

Curriculum planning

Unit 1

- Lazar chapter 1 + short quiz (as a tutorial) → 7 contribution types, HCI research characteristics, audience, triangulation definition, in-lab vs in-the-wild, inherent trade-offs, what makes a good RQ + types of RQ, DVORAK example.
- Lazar chapter 5 → surveys, pros and cons of surveys, surveys in HCI research, when to use surveys, goals and targeted users, defining the population frame, probabilistic sampling, random sampling, stratification, response size, errors, non-probabilistic sampling + standard approaches, survey questions, survey structure, paper vs online surveys, pilot testing, response rate, data analysis.
- Chapter 5 quiz [I think each chapter should have 20-30 questions each. I will try to look into whether or not Figma has any type of plugin that can allow me to make a 'data base' of questions/exercises, so that each quiz is randomized. I think that would make the app much more interesting. On the other side, if that is not possible, I can manually make different quizzes on the same chapter, so that the students have more to choose from.
- Lazar chapter 8, 2 parts (part 1 = interviews, part 2 = focus groups) → Part 1: interviews pros and cons, application of interviews in HCI, 3 phases, who to interview, interview strategies, focused and contextual interviews, question types, conducting an interview, analyzing interview data. → Part 2: interviews vs focus groups, pros and cons of focus groups etc.
- Chapter 8 quiz.
- Chapter 1, 5, 8 quiz [At the end of each unit the student will unlock the option to have a quiz from all the chapters in that unit. This will slowly simulate the feeling of the real exam.].

Unit 2

- Chapter 10 → Usability testing, examples of methods, main goal, usability testing and traditional research, types of usability testing, Schneiderman, formative vs summative testing, stages, users, locations, task lists, measurement, understanding data, other variations.
- Chapter 10 quiz.
- Chapter 11 → qualitative data, goals, stages, content analysis, grounded theory (pros and cons), emergent coding, a priori coding, theoretical frameworks, code structure, data analysis.
- Chapter 11 quiz.
- Chapter 10 + 11 quiz.
- Chapter 1, 5, 8, 10, 11 quiz.

Unit 3

- Chapter 2 → experimental research, behavioral research types, hypotheses, null + alternative, dependent & independent variables, randomization, significance tests, type I and II errors, limitations, risks.
- Chapter 2 quiz.
- Chapter 3 → experimental design, 3 groups, experiment design types, true experiments characteristics, issues, between-group vs within-group, pros and cons, choosing the right approach, factorial design, split-plot design, reliability, random errors, systematic errors, the 5 major sources of errors, experimental procedures.
- Chapter 3 quiz.
- Chapter 4 → statistical analysis, preparing data, coding data, descriptive statistics, measurements, T-tests, comparisons, interpretation, analysis, one-way ANOVA, factorial ANOVA, repeated measures ANOVA, f-tests, correlation, regression, non-parametric, chi-square.
- Chapter 4 quiz.
- Chapter 15 → working with human subjects, potential participants, number, recruitment, risks, consent (13 sections), concerns.
- Chapter 15 quiz + big quiz.