

# Developing an Engaging UX Lesson Series Using a Tinkering Approach

Graduation Project - Master Interaction Technology

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7<sup>th</sup> of June 2024

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## Abstract

This research addresses the decline in high school students' motivation, which affects active participation in classrooms, with the focus on courses in the field of Computer Science. Traditional top-down teaching approaches have shown limited effectiveness in fostering engagement and interest among students. To tackle this challenge, this study explores the implementation of a non-traditional educational method, i.e. tinkering, to enhance student engagement in the User Experience (UX) topic, which is an elective within Computer Science.

Therefore, a lesson series is developed where students design their own game with the use of tinkering. While students are engaged in developing their game, they explore UX concepts in a playful and experimental manner. This new lesson series is supported by research in topics such as relevant learning objectives related to UX, existing UX lesson series, and fundamentals of tinkering. Furthermore, student materials including a Unity template and a teacher guide for this lesson series are constructed.

Through multiple evaluations, including usability tests, a field study, and a survey with participants from different backgrounds, feedback was gathered to improve components of the lesson series, which were subsequently implemented. This resulted in a comprehensive lesson series containing all necessary information for teaching, from student materials to the teacher guide, enabling students to learn about UX and game design through a tinkering approach. Through iterative design and the incorporation of feedback, this research contributes to the development of effective lesson series that promote active learning in Computer Science education.

## Acknowledgement

I want to thank my supervisors, Angelika Mader and Ingrid Breymann, for their continuous feedback and support throughout the process of this project. I also want to thank both for their input, suggestions, and help in organizing participants for evaluations. Furthermore, I want to thank all participants for their time and for sharing their thoughts with me. And lastly, I want to express my gratitude to my family and friends who stood by the sidelines and provided me with the support I needed.

## Table of Contents

Abstract.....	3
Acknowledgement .....	4
Table Overview.....	8
Figure Overview .....	8
Chapter 1: Introduction.....	10
1.1 Background .....	10
1.2 Motivation.....	10
1.3 Research Questions.....	11
Chapter 2: User Experience .....	13
2.1 User Experience .....	13
2.2 User Experience in Educational Setting.....	15
2.3 User Experience Lesson Series .....	16
2.4 Conclusion.....	19
Chapter 3: Tinkering.....	21
3.1 What is Tinkering?.....	21
3.2 Designing for Tinkering .....	21
3.3 Tinkering in Education.....	24
3.4 Tinkering Tool .....	25
3.5 Conclusion.....	27
Chapter 4: Lesson Serie Components .....	28
4.1 Teacher Guide Components.....	28
4.2 Teaching Methods.....	29
4.3 Student Engagement.....	32
4.4 Conclusion.....	33
Chapter 5: Design Requirements .....	35
5.1 General Requirements of Lesson Series.....	35
5.2 Designing for Tinkerability .....	35
5.3 Student Material .....	36
5.4 Teacher Guide .....	37
Chapter 6: Design Methodology .....	39
6.1 Approach.....	39
6.2 Evaluation Methods .....	40
6.3 Ethics .....	41
Chapter 7: Essential Game Elements .....	43
7.1 Goal .....	43

7.2 Participants .....	43
7.3 Procedure.....	44
7.4 Results .....	45
7.5 Conclusion.....	47
Chapter 8: Design Iteration 1 .....	48
8.1 Defining the Learning Objectives .....	48
8.2 General Decisions Lesson Series .....	50
8.3 Assignment Description & Assessment Method.....	51
8.4 Game Design Components.....	53
8.5 User Experience Components.....	57
8.6 The Teacher Guide .....	59
Chapter 9: Evaluation Student Materials 1 & Design Iteration 2 .....	60
9.1 Goal .....	60
9.2 Participants .....	60
9.3 Procedure.....	60
9.4 Results Expert Usability test.....	61
9.5 Design Iteration 2 .....	63
9.6 Results Non-expert Usability Test .....	65
9.7 Conclusion.....	66
Chapter 10: Design Iteration 3 .....	68
10.1 Game Design Components.....	68
10.2 Teacher Guide .....	73
Chapter 11: Evaluation Student Materials 2 .....	74
11.1 Goal .....	74
11.2 Participants .....	74
11.3 Procedure.....	74
11.4 Results.....	77
11.5 Conclusion.....	80
Chapter 12: Evaluation Student Materials 3 .....	81
12.1 Goal .....	81
12.2 Participants .....	81
12.3 Procedure.....	81
12.4 Results.....	84
12.5 Conclusion.....	89
Chapter 13: Evaluation Teacher Guide.....	90
13.1 Goal .....	90

13.2 Participants .....	90
13.3 Procedure.....	90
13.4 Results.....	92
13.5 Conclusion.....	99
Chapter 14: Final Design .....	100
14.1 General Changes to the Lesson Series .....	100
14.2 Game Design Components.....	100
14.3 UX Components .....	108
14.4 Teacher guide .....	108
Chapter 15: Discussion.....	110
Chapter 16: Conclusion.....	112
Chapter 17: Recommendations .....	113
Chapter 18: Reflection .....	114
Remarks.....	115
References.....	116
Appendix A: Focus Group Information Brochure and Consent.....	121
Appendix B: Fill-In Document Process .....	124
Appendix C: Assessment Method .....	126
Appendix D: Game Design Explanation Cards.....	128
Appendix E: Usability Test Information Brochure and Consent .....	134
Appendix F: Teacher Guide .....	137
Appendix G: Field Study Information Brochure and Consent .....	165
Appendix H: Evaluation Session Information Brochure and Consent .....	168
Appendix I: Survey Information Brochure and Consent .....	171
Appendix J: Unity Scripts.....	176
Appendix K: Presentation Slides Teacher Guide .....	188
Appendix L: Teacher Guide Final Version .....	190

## Table Overview

Table 1: Key Recommendations and their description (Resnick & Rosenbaum, 2013) .....	24
Table 2: Teaching Methods based on Vietnam Teaching Jobs (Vietnam Teaching Jobs, 2023) .....	29
Table 3: Overview of activities (Marren, 2021) .....	30
Table 4: Overview of the use of the evaluation methods. ....	40
Table 5: Overview of the pre-made game elements .....	43
Table 6: Overview guide of the Focus Group .....	44
Table 7: Results of sorting the cards .....	45
Table 8: Results of ordering game elements from basic to advanced. ....	46
Table 9: Results from ordering elements in desired sequence .....	47
Table 10: Overview of the learning objectives .....	49
Table 11: Overview of lesson series of five weeks .....	50
Table 12: Part of the fill-in document to track the progress. ....	52
Table 13: Overview of the elements for the explanation cards. ....	55
Table 14: Session Guide for the Usability Test .....	61
Table 15: Overview of the materials that will be collected.....	75
Table 16: Evaluation Form.....	76
Table 17: Evaluation Discussion Guide .....	76
Table 18: Results average score of usefulness for each material.....	78
Table 19: Overview of the tasks of the evaluation session .....	82
Table 20: Overview of Evaluation forms (Individual & Group).....	82
Table 21: Group Discussion Guide.....	83
Table 22: Survey Questions.....	90

## Figure Overview

Figure 1: Design thinking framework (Francis, 2022-b) .....	14
Figure 2: Flow channel in games (Game developer tips, n.d.) .....	23
Figure 3: Revised Bloom's Taxonomy (Andreev, 2003).....	32
Figure 4: A model of student Engagement (Grocchia, 2018 (Adapted from Burns et al., 2004; Grocchia and Hunter, 2012)) .....	33
Figure 5: Mindmap of what the student can do after completing the lesson series. ....	49
Figure 6: The Unity Template. ....	54
Figure 7: Examples of the different explanation cards for each category: Game-essentials (blue), Game-elements (green) and Unity cards (red). ....	56
Figure 8: Fill-in Cards.....	57
Figure 9: The UX-cycle: Design Thinking Process .....	58
Figure 10: Overview of the UX method cards for each step. ....	59
Figure 11: Example view of Unity Template Redesign .....	64
Figure 12: Redesign of the fill-in card. ....	64
Figure 13: Inspector view of Player Object .....	69
Figure 14: Hierarchy view of Player object .....	69
Figure 15: Inspector view of Enemy Object .....	70
Figure 16: View of object in Prefab Folder.....	70
Figure 17: Hierarchy view of Text object.....	70
Figure 18: Overview of the Prefab folder.....	71
Figure 19: Overview of the Scripts.....	71



Figure 20: Overview of the Test Scene of the Unity template. ....	72
Figure 21: Overview of the redesign of the game element cards.....	72
Figure 22: Results of agreement per statement. ....	78
Figure 23: Overview of the usefulness of the different materials. ....	84
Figure 24: Overview of tinkrability of the different materials.....	85
Figure 25: Clarity of the lesson series goal .....	92
Figure 26: Clarity Explanations Chapter 2 .....	93
Figure 27: Clarity of Learning Objectives .....	93
Figure 28: Feasibility of the learning objectives.....	94
Figure 29: Relevance of the learning objectives. ....	94
Figure 30: How much added value of chapter 4. ....	95
Figure 31: Clarity of description to give the lessons. ....	95
Figure 32: Alignment of assessment method with learning objectives.....	96
Figure 33: Clarity of assessment method.....	96
Figure 34: Agreement with weighting factors.....	96
Figure 35: Clarity of the student assignment. ....	97
Figure 36: Clarity explanation of student materials.....	98
Figure 37: Clarity of teacher guide.....	98
Figure 38: Overview of the Prefab folder with the different prefab objects. ....	101
Figure 39: Inspector view of Bullet .....	101
Figure 40: Inspector view of Enemy_Bullet .....	101
Figure 41: Overview of the Enemy Object .....	102
Figure 42: Overview of the Player object.....	103
Figure 43: Inspector view of Collectable object.....	105
Figure 44: Inspector view and hierarchy of Teleport Object.....	105
Figure 45: Inspector view of Push_Object .....	106
Figure 46: Inspector view and hierarchy of Text Object.....	106
Figure 47: Overview of the Simple Objects Prefabs.....	106
Figure 48: Overview of the Materials Folder .....	107
Figure 49: Overview of the Scripts Folder.....	107
Figure 50: Test Scene.....	107

## Chapter 1: Introduction

### 1.1 Background

In recent years, there has been a decline in the motivation of high school students in the Netherlands (RTL Nieuws, 2019; VO Raad, 2019; Inspectie van Onderwijs, 2021). Especially since the Covid pandemic, student's motivation to work as led to a decrease (Inspectie van Onderwijs, 2021). When students lack motivation and they express that "traditional education is too boring" (RTL Nieuws, 2019), it becomes challenging for the teacher to encourage them to actively participate in the classroom. This issue of low motivation is also evident in the Computer Science course in Dutch high schools.

The Computer Science course in the Netherlands is taught differently than other courses, as students get next to theoretical lessons practical assignments that allow them to apply theory in practice. By asking students to participate in a more practical way, it requires a higher engagement and involvement of the students which increases their motivation (Learning Matters, n.d.)

To tackle the lack of motivation even more, various strategies have been explored and implemented. A few examples are the bottom-up method, different classroom setups, visual aids, game-based techniques, and various applications (Gamage, 2021). The utilization of these diverse strategies aims to foster an active learning environment that encourages students to apply critical thinking skills (Gamage, 2021).

However, most of the lesson series that are currently employed in the Computer Science course follow a conventional top-down approach. In this approach, the theory is divided into paragraphs, and students are required to complete assignments for each paragraph. After all the paragraphs have been discussed, students are tasked with a final assignment to test students' knowledge on the theory from the different paragraphs. This approach does not allow students to actively work towards a goal from the start. It makes students unaware of the relevance of the theory that is discussed, as the students receive the final assignment at the end. Meaning that the engagement and interest of students is quite low.

To heighten the engagement of students, which simultaneously makes students more motivated, a non-traditional form of education will be explored, i.e. tinkering. Tinkering is a playful and experimental approach where a hands-on experience with different building blocks is used (Resnick & Rosenbaum, 2013). Using this approach, a lesson series will be designed on the topic of User Experience (UX), which is one of the elective topics of Computer Science, in which students will develop a game.

### 1.2 Motivation

The aim of this graduation project was to develop a lesson series on UX that enhances student engagement through the implementation of the novel teaching method tinkering. There are several reasons behind this graduation project.

Firstly, there was the wish to combine the knowledge gained from both the Interaction Technology and Education Science Master's programs. This prompted the idea of designing a lesson series.

Secondly, since the update of the Computer Science course in 2019, new topics have been introduced. Organizations such as SLO (Curriculum Development Foundation), I&I (Association of Computer Science and digital literacy), and the three Computer Science teaching platforms (Fundament-online, Informatica-Actief, and VO-Content) have been actively involved in developing

various lesson series covering these new topics. New insights that will be gathered through this research will hopefully contribute to the development of the new curriculum topics.

Thirdly, the selection of the lesson series topic was based on the personal preference for UX, which is an elective course in Computer Science.

Lastly, it is an intriguing concept to incorporate tinkering into a Computer Science lesson series. Tinkering has the potential to aid students in comprehending complex concepts such as programming from an experimental point of view. Moreover, tinkering aligns with the iterative process inherent in UX-design. Besides, there are currently no Computer Science lesson series for Dutch high schools that integrate tinkering. Although tinkering materials are available for teachers, a complete lessons series with the necessary materials is not yet available.

### 1.3 Research Questions

Based on the background and motivation this research aims to answer the following research question:

How to develop an engaging UX lesson series with a tinkering-approach?

This main research question will be answered with the help of the following sub-research questions. The questions are divided into three topics: research questions, design questions, and evaluation questions.

Research:

1. What are the relevant learning objectives related to the UX topic?
2. What are the existing UX lesson series and features?
3. What is tinkering and what are its core components?
4. What tools can be employed for tinkering in the context of UX?
5. What are the different components of a lesson series?

Design:

6. What are the learning objectives of this lesson series?
7. What are the essential elements that constitute a game?
8. What components and guidance should the teacher guide encompass to assist teachers in implementing the tinkering based UX lesson series successfully?

Evaluation:

9. How do the designed materials allow students to tinker?
10. How user-friendly and understandable are the designed materials of the lesson series?
11. What is the effect of the lesson series on the engagement of the students?
12. How much does the design of the lesson series align with the pre-defined design requirements?

To address the sub-research questions, a literature review was conducted initially. Subsequently, a lesson series was developed, with a focus on first defining the learning objectives and essential elements, before proceeding to create all the necessary materials for the series. Finally, the lesson series was evaluated by various experts and users to enhance the lesson series on the ease of use, usability, tinkerability, and engagement.

The remainder of the report is structured as follows: Chapter 2 provides insights into the topics of User Experience, covering both general information and specifically on how UX is implemented in Computer Science. Chapter 3 explores the tinkering approach, beginning with a broad explanation of its concepts before delving into the necessary elements for designing with a tinkering approach. Chapter 4 discusses the different components of a lesson series, ranging from a teacher guide to teaching methods. Building upon these insights, Chapter 5 establishes the design requirements for the lesson series. Chapter 6 outlines the methodology employed in the design and evaluation of the lesson series. Chapter 7 describes the focus group that helped to gain insights into essential game elements. Chapter 8 presents the first iteration of the lesson series design. Subsequently, Chapter 9 highlights the usability testing conducted in two rounds, which led to the redesign and a second iteration of the lesson series.

Chapter 10 describes the third design iteration, while Chapter 11, 12, and 13 describe various evaluations conducted with different users to assess the lesson series. Chapter 14 delves into the final design, including any last adjustments. The report concludes with Chapter 15 the discussion, Chapter 16 the conclusion, Chapter 17 the recommendations and Chapter 18 the reflection.

## Chapter 2: User Experience

This chapter focuses on explaining the main topic of what the lesson series is about: User Experience (UX). More specifically, this chapter delves into UX, not only an explanation of the topic itself but also how UX is introduced into the high school educational setting, and a brief introduction of existing lesson series about UX. For each lesson series that is currently available, advantages and disadvantages are discussed that will be considered when designing the lesson series.

### 2.1 User Experience

UX is about the interaction between an user and the product or system they engage with (Nagalingam and Ibrahim, 2015), which shares a close relationship with User Interface (UI). While UX primarily focusses on understanding the interaction between users and products, UI is centred on designing the functional product (UsabilityHub, 2022).

UX is a broad domain, encompassing two distinct types: UX Design (UXD) and UX Research (UXR). UXD focuses on designing the actual product, whereas UXR is primarily focused on researching data (Stull, 2018).

When designing from an UX-perspective, there are numerous principles to consider. Some principles are broad in scope, while others are more specific to a product, such as websites or applications. Among these principles, the most crucial one for UX is using a user-centred approach. Other valuable principles include usability, usefulness, desirability, accessibility, consistency, hierarchy, and context (Stevens, 2022; Morville, 2004; Georgieva, 2022; Francis, 2022-a).

Designing with a UX-approach involves various activities. According to Desmet and Shifferstein (2011), these activities relate to three main concepts (de Bont et al., 2013):

1. *Understanding*: Activities performed to help comprehend the user and their current situation when using the product/system.
2. *Envisioning*: Activities carried out to envision and define the target UX.
3. *Creating*: Activities undertaken to conceptualize, materialize, and test new concepts.

These three main topics align with the UX design process, also called design-thinking, which is a non-linear, iterative process to understand it's users. As the process is iterative, a designer cycles through the design process multiple times (Allabarton, 2023). This design-thinking process helps students with the creation of designs that enhance user-product interactions (UsabilityHub, 2022). Applying this process in the creation of products and systems helps to provide a seamless and an effective UX. The process consists of five steps, as shown in Figure 1: Empathize, Define, Ideate, Prototype, and Test.

# DESIGN THINKING

## A FRAMEWORK FOR INNOVATION



Figure 1: Design thinking framework (Francis, 2022-b)

These five steps answer the previous mentioned concepts; gaining an understanding of the user by empathizing, envisioning what it might look like by defining the problems and ideating different solutions, and creating the new concepts by prototyping and testing. Each step will be explained below.

### *Empathize*

The Empathize phase revolves around developing empathy for the user to comprehend the problem thoroughly (Francis, 2022-b). During this phase, the context of the issue is explored by investigating users' desires and challenges to gain new insights (PO Raad, 2018). To acquire these insights, various methods, such as interviews, competitive research, and empathy mapping, can be used (Codiant, 2022).

### *Define*

Drawing from the information and research gathered in the Empathize phase, the next step is to define the problem statement (PO Raad, 2018). Defining the correct problem statement hinges on a comprehensive understanding of the user (Codiant, 2022). To ensure this complete understanding, techniques like creating user personas, scenarios, or storyboards can be utilized (Codiant, 2022). These techniques enable meticulous mapping of acquired user insights. Together with the previous phase, these two stages involve analysing the current context to derive insights and establish a clear problem statement before progressing to the next step: ideation.

### *Ideate*

The Ideate phase is about brainstorming various ideas or solutions to address the problem statement established earlier (PO Raad, 2018). Various brainstorming techniques, including mind mapping, reverse brainstorming, rapid ideation, and round-robin, can be employed (Lucid Content Team, n.d). It's crucial during this phase to continue brainstorming beyond initial ideas to explore creative solutions in-depth (Francis, 2022-b). At the end of the brainstorming a final idea is chosen to work out in the next phase.

## *Prototype*

Following the Ideate phase and the selection of an idea, the next step involves bringing the idea to life through prototyping. A prototype represents the initial design of an idea and can be as simple or sophisticated as required (PO Raad, 2018). There are two types of prototypes: low-fidelity and high-fidelity (Zijlstra & Lugtenburg, 2020). A low-fidelity prototype is easy to create and is often used for early-stage testing of a concept or general functionality, not focusing on the final visual design (Zijlstra & Lugtenburg, 2020). Techniques for low-fidelity prototyping include paper prototype and wireframes. A high-fidelity prototype resembles and functions as closely as possible to the final product (Zijlstra & Lugtenburg, 2020). High-fidelity prototypes are typically created after initial concept tests, allowing for more complex design features to be tested through usability testing (Zijlstra & Lugtenburg, 2020).

## *Test*

After building a prototype, whether simple or advanced, it must undergo testing. The testing process varies depending on the type of prototype. A basic paper prototype may involve testing with a few individuals, focusing on the concept itself, while a more advanced prototype may undergo usability testing or A/B testing to observe how users interact with it. Usability testing can involve making observations and using the think-aloud method to gain a better understanding of user interactions and decision-making. Additionally, questions can be posed through surveys or questionnaires to gather further insights (Codiant, 2022; Allabarton, 2023).

As previously mentioned, this process is iterative, and going through the process multiple times is fundamental in achieving the best results and improving the product. By applying this design-thinking approach, the designer gets a greater understanding of the users their wishes are and how these wishes should be applied.

## 2.2 User Experience in Educational Setting

UX is one of the elective domains of the Computer Science high school course in the Netherlands. The course comprises of a total of six mandatory domains and twelve elective domains (SLO, 2023). According to the SLO (Curriculum Development Foundation) guidelines, that outline the essential competencies, there are two key learning objectives for the elective UX. These objectives focus on analysing and designing and are as stated as follows (SLO, 2023):

*Analysis: "The candidate can explain the relationship between design choices of an interactive digital artefact and the expected cognitive, behavioural, and affective changes or experiences."*

*Design: "The candidate can design user interactions for a digital artefact, justify design decisions, and implement them for a simple application."*

It is imperative that students master both the art of designing and the skill of analysing interactive digital artefacts. A digital artefact can take various forms. Commonly used examples are websites or applications, but it also extends to options such as social robots or games. In short, students need to create any type of digital product.

Moreover, students must develop a comprehensive understanding of the subtleties inherent in design choices and their profound impact on the experience of the user on different levels. To accomplish this, students need to form well-founded reasoning and justifications for the decisions they make. This process is rooted in the research they conduct with their users, ensuring that their design choices are not arbitrary but firmly grounded in empirical insights. This is not an easy task, and it requires careful planning to ensure that students learn how to perform this on a basic level and come to the realisation that their design choices have an impact on users' behaviour. To make sure students grasp these

concepts, it is important to help them understand how they are currently influenced by products and how these influences have changed their behaviours. Reflecting on this impact can be done by presenting and discussing examples.

This approach equips students with proficiency to make informed design choices. By implementing the UX-design process, students learn how to systematically define problems, conceptualize solutions, and evaluate whether their proposed ideas effectively resolve the identified issues.

In addition to the two end terms provided by SLO, there are other domains in the Computer Science course related to UX. These domains are Skills (Domain A) and Interaction (Domain F), which are both mandatory domains of Computer Science. Within these two domains, the following sub-domain objectives are noteworthy (SLO, 2023):

Sub-domain A1: Designing and developing – Involves designing a digital artefact and making specific choices during the design process based on research and experimentation.

Sub-domain A3: Cooperation and interdisciplinary – Requires the candidate to collaborate in a structured manner during the design and development of digital artefacts.

Sub-domain A6: Working in contexts – Encompasses the candidate's ability to apply skills in professional, societal, and scientific contexts (specific requirement for Vwo-students).

Sub-domain F1: Usability – Involves the candidate's capacity to evaluate user interfaces of digital artefacts based on heuristics and apply rules of good design in the design and development of digital artefacts.

These sub-domain end terms exhibit similarities with UX end terms, particularly in designing and developing a digital product. Additionally, other end terms related to cooperation, working in context (a casus), and usability can be seamlessly integrated into the lesson series. These topics align well with UX concepts or with the given tinkering approach.

### 2.3 User Experience Lesson Series

For the UX domain there exist a multitude of related lesson series. In this section, an overview of these lesson series as well as closely related topics such as Usability and Interaction Design, is provided. For each of these series an assessment of their advantages and disadvantages is conducted. In total, there are six available lesson series that cover topics related to UX, provided by I&I (Association of Computer Science and digital literacy) or a teaching platform. These lesson series are accessible on various Computer Science teaching platforms including Fundament, Informatica-Actief and VO-Content, as well as on the general website of I&I.

#### 2.3.1 User Experience Reader

The *User Experience Reader* presents three teaching options for teachers to pick from (Keuzethema, 2023; Docentenhandleiding, 2023<sup>1</sup>):

1. Covering the entire reader, spanning from chapter 1 to chapter 8.
2. Working through the first four chapters of the reader and then continuing with a project on *Social Robots in Elderly Care*.
3. Working through the first four chapters of the reader and then continuing with a project on *Facial Expressions*.

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<sup>1</sup> The first three lesson series mentioned 2.3.1 to 2.3.3 (User Experience Reader, Social Robots in Elderly Care, and Facial Expressions) are also offered as lesson series on Fundament and Informatica-Actief.



The reader consists of two primary sections. The first section delves into the essential theory related to UX such as the historical development, usability principles, and a UX model. The second section discusses the design cycle, incorporating an integrated project scenario where students must develop their own application, with a focus on the design and the testing of the application.

This reader provides several advantages. In the first place, it presents a well-structured set of introductory assignments that actively engage students and help them become familiar with the UX field through relatable topics. Secondly, the practical assignment is broad in scope, granting students the freedom to select their own subject matter. Third, the reader incorporates numerous examples and assignments that students can easily relate to, such as Snapchat or travel apps.

Nevertheless, there are a few drawbacks. One limitation is that the focus of the assignments primarily is on design and testing. This method lacks an analytical phase where students investigate user preferences and engage in brainstorming sessions to explore different ideas before finalizing their designs. Another drawback is that the teaching approach requires students to first delve into theory and complete assignments before tackling the practical assignment. As a result, a substantial amount of time is allocated to theory understanding, leaving limited time for students to fully immerse themselves in the UX design process.

### 2.3.2 Social Robot in Elderly Care

The *Social Robot in Elderly Care* project (van t' Klooster et al., 2019) is a continuation of the first four chapters covered in the reader. This project encompasses four key phases: user research, literature research, design, and evaluate. The first step is to conduct interviews with their grandparents to gain insight into their preferences. Subsequently, they explore the technological capabilities, combining these findings to formulate a set of requirements that serve as the foundation for their paper prototype design. Finally, students evaluate this prototype.

This project offers several advantages. Firstly, it emphasizes user research, requiring students to investigate into their interviewees' preferences. Therefore, they are enhancing their understanding of user needs. Additionally, it encourages students to explore the possibility of technology, fostering a deeper comprehension of its potential applications.

There are however a few disadvantages to consider. The project lacks an ideation phase, where students brainstorm various potential solutions. It also incorporates numerous technical terms related to social robots that may be overly detailed and specific. Moreover, the assignment's focus is solely on the creation of a social robot with a telepresence system. This format limits the creative freedom of students.

Lastly, as a remark, the project centres on a target group (the elderly) that may be significantly distinct from students in terms of interests and perspectives. Students may find it challenging to empathize with their grandparents' viewpoints and may not be particularly engaged with the topic of elderly care. However, getting students involved in designing something for their grandparents does educate students on societal aspects.

### 2.3.3 Facial Expressions

For the *Facial Expressions* project, students are tasked with creating a model that can respond to Twitter messages (Gezichtsuidrukkingen – docentenhandleiding, n.d.). During this project, students gain insights into modelling, software development, and webservicees. The primary emphasis within this project lies in the technical aspects, including modelling, programming skills, comprehension of expression and their integration.

Unfortunately, the project lacks a comprehensive incorporation of UX theory, design elements or product evaluation. It predominantly centres on technical facets, particularly the development of a model that responds to Twitter messages. Consequently, it does not align with the principles of UX.

#### 2.3.4 User Interface

The *User Interface* lesson series takes students through the design process, with the added focus on usability (VO-content, 2023). A design process of five steps (analyse, ideate, prototype, evaluate, implement) is explained, accompanied by multiple assignments. The theoretical components encompass elements such as user cases, task models, user profiles, personas, and the development of a program of requirements. Additionally, the series delves into usability aspects, including typography and colour theory. The lesson series begins with lesson objectives and theory before moving on to assignments. At the end the students must show their understanding through the practical assignment where they get to make a design for a parking application. For this assignment the focus is only on the global design and evaluation of the prototype.

There are several advantages to this lesson series. First, it offers extensive coverage of theory, particularly focussing on the empathize phase, which involves thorough research into user preferences and the highlight of dilemmas and concerns through personas and related methods. Second, students are required to evaluate their designs and prototypes based on scenarios they have formulated themselves, promoting critical thinking about testing criteria.

A disadvantage of this lesson series is that the practical assignment is very precise and may not be particularly engaging for students, especially in terms of how a parking app relates to their daily lives and interests as high school students. Additionally, like the previously mentioned lesson series, they lack iterative components after the prototype and evaluation phase. Consequently, students go through the design cycle only once and do not engage in the redesign of the product based on evaluation feedback.

#### 2.3.5 Interaction Design

The *Interaction Design* lesson series, from the mandatory domain F – Interaction, places a strong emphasis on the entire design thinking cycle: empathize, define, ideate, prototype, and test (Informatica-Actief, n.d.). The approach in this series involves students actively working on their practical assignments while sequentially navigating through each step of the design cycle. At the beginning students have the option to choose between two categories for their assignment: school-related or society-related, allowing them to select a topic of personal interest. While there are some suggested topics, the overarching idea is to change user behaviour (e.g., promoting healthier eating habits among students) and students are encouraged to explore creative topics. Additionally, after completing the initial cycle, students engage in a second iteration where they implement feedback and reevaluate their designs.

There are several advantages to this lesson series. First, it comprehensively covers all phases of the design cycle, ensuring that no crucial steps are omitted. The inclusion of a second iteration enhances students' familiarity with feedback implementation and the overall design cycle. Second, the series integrates theory into the practical assignment seamlessly, enabling students to directly apply theoretical concept to their final practical assignments without the need for unrelated preliminary assignments.

However, one notable disadvantage is the relatively broad assignment description. While students have the freedom to choose their topics, the assignment does not guide students to come up with an creative idea.

### 2.3.6 User Experience Gaming

In this lesson series (Bergvoet et al., 2021), students experiment with creating their own 3D games using Unity. The series comprises a total of five documents, with the initial one offering an overview of the entire lesson series and the subsequent four delving into theoretical aspects of game design principles. While the introduction prompts students to share their experiences with specific games, there isn't a specific emphasis on UX. Instead, the series places a significant focus on various game elements, including mechanics, storyline, technology, and aesthetics.

One of the notable advantages of this series is its unique focus on an area where UX plays a crucial role: games. Unlike the prevailing emphasis on applications, this series explores the intricacies of creating engaging game experiences. Additionally, it stands out for its comprehensive explanations of diverse game design elements.

However, there are a few drawbacks to consider. Notably, the UX-cycle or any explicit mention of UX is absent from the series, meaning that the focus on UX is indirect at best. Moreover, the primary emphasis lies in the creation of a game design document and a demo level, potentially overlooking the full development and evaluation of the UX.

### 2.3.7 Other Lesson Series

There are also other lesson series related to game design, such as Making and Experiencing Games (Keuzethemas, n.d.), where the primary focus remains confined to either the game's design aspects or the programming involved. There is limited to no attention to the UX design process and UX itself. Because of the very limited focus on design, it will not be further discussed.

## 2.4 Conclusion

In summary, UX deals with the interaction between its user and the products or systems they engage with, which is a topic closely related to UI. A common process is the design thinking process focussing on finding and determining the problem, coming up with as many different ideas as possible to the problem, creating simple prototypes, and testing these with users to create products better fit to the users wants and needs.

In the educational context, UX is offered as elective in Computer Science, with two key learning outcomes focussed on analysing and designing. Students engage in both designing and analysing interactive digital products, with a focus on making well-informed design choices grounded in research by applying the UX design process. This prepares them to be able to design thoughtfully and make evidence-based decisions. Alongside these learning outcomes, various related outcomes are specified in different mandatory domains, closely aligned with the UX topics or in the lesson series. The learning outcomes are expressed in abstract terms, meaning that for the design of this lesson series there is a considerable amount of flexibility in interpreting and refining the overarching objectives to fit to the lesson series. Consequently, when developing the lesson series, the initial step be to define the general objective, followed by creating specific learning objectives to facilitate the attainment of the overarching objective and the two end terms of SLO to make sure the lesson series is appropriate.

In the context of the already existing lesson series on the topic of UX, the benefits and drawbacks of existing lesson series can serve as valuable insights for the development of the lesson series. Drawing inspiration from the theoretical concepts, their explanations, and the nature of assignments, such as introductory tasks from the reader, can guide the design process. In total, three main takeaways are identified. Firstly, the existing practical assignments on making an application or website are, in general, quite good lesson series that cover UX nicely. However, it is observed that these lesson series primarily concentrate on game design and programming principles, sidelining UX design principles.

Consequently, there is an opportunity to create a lesson series on the topic of game design, placing a stronger emphasis on design elements rather than programming aspects. Secondly, in many current practical assignments, students only can go through the design cycle once, and sometimes certain steps of the cycle are skipped. To enhance student understanding of the cycle's importance, it is crucial for students to navigate through the cycle multiple times in the lesson series. Lastly, the current approach often involves students working through a set of assignments that may not align with the practical assignment at the end. A more effective method would be to allow students to learn information directly relevant to their final assignment. An example of this effective approach is found in the Interaction Design lesson, where students put theory directly into their practical assignment.

With these insights gained on what UX is, educational demands of what students need to learn about UX, and the review of all the existing lesson series, well informed decisions and choices can be made to make a lesson series that applies to the learning objectives of UX.

## Chapter 3: Tinkering

The lesson series to be designed will use a tinkering approach. In this chapter, the following elements are explained in chronological order: the concept of tinkering, how to design a lesson series with a tinkering approach, tinkering in educational setting, and making a consideration about the most suitable tinkering tool for the lesson series.

### 3.1 What is Tinkering?

Tinkering is closely aligned with the concept of *making*, which has gained popularity thanks to the Maker Movement. The Maker Movement is a diverse community of kitchen tinkers, hackers, designers, and inventors (Bevan et al., 2014). *Making* and the Maker Movement are a driver for creativity, excitement, and innovation with a particular emphasis on STEM (Science, Technology, Engineering and Mathematics) related subjects (Bevan et al., 2014). *Making* centres on the construction of a desired creation (Gutwill et al., 2015) and the physical act of building, and tinkering introduces the type of mindset needed to build the creation: a playful mindset that is essential to the creative process (Gutwill, 2015). The tinkering approach is a playful, experimental, iterative style of engagement where makers are continually reassessing their goals, exploring new paths, and imagining new possibilities (Resnick & Rosenbaum, 2013).

This creative process of tinkering can be broken down into three distinct stages: exploring, experimenting, and trying (Resnick & Rosenbaum, 2013). It often starts with the development of a meaningful idea, which is a concept that ignites the tinkerers imagination, by exploring what the possibilities are (Resnick & Rosenbaum, 2013). However, it is during the physicalising that the heart of tinkering comes into play. This stage frequently involves encountering challenges and getting stuck. Through experimentation with the given challenges, the tinkerer tries new options (Bevan et al., 2014; Resnick & Rosenbaum, 2013). Despite obstacles, the tinkering approach encourages tinkerers to persist through the obstacles, experiments, and iterations until they achieve a breakthrough (Bevan et al., 2014).

Tinkering has a bottom-up approach, where the tinkerer starts with experimenting until a goal emerges. From this initial exploration, it is an ongoing continuous iterative process while the tinkerers focus on one specific activity (Resnick & Rosenbaum, 2013). This iterative process of trying and experimenting helps a tinkerer reassess their goals, explore new pathways and envision new possibilities (Gutwill et al., 2015). Tinkering thrives on curiosity and a willingness to explore uncharted territory, often resulting in unexpected and innovative solutions. Tinkering promotes a Hands-on Minds-on approach to learning, which fosters creativity, problem-solving skills, and a deeper understanding of the creative process where the tinkerer plays an active role. Necessary skills for tinkering are being able to improvise, adapt and iterate (Resnick & Rosenbaum, 2013).

Tinkering is usually linked to the trial-and-error approach. However, the trial-and-error approach makes random attempts until the correct solution is found. This characteristic does not accurately capture the essence of tinkering, where tinkerers engage in a purposeful experimentation – i.e. an educated guess – rather than a random process. Additionally, describing tinkering as involving errors is misleading since it involves trying different approaches to see if they work, without necessarily categorising any attempt as inherently incorrect.

### 3.2 Designing for Tinkering

To design for tinkering, it is important to consider the various needed components. Mader and Dertien (2016) developed a comprehensive framework that outlines various aspects for conducting successful

tinkering sessions. Below, all aspects of this framework are explored in terms of relevance with respect to the design of a lesson series using a tinkering approach.

### *Playground*

The notion of a “playground” encompasses two dimensions. Firstly, it represents the physical environment where tinkering activities occur (Mader and Dertien, 2016). Secondly, it extends to capturing the entire setting, including other critical elements (such as the seed, time, discovery, and the process) (Mader and Dertien, 2016). When focusing on the environmental aspect of the playground, an effective tinkering session needs to be in a stimulating place that encourages creativity and experimentation (Mader and Dertien, 2016). As the lesson series presumably takes place in a classroom, a setting should be created where students can easily talk to each other and where students notice an open atmosphere. This will not only stimulate and encourage creativity, but also collaboration between students. In this classroom, students should be provided with stimuli for creativity, such as inspirational games, sticky notes, paper, coloured pens, etc.

### *Seed*

The “seed” serves as a trigger or prompt that initiates the tinkering session (Mader and Dertien, 2016). This seed must be designed in a manner that fosters self-directed exploration (Mader and Dertien, 2016). As mentioned before, tinkering builds on the concept of exploring and even more on the self-chosen exploration, because it fosters a higher motivation among the tinkerers. Depending on the tinkerers prior experience with tinkering, the seed can take various forms, ranging from a simple example project to an initial goal or introducing new material (Mader and Dertien, 2016). For the lesson series one clear goal that students must work towards would be the seed, something probably along the lines of: “*Design a game that fits a user problem determined by exploring the current situation with users.*” This goal provides students with a clear assignment, but they can give their own interpretation to explore solutions to the problem statement.

### *Discovery*

Discovery is as one of the most pivotal aspects of tinkering. It involves defining self-directed goals, allowing tinkerers to take ownership of their own learning journey (Mader and Dertien, 2016). The ability to set and pursue individual goals plays in the ownership of the tinkerers learning process (Mader and Dertien, 2016). For the lesson series this is challenging, as students must conform to certain learning objectives and certain assignments and steps, such as using the UX design thinking cycle. However, the UX design process itself does allow for discovery since students have to empathize with the user to determine the problem statement. Setting individual or group goals that will differ for each group, gives students more ownership to their learning journey.

### *Toolbox*

The toolbox encompasses the building blocks provided during tinkering sessions. These building blocks may comprise physical objects and materials. An example of a material is the Little Bits, designed by Ayah Bdeir, where tinkerers can experiment with electronics without getting stuck in the technical details, promoting exploration and play. Additionally, the toolbox can include virtual or conceptual resources, broadening the range of possibilities for tinkering experiences. For the lesson series there are many tools available to design a digital game. Some are more suitable to the context of tinkering than others. Next to the digital software platform needed to create the game other materials can help students throughout the tinkering phases, such as sticky notes and clay.

### *Facilitator*

A facilitator must strive to find a balance between aiding tinkerers to overcome obstacles, offering feedback, and maintaining a certain distance to allow tinkerers to explore and discover on their own (Ryoo et al., 2015). As facilitator, it is important to work with the tinkerers and not try to do the work for them. This way, tinkerers come to the necessary solutions themselves (Ryoo et al., 2015). A facilitator has three primary objectives, as outlined by Gutwill and colleagues (2015).

1. Ignite the initial interest: The facilitator's first goal is to spark tinkerers' initial interest, motivating them to embark on the learning journey and get started on the task or project.
2. Sustain tinkerers' engagement: It is crucial for the facilitator to sustain in the active participation of tinkerers throughout the learning process. This involves keeping tinkerers engaged and interested in the subject matter or activity.
3. Deepen understanding and commitment: Another important role of the facilitator is to deepen tinkerers' comprehension and commitment. This means guiding tinkerers to develop a deeper understanding of the topic at hand and fostering their dedication to the learning process.

By skilfully balancing these three objectives, a facilitator plays a key role in creating an effective and engaging learning environment.

### *Scaffolding*

Scaffolding is an instructional practice where the teacher slowly but steadily removes the guidance and support as students learn and become more competent on the topic (University at Buffalo, n.d.). In the context of tinkering, facilitators can employ scaffolding to foster and nurture the tinkering mindset, promoting independent learning and guiding learners toward greater competency (Mader and Dertien, 2016). There are several strategies that can be employed to achieve this, including asking probing questions, utilizing visual aids, posing open-ended questions, employing the think-aloud strategy, or incorporating educational games (Cornell, 2023).

### *Flow*

As previously mentioned, it is the facilitators' responsibility to ensure that tinkerers remain engaged and active throughout the tinkering session. One effective approach to achieve this is by maintaining a learning flow. This concept is also a fundamental aspect of game design which is closely tied to the balance between challenge and skill level (Reid-Thomas, 2015). Gamers, for example, are more likely to continue playing a game when the level of skill required aligns with the challenges presented than when challenges are too easy. This can lead to boredom (Reid-Thomas, 2015). The opposite can happen when the challenges are too difficult in comparison to the current skills of the gamer, which can lead to anxiety (Reid-Thomas, 2015). This is depicted in Figure 2 below.

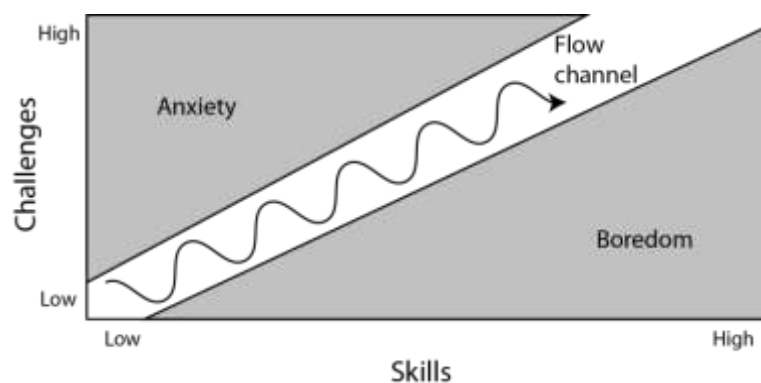


Figure 2: Flow channel in games (Game developer tips, n.d.)

By skilfully managing the learning flow and aligning challenges with learners’ skills, facilitators can sustain a high level of engagement and optimize the learning experience.

### 3.3 Tinkering in Education

As discussed in the previous section, there are numerous factors to consider when designing for tinkerability. Despite the various experiences related to the integration of tinkering into meaningful forms of STEM-learning (Quinn & Bell, 2013), teachers are still sceptical about tinkering (Hancock, 2003). In developing a lessons series that adopts a tinkering approach, several additional critical aspects must be addressed, aside from the aforementioned components. When designing the toolbox and the overall tinkering experience, it is crucial to adhere to three core principles: giving immediate feedback, allowing for fluid experimentation, and providing for open exploration (Resnick and Rosenbaum, 2013). Moreover, there are key recommendations for designing for tinkerability, according to Resnick and Rosenbaum (2013), that can be considered when incorporating tinkering into education. This is summarized in Table 1.

Table 1: Key Recommendations and their description (Resnick & Rosenbaum, 2013)

Key lessons	Description
Prioritize the process over the product	Emphasize that the tinkering process is more important than the final product. The goal for students is to learn through an iterative process, like the design-thinking process in UX.
Set themes, not challenges	To enable students to explore freely, themes should be set instead of challenges. However, in an educational setting, it will then be important to guide students to the concrete learning goals.
Highlight diverse examples	When explaining assignments or lesson series, it often helps to showcase a various set of examples, if necessary. Demonstrating various examples can encourage students to think creatively about their own concepts, instead of producing very similar products with minor alterations when only one example is shown.
Tinker with space	The classroom setup can either foster or hinder creativity and the desire to tinker. Consider factors like classroom setup, among others the position of the tables.
Encourage engagement with people, not just materials	Facilitating discussions and conversations among students can provide them with diverse insights.
Pose questions instead of providing answers	As facilitator, try to pose questions to students rather than answering and resolving everything for them. It’s important to work with students instead of for students, allowing students to explore and answer their own questions.
Combine diving in with stepping back	While it’s beneficial for students to immerse themselves in the making process, it’s equally important for them to step back periodically and reflect on their progress.

To incorporate a tinkering approach into a high school lesson series, careful consideration is needed to balance the freedom for students to choose their own goals and the essential learning objectives outlined in the series. While the tinkering approach encourages engagement by allowing students to pursue their interests, it is crucial to ensure that they acquire specific knowledge in line with the given end terms. One strategy for alignment is to design the toolbox and materials in a way that guides



students toward the required learning outcomes while still granting them the freedom to explore topics of personal interest.

### 3.4 Tinkering Tool

When developing a lesson series focusing on User Experience (UX), students need to engage in the creation of a digital product. As discussed in section 2.3, one digital product stands out in the lack of comprehensive use of UX: game design.

To design a lesson series that integrates UX and game design, the selection of a suitable software tool becomes crucial. There are several software platforms to choose from, each offering unique capabilities. To make a well-considered decision, four options are explored. Both the advantages and disadvantages of each platform are discussed, and this results in a recommendation of which platform is best suited for this lesson series.

Tinkering with technology can be challenging, especially when students are unfamiliar with the program intricacies. Starting with complex programming software may consume excessive time, hindering the rapid experimentation and iterative process conducive to tinkering and UX (Resnick and Rosenbaum, 2013). Therefore, it is important that the chosen software tool minimizes setup hurdles and facilitates swift engagement, allowing students to start experimenting promptly.

#### 3.4.1 Scratch

Scratch is an interactive software platform designed for students to create interactive stories, games, or animations (Northwestern University, 2023). The primary purpose is to facilitate the learning of programming in an accessible and visual manner. Scratch facilitates a user-friendly visual interface that simplifies the process of programming (Resnick and Rosenbaum, 2013). Focused on 2D design, Scratch utilizes a block-based system that allows students to effortlessly drag and drop blocks to construct scripts. A feature of Scratch is the real-time simulation screen that illustrates the functions of each block, providing instant feedback to students. Furthermore, each block includes a default value, allowing students to grasp the fundamental operations of the block before engaging in experimentation.

Scratch is a well-established and popular tool in educational settings, particularly for introducing students to the foundational principles of programming. An additional advantage is that Scratch is a web-based platform, eliminating the need for students to download any software. However, there are certain limitations to using Scratch for high school game design. First, its' childish design may not resonate with high school students, potentially limiting their long-term engagement. Second, Scratch relies solely on visual programming, offering an over-simplified approach to teaching programming concepts. While this is beneficial for beginners, it may be overly simplistic for older students looking for a more in-depth understanding of programming. Lastly, Scratch's capabilities are restricted to 2D game development, limiting the scope of game possibilities which may not fully align with high school students' preferences.

#### 3.4.2 Construct 3

Construct 3 is a versatile tool suitable for classroom environments, offering a comprehensive approach to teaching various aspects of programming (Geeks For Geeks, 2022). It covers essential areas such as programming principles, JavaScript coding, design, teamwork, and marketing (Construct 3, n.d.). In comparison to Scratch, Construct 3 is tailored to high school students, providing a platform for learning about coding and programming. To facilitate this learning journey, Construct 3 offers a curriculum consisting of 13 lessons that delve into different programming topics, including inputs and outputs, events and actions, data types, and global variables, among others (Construct 3, n.d.).

While Construct 3 is slightly less visual than Scratch, it still offers some visual interface options. Instead of employing blocks, Construct 3 utilizes a more code-like appearance, resembling actual programming. Similar to Scratch, Construct 3 operates as a web-based platform, enabling students to access their accounts from various computers without the need for specific software downloads. Additionally, it provides a graphical user interface-driven game maker that allows for a drag-and-drop implementation. Unfortunately, Construct 3, like Scratch, is primarily suited for the development of 2D games. Furthermore, it predominantly focuses on coding within specific topics, which might limit its suitability for more complex game development tasks.

### 3.4.3 Unity

Unity is a widely recognized tool within the game industry, with approximately fifty percent of game developers choosing it for game development (Unity, n.d.). Unlike the previous two platforms, Unity requires installation as standalone software but offers a broader spectrum of capabilities. It enables users to create games in both 2D and 3D dimensions.

Unity offers a substantial collection of tutorials and an extensive library, providing valuable resources for aspiring game developers. It primarily employs the C# programming language for game development, contributing to its popularity among developers. However, in contrast to the previously discussed platforms this makes Unity a more complex program, requiring a time investment to become proficient. The learning curve for Unity is steep, but it compensates for this by offering advanced features suitable for complex and highly customized game development projects.

### 3.4.4 Unreal Engine

The Unreal Engine is another robust software platform, similar to Unity, but it primarily focuses on model design and game visualization (Northwestern University, 2023). A significant distinction between Unity and Unreal is the programming language they employ (Kevuru games, 2023). Unreal Engine utilizes C++, while Unity utilizes C#. Generally, C# is considered easier to learn compared to C++ (Kevuru games, 2023).

Unreal Engine is typically favoured for high-performance, large-scale projects that require substantial hardware resources. However, it's important to note that the Unreal Engine has a steep learning curve, making it better suited for advanced, experienced users.

### 3.4.5 Which Platform to Use?

Out of the four mentioned game software platforms, Scratch and Construct 3 are more accessible for tinkering due to their user-friendly interfaces and minimal setup requirements. Although these platforms offer advantages, such as being web-based, they are limited in their capacity to develop 3D games. Additionally, Scratch, with its somewhat child-like design, may not retain the interest of high school students' long term.

Contrary to this, based on personal experience, Unity is a popular choice among high schools for practical assignments involving game creation. In Unity, games can be made in 2D and 3D dimensions. However, Unity lacks readily available tools for students to initiate game development seamlessly. The platform heavily relies on tutorials, guiding students through the development process step by step. While Unity offers numerous opportunities, the initial setup can be time-consuming before students know how to customize the game to their specific preferences. Unreal is not suitable to use for students in high school due to its very advanced platform and focus on visual aspects and big projects.

Given the widespread utilization of Unity within the educational context and its capability to enable students to develop complete games while providing a vast array of creative possibilities, it is the most logical choice. To facilitate a tinkering approach using Unity, it becomes imperative to construct a Unity

toolkit. This toolkit should establish a foundational game environment that facilitates a swift and effortless start of exploration and experimentation with game design. Scratch, as a very tinkerable platform, can be used as inspiration in the design of a toolkit. The main core is to create an Unity environment that allows students to focus on creating a prototype of a game and less on the programming aspects of game making.

### 3.5 Conclusion

Tinkering is a playful and experimental approach that encourages students to learn and work on a project by engaging in experimentation and building until they achieve their self-defined goals. This iterative process emphasizes experimentation and making changes based on feedback which is very similar to the design process of UX. UX also includes an iterative process and implementing feedback, however UX has a more structured process in comparison to tinkering. So, when combining these two components it is important to make sure that the structure of the UX design process is correctly applied while still leaving students with the freedom to explore and experiment.

To design for a tinkering session, various components, including the seed, playground, and especially the tinkering tool (comprising all necessary materials for tinkering), need careful consideration. When creating a tinkering environment, it is crucial to incorporate key lessons that enable students to fully embrace tinkering, fostering a sense of ownership in their learning experience, and enhancing motivation and engagement. Designing with a tinkering approach presents the challenge of finding a balance between allowing students to set their own goals and ensuring alignment with the required objectives defined by the lesson series' learning objectives.

For the design of a tinkering orientated UX lesson series, various software tools can be employed as tinkering tool as part of the toolbox, particularly in the context of game design and game design software. In this chapter, four popular software platforms were discussed: Scratch, Construct 3, Unity and Unreal. Based on a comparison Unity resulted as the top choice, for it allowed quite extensive freedom for students to design a game. Although students exhibit enthusiasm for designing games, Unity still poses a steep learning curve, necessitating the creation of a template within Unity to provide students with easier access to experimentation without investing a significant amount of time in coding.

With the gained knowledge on tinkering the lesson series can be designed incorporating tinkering. This will be done by using the framework as reference point in the designing of the elements of the lesson series including the student materials, incorporating the key lessons in the lesson series, and including Unity as software tool that allows for tinkering in the toolbox.

## Chapter 4: Lesson Serie Components

A lesson series is constructed based on the formal aspects of a curriculum, as outlined in the domains and end terms provided on the SLO website for Computer Science (Leerling2020, n.d.). These end terms provide the groundwork for creating a comprehensive lesson series, which is documented in a teacher's guide (Mickyjtjuh, 2012; Aralia, 2023; Leerling2020, n.d.). In this chapter, various components required for the documentation of a lesson series are discussed. Additionally, different teaching methods that can be applied in a lesson series are explored as they are also a part of how to specifically teach a lesson series and it is explored how to increase the student engagement.

### 4.1 Teacher Guide Components

A teacher guide provides various key elements, including learning objectives, a general overview of the lesson series, a breakdown of the covered topics, and a time planning. It also includes essential resources for both students and teachers, such as presentations, theoretical materials, and evaluation forms. Each of these components will be discussed in more detail below. Based on the components mentioned below, a complete teacher guide can be developed that allows teachers to teach the lesson series to high school students.

#### *Description*

The teacher guide starts with a general description of what the lesson series entails, including a general description of the learning objectives, for whom the lesson series are applicable, the length of the lesson series and how the lesson series fits in the general curriculum of Computer Science. This way teachers understand what the lesson series entails.

#### *Learning Objectives*

Learning objectives define what students should know or be capable of by the end of the course or lesson (Devid, 2020). It is important that the learning objectives are clear at the start, so that both the teacher and students know what is expected from them, and to give direction to learning. It also improves self-regulation and students' responsibility of their own learning (Devid, 2020). With clear learning objectives, providing feedback becomes more effective, for the given feedback can be more specified (Devid, 2020).

#### *Topics and Timeline*

An overview of the various topics covered in each lesson is provided, along with a suitable timeline that outlines the duration of the entire lesson series (Aralia, 2023). This way teachers get an idea of how the lesson series is structured and what topics are discussed. This can be a brief overview, or it can be a more detailed description of the different topics.

#### *Assessments methods*

Assessment methods can be interpreted in two ways: as a type of test or a list with different competencies (Cito, 2016). A test can be a formative test, a written test, or any type of practical assignment. For a practical assignment there are several ways students can hand in their work such as a portfolio, by giving a presentation, a product, a reflection report, or through a video or sound-recording (Berkeley, n.d.; Groenendijk et al., 2016). To assess if a student mastered the specified learning objectives, an assessment form is used where the different criteria are stated based on the learning objectives (Learn Alberta, 2008). A few examples of these forms are a checklist, rubrics, score forms or comparative assessment (Learn Alberta, 2008). Both types of assessments methods are to be included in a teaching guide. In this case, the students will be tested through a practical assignment in

which they will have to show their knowledge on UX. To help in the assessment, an assessment method will need to be chosen that helps teachers in assessing the very different games in a fair and objective manner.

### *Materials and resources*

A teacher guide should incorporate all the necessary materials essential for giving the lesson series, with an explanation on how to use the materials (Aralia, 2023). This encompasses not only student materials and assignments, but also additional resources, such as required tools. Student materials include among others the description of the assignment, what they will be assessed on, and the necessary materials for them to get started, such as a document that informs them of all the necessary information on UX and game design.

## 4.2 Teaching Methods

In addition to the teacher guide and its necessary components, it is important to discuss the used teaching approaches, activities, and to consider the learning stages of the students. Below the three different topics are discussed in more detail.

### 4.2.1 Teaching Methods

Various teaching methods can be employed to attain different learning outcomes. There is a wide array of teaching methods available, and in Table 2 below, a list of the different methods along with brief explanations are provided (Vietnam Teaching Jobs, 2023).

*Table 2: Teaching Methods based on Vietnam Teaching Jobs (Vietnam Teaching Jobs, 2023)*

<b>Name</b>	<b>Description</b>
Teacher-centred instruction	Method where the teacher is positioned at the core of the learning process, serving as the primary source of knowledge and guidance. The teacher directs the learning process, dictates the pace, and controls the flow of information.
Student-centred	Method in which the student is placed at the heart of the learning process, with the teacher acting as a facilitator guiding students to explore and discover independently.
Differentiated instruction	Method that focuses on tailoring instruction to address the diverse needs of students.
Technology-based learning	Method that integrates technology into the learning process.
Project-based learning	Method that empathizes hands-on learning in a collaborative environment centred on problem-solving to produce tangible outcomes or solutions.
Group learning	Method that prioritizes teamwork and social interaction. Students collaborate on various tasks and learn from one another.
Individual learning	Method that places the responsibility of learning on the student, allowing them to take an active role in their own learning at their own pace.
Inquiry-based learning	Method centred on students' exploration and discovery through asking questions and investigating.
Kinaesthetic learning	Method that involves physical activity to aid students in learning and retaining new information.
Game-based learning	Method that incorporates games or game elements to facilitate learning.
Expeditionary learning	Method that involves learning through experiential and exploratory methods.
Flipped classroom	Method that reverses the traditional sequence of learning activities.

Role-playing	Method in which specific scenarios are enacted to enhance learning and understanding.
Problem-based learning	Method focusses on solving real world problems.

As can be seen in Table 2, there are many different teaching methods, each with a different focus. Selecting the appropriate teaching method depends on the type of lesson series and the desired activities. The choice of teaching method can have an impact on how the lesson series and activities will be executed. This means that for this lesson series that incorporates a tinkering-approach, a student-centred approach is used. The teacher acts as a facilitator and lets students explore and discover independently.

The structure of the lessons follows a whole task first method. The whole task first method reverses the traditional sequence of lessons, which typically begins with a theory explanation, followed by smaller assignments, and ends in a larger assignment (Janssen et al., 2016). Instead, the whole task first concept introduces the end assignment at the beginning of the lesson series, allowing students to explore and gather their own necessary information to complete it (Janssen et al., 2016). Several benefits of using this method include (Janssen et al., 2016):

- Enhancing content-wise motivation among students at the onset of the lesson, as they are aware of the goals from the start.
- Encouraging students to practice and identify areas of improvement during the lessons, fostering a deeper understanding of their own capabilities and learning needs.
- Allowing students to work at their own pace, creating differentiation in the classroom which accommodates to various learning styles and abilities.
- Providing more challenge for advanced students from the start while allowing others to progress at pace that suits their needs.
- Enabling teachers to offer tailored support to students based on their individual progress and needs, ensuring that help is provided in a personalized and effective manner.

This approach places students at the centre of the learning process, enabling teachers to take on a more facilitating role by providing tailored feedback. The concept of tailored feedback is not a new concept and has long been referred to as “scaffolding” in educational research (Janssen et al., 2016). Scaffolding is a term that is commonly used with tinkering. Therefore, the whole task first method aligns well with the principles of tinkering and creating a student-centred learning environment.

#### 4.2.2 Activities

Like the different teaching methods, there also many different activities. Various activities can be applied in each lesson, including homework assignments, group work, and interactive discussion, all varying in the amount of interaction and activity from students (Marren, 2021). Marren (2021) mentions that there are six types of activities that can be used for Computer Science lessons. In table 3 each activity is shortly discussed. These methods can be alternately used in the lesson series, all depending on the type of lessons and used approach.

Table 3: Overview of activities (Marren, 2021)

Name	Description
Instructional teaching methods	Three options; teacher explains theory while students listen, a demonstration by the teacher, or watching a video. All these instruction methods are limited in interaction and only ask students to listen watch.

Conversation formats	Different types of conversation formats such as educational student conversations, learning conversations, circle conversation or group discussions. These are methods of discussing or asking questions to help students in a more interactive manner.
Guided practical moments	For this method students follow instructions while the teacher demonstrates. This is a method that allows students to participate and have a more active learning experience.
Group formats	There are different formats for groups: pairs or groups. When it comes to group work it is important to think of the size, pre-knowledge of the students and why groups are important.
Individual working methods	An individual working method is guided self-study where students work independently on getting insights. There are also other individual working methods such as self-study packets, not guided practical moments and practical practice.
Homework	This method involves tasks and assignments students must do outside of the classroom.

The expected level of student engagement varies depending on the chosen activity. A distinction can be made between passive, active, constructive, and interactive learning (Chi, 2008). The higher the degree of student activity, the more engaged they become in their own learning, ultimately leading to improved learning outcomes (Chi, 2008). Thus, to engage students as much as possible in activities, it is important to choose a method that asks the most of students during an activity. Having in mind the tinkering approach with the whole task first method, activities could be most effectively organised in group formats. Group formats allow students to work in groups or pairs during the assignment and discuss with each other on their findings, etc.

#### 4.2.3 Learning Stages – Bloom’s Taxonomy

When teaching, it is important to think about the type of learning stages students go through. A commonly used classification system of the different learning stages is Bloom’s Taxonomy, which has been revised by Anderson et al. (2001). Students go through various learning stages that progressively challenge students’ cognitive abilities, from knowledge acquisition to critical thinking and application (Fuller et al, 2007). In total, there are six different learning stages according to Blooms Taxonomy, each stage building upon the previous one (Andreev, 2023). The simplest stage in learning is the remember stage. In this stage, students recognize and remember information. The most advanced stage is producing new or original work. In Figure 3 each step is briefly described.

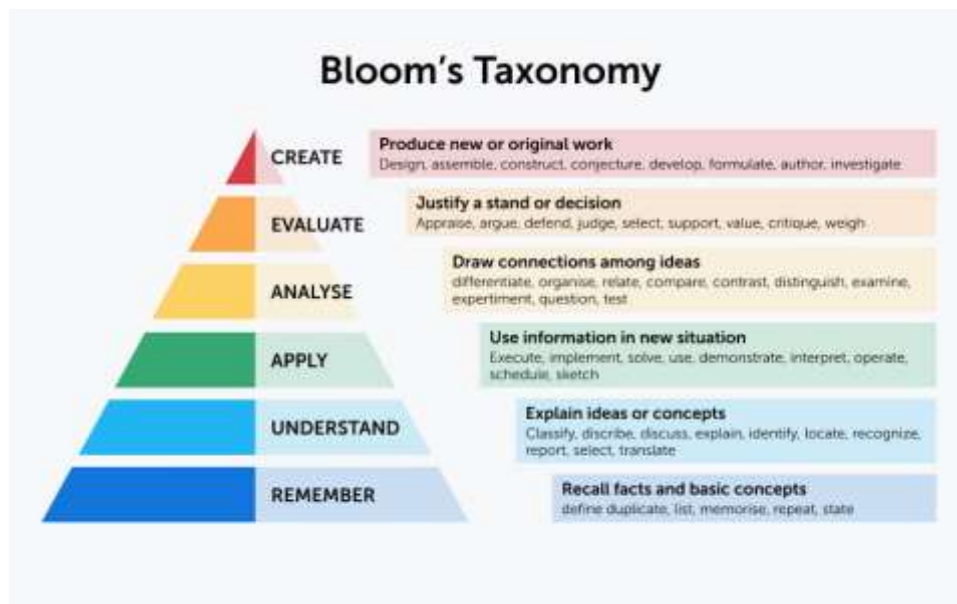


Figure 3: Revised Bloom's Taxonomy (Andreev, 2003)

As can be observed, there is also a progression in students' activity for each learning stage. In the initial stage, it primarily involves recalling facts, which demands little to no active learning. However, to advance to the stages of application and analysis, a higher level of activity and participation in learning becomes essential for students. The highest level of activity is necessary in the "create" learning stage, where students are required to generate their own work, demanding the highest form of activity from them. Students will have to go through all levels of the learning stages during the lesson series. Applying it to the assignment of the lesson series, students should remember facts and basic concepts about UX, such as the five different stages of design thinking, and create their own game.

### 4.3 Student Engagement

Between 40 to 60 percent of high school students are disengaged (Klem & Conell, 2004). However, research indicates that a higher level of student involvement is associated with more positive learning outcomes across academic, social, and emotional domains (Klem & Conell, 2004). To address the disengagement of students and foster a more engaging classroom environment, the concept of student engagement has gained considerable attention. Student engagement, a term with a rich history spanning over 70 years, has been a focal point for understanding and enhancing student learning (Taylor & Parson, 2011). It encompasses various forms of involvement and operates on multiple levels, including cognitive, emotional, and behavioural dimensions, both within and outside the classroom (Taylor & Parson, 2011).





Figure 4: A model of student Engagement (Grocchia, 2018 (Adapted from Burns et al., 2004; Grocchia and Hunter, 2012))

Grocchia (2018) refined a comprehensive model of student engagement, as depicted in Figure 4. This model offers a multidimensional perspective on student engagement, illustrating the diverse ways in which students can engage throughout their academic journey (Grocchia, 2018). According to this model, students can engage through various avenues, such as teaching, learning, research, interactions with the community, peers, and faculty (Grocchia, 2018). Moreover, the model delineates three distinct levels of student engagement: doing, feeling, and thinking. Doing is about the behavioural aspects of student engagement, encompassing their actions and behaviours within the educational setting. Feeling focuses on the emotional dimension, reflecting students' affective responses and attitudes towards learning. Finally, thinking encompasses the cognitive and psychological aspects of student engagement, including their critical thinking skills, problem-solving abilities, and intellectual engagement with course material.

To create a lesson series that enhances student engagement and makes the lessons series more engaging than traditional lesson series, various methods will be employed, incorporating the three distinct levels of engagement as illustrated in Figure 4. First, the use of tinkering offers students an interactive and playful approach to learning, allowing them to understand materials through hands-on activities. His method engages students by involving them in active learning, research and collaboration with peers. Additionally, a student-centred approach is adopted, placing students at the core of the learning process. This shifts away from traditional teaching methods and focuses on higher levels of engagement. It emphasizes the development of students' critical thinking and problem-solving skills. By integrating these diverse, interactive, and active methods, the lesson series aims to provide a more engaging and effective learning experience for students.

#### 4.4 Conclusion

In this chapter, different components of a lesson series were discussed, focusing on three main aspects: the teacher guide, the teaching method, and the student engagement. The teacher guide must incorporate all necessary information, including the materials for both students and teachers, and provide a detailed explanation of the teaching methods and activities used in the lesson series. This means there should be extensive explanations on tinkering, the whole task first concept, and the role

of the teacher to ensure teachers understand how to apply the methods correctly. Moreover, this lesson series is student-centred, fitting well with the tinkering approach. To ensure the lesson series is engaging, student engagement was discussed. Initially, it was briefly defined, followed by a detailed discussion on how it would be achieved in the lesson series. Engagement among students is heightened by applying hands-on approaches such as the tinkering approach and whole task first concepts, creating an environment where students control their own learning.

Overall, this chapter discussed the documentation of the lesson series to be able to share it with other teachers and delved deeper into the teaching elements necessary to create an engaging lesson series. With these findings, a comprehensive list of design requirement could be made.

## Chapter 5: Design Requirements

The design of the lesson series primarily consists of two components: student materials (containing information for students, including the assignment and the assessment method<sup>2</sup>) and the teacher guide (which provides teachers with specific instructions for implementing the lesson series). Because the lesson series employs a tinkering approach, the student materials must be designed accordingly. Specific requirements for each element along with general design requirement applicable to all components of the lesson series are outlined based on findings from the previous chapters. These requirements are discussed in corresponding sections, beginning with the general requirements, followed by those for designing for tinkerability, student materials, and the teacher guide.

### 5.1 General Requirements of Lesson Series

To determine the general requirements of the lesson series, two main arguments were considered. First, design decisions were made to incorporate tinkering as the method and UX as the main topic of the lesson series, specifically tailored for the Dutch high school course Computer Science. Second, findings from the literature research were utilized to establish the emphasis of the lesson series. These findings detailed in sections 2.2 and 4.2, were based on the general end terms provided by SLO for UX and the chosen teaching method.

1. Emphasis:
  - a. The lesson series places a stronger emphasis on design and UX rather than programming aspects, allowing students to learn more about the UX principles without delving too deeply into coding specifics.
  - b. The focus of the lesson series is on analysing and designing of a digital artifact, teaching students how to articulate their design choices effectively.
2. Method:
  - a. The materials are designed in such a way that it allows students to use a tinkering approach during the lesson series.
  - b. The whole task first concept is implemented to allow students to acquire information directly relevant to their final assignment, which aligns well with the tinkering approach.
3. Language:
  - a. The lesson series is in Dutch, as it is specifically designed for the Dutch high school course in Computer Science.
4. Context:
  - a. The lesson series is designed for the Computer Science course in Dutch high schools.

### 5.2 Designing for Tinkerability

The following requirements enable a tinkering approach. To determine these specific design requirements, the findings from the framework discussed in section 3.2 were used as the main argumentation. The requirements are divided into the different elements of the framework, with the most important requirement identified for each element. These requirements were applied throughout the entire design process, focusing on the different components of the lesson series.

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<sup>2</sup> Even though the assignment and assessment method are part of the category of student materials, they will be individually discussed and included in the teacher guide.

1. Seed:
  - a. The lesson series should incorporate a seed that triggers the students to start tinkering. This trigger can be as simple as showing an example, presenting an assignment, or introducing new materials.
2. Playground:
  - a. The lesson series should be conducted in an environment conducive to stimulating and encouraging creativity.
3. Discovery:
  - a. The lesson series ensures that students discover and set their own goals within the required learning objectives.
4. Toolbox:
  - a. The toolbox should contain various building blocks that enable students to explore and experiment with materials to gain the necessary insights.
5. Scaffolding:
  - a. The guidance provided by the facilitator should allow for scaffolding exercises, gradually decreasing the amount of guidance and instruction from the facilitator.
6. Flow:
  - a. The lesson series should challenge each individual student in their skill level to create the best learning flow.
7. Facilitator:
  - a. The role of the facilitator is to spark initial interest for students, help them sustain engagement, and deepen their understanding.
  - b. The role of the facilitator is to keep a balance between aiding students and giving them the appropriate tools to figure out the solutions by themselves.

### 5.3 Student Material

The student materials are divided into two topics: UX and game design. For these materials, design requirements were established, including both specific requirements for each topic and general requirements for all materials. The UX-material requirements are based on literature findings from sections 2.1, 2.2, and 2.3, which highlight the importance and emphasis of the UX materials, the UX cycle and its accompanying methods, and the need to ensure that students go through the UX cycle multiple times. The game design requirements are based on the context of the lesson series and design choices to ensure that the game design materials align with the UX materials and are crafted to allow for tinkering. Lastly, the general requirements for the student materials are based on design principles, such as ease of use, provision of all necessary information, and guidance to help students feel a sense of ownership fostered by using the different teaching methods.

#### UX material:

1. Emphasis:
  - a. The UX material enables students to both design and analyse interactive digital products.
  - b. The UX material emphasizes the importance of making informed design choices rooted in research through the application of the UX design process.
2. UX-cycle:
  - a. To enhance student understanding of the UX design cycle, it is important for students to go through the cycle multiple times during the lesson series.
  - b. The UX design cycle is broadly explained to the students and includes different methods students can apply to accomplish the different steps of the cycle.

### Game design material:

1. Alignment:
  - a. The game design materials align with the UX materials.
2. Usability:
  - a. The game design materials help students understand the different aspects of a game to come up with a well thought out game idea.
  - b. The game design materials allow students to quickly create a first working prototype of their game.
3. Unity template
  - a. The Unity template should enable students to focus not on programming but on a functioning core concept of their game within a short time frame.

### General requirements:

1. The student materials provide students with necessary information to accomplish the learning objectives.
2. The student materials are easy to use and understand.
3. The materials allow for a student-centred focus.
4. The materials foster a sense of ownership in students' learning experience and enhance their motivation and engagement.

## 5.4 Teacher Guide

Lastly, there are numerous requirements for the teacher guide. The teacher guide should provide teachers with all the essential information needed to implement the lesson series. The list of requirements is based on the findings of sections 4.1 and 4.2, which discuss the various components of a teacher guide and teaching methods. These findings led to the formulation of specific requirements for each element of the teacher guide, covering aspects from its overarching goal to the contents it should encompass.

1. Goal and target audience:
  - a. The teacher guide serves as main material to equip Computer Science teachers with the necessary resources to conduct a UX lesson series.
  - b. The target audience for the teacher guide are Computer Science teachers interested in teaching an UX lesson series.
2. Contents:
  - a. The teacher guide should feature a clear and easily navigable structure to provide quick access to essential information.
  - b. It should encompass the following information:
    - i. Lesson series description, including its suitability for specific classes.
    - ii. Lesson series objectives and learning goals.
    - iii. Lesson timeline and overviews.
    - iv. Assessment and feedback materials.
    - v. Recommended resources and answers.
3. Language and style:
  - a. The teacher guide must employ clear and understandable language.
  - b. Visual elements such as illustrations and images should be integrated to enhance clarity.
4. Learning objectives and assessment method:

- a. The teacher guide should articulate specific, measurable learning objectives and evaluation criteria for each lesson.
  - b. It should be clear how the students' work will be assessed.
- 5. Teacher role:
  - a. The teacher guide must explicitly define the teacher's role in the classroom as a facilitator.
  - b. The teacher guide must explicitly state the teaching method, learning styles, and activities.

## Chapter 6: Design Methodology

By defining the design requirements, an approach to designing and evaluating the lesson series could be determined. This chapter discusses the approach taken to design and develop the lesson series. Additionally, it describes the evaluation methods and delves into the ethics of involving users.

### 6.1 Approach

Given that the lesson series will focus on UX, the decision was made to also use an UX-centred approach throughout the development of the lesson series. The reason behind this decision was based on the importance of including users, so students and teachers, to create a lesson series that fits to their desires. Incorporating the UX-cycle involves actively engaging end users, including both high school students and teachers, in the iterative process of designing and testing the lesson series. By seeking diverse user inputs and expert feedback, the aim is to achieve a comprehensive understanding to design a lesson series that fits the needs of high school students.

#### 6.1.1 Determining the Learning Objectives and Essential Game Elements

Prior to starting the design phase of the lesson series, it is important to address two questions that were not yet answered in literature research:

1. What are the key elements for developing a game?
2. What are the learning objectives of this UX lesson series?

Answering the first question involves identifying the essential game elements. To gather these insights, a focus group with experts was conducted where participants were asked to rank game elements. Based on the focus group, the most important game elements can be included in the lesson series. The second question focuses on defining the specific learning objectives. Establishing these objectives upfront provides clarity and focus during the design phase.

#### 6.1.2 Creating the Materials

After identifying the essential game elements and defining the learning objectives, the different student materials were created, both UX and game design materials. The development of the game design materials began with the creation of an initial version of the Unity template. This template was developed using a bottom-up approach. Subsequently, additional materials related to game design were created to explain Unity and to assist students in the ideation phase of game development. The results from the focus group were utilized to determine which elements should be included. Finally, the UX materials were designed, taking inspiration from existing lesson series discussed in Chapter 2.

#### 6.1.3 Evaluating the Materials

The student materials were evaluated multiple times and had subsequent redesigns. The game design materials were twice usability tested by experts and non-experts in game design. Between these rounds and after the second round, the game design materials were redesigned.

Following this, the student materials underwent two additional types of evaluations aimed at assessing various aspects such as ease of use, usability, student engagement and tinkerability from different perspectives. A field study was conducted with high school students over six lessons, introducing the student materials in a workshop setup to assess ease of use, student engagement, and overall usability. Additionally, the student materials were assessed during a lecture attended by university students with expertise in tinkering to evaluate the tinkerability of the student materials. Lastly, the teacher guide, containing all necessary explanations and materials, was sent to high school Computer Science teachers for an evaluation via survey. The aim was to gather insight into the usability and understandability of the teacher guide and to determine if it provided sufficient information for other

teachers to be able to give the lesson series. Following the evaluations, a final design of the lesson series was created.

## 6.2 Evaluation Methods

In total, five different methods were used, including the focus group conducted before the start of the design. First, an overview is provided, detailing each method, its purpose, application, timing, and the participants involved. Subsequently, a general description of each method is provided highlighting key distinctive features for each.

### 6.2.1 Application of the Evaluation Methods

Table 4 below presents an overview of the different evaluation methods employed. The table outlines the type of evaluation, its intended purpose, how it is applied, the participants involved, the stage of the design process at which each method is applied.

Table 4: Overview of the use of the evaluation methods.

Type of evaluation	Purpose	How?	When?	Participants:
Focus group	Determine the essential game elements.	By sorting and then ordering a pre-made list of game elements.	Before first design iteration	Experts on game design
Usability test	Find possible issues with the materials and see the interaction with materials.	By performing three tasks with the materials and then a semi-structured interview.	Testing of first and second design iteration	Experts and non-expert university students
Field study	Gather insights into the use of the materials and students' opinion on materials.	A six-lesson workshop where students got different assignments to perform.	After design iteration three	High school Computer Science students
Evaluation session	Test the tinkability of the materials with experts on tinkering.	Performing of a few task to gather an insight into the use of all the different materials.	After design iteration three	Expert University students on tinkering
Survey	Determine if the teacher guide contains all necessary information to teach the lesson series and gather teachers' opinion on the lesson series.	Reading through the teacher guide and then filling in a online survey with questions per chapter of the teacher guide.	After design iteration three	High School Computer Science Teachers

### 6.2.2 Focus Group

A focus group consists of a group of ideally five to ten participants to provide insights in response to a series of questions or to offer feedback on a concept or product (Baxter et al, 2015). Participants are typically asked to engage in tasks to enhance their understanding of the product or concept (Baxter et al, 2015). Facilitated by a moderator, the focus group fosters an open and non-judgmental environment where participants share their experiences and opinions (Baxter et al, 2015). One of the key advantages of a focus group lies in its ability to uncover topics that may not emerge during an individual



interview, stimulating the generation of new ideas and encouraging participants to discuss topics they might not otherwise address (Baxter et al, 2015). Additionally, a focus group facilitates the collection of diverse viewpoints within a single session, allowing for comprehensive feedback and a broader understanding of the topic.

### 6.2.3 Usability Test

Usability testing involves systematically observing users as they attempt to complete specific tasks with a product, typically within a defined scenario (Baxter et al, 2015). In individual sessions, participants interact with the product while verbalizing their thought process – a practice known as the think-aloud protocol (Baxter et al, 2015). Multiple participants are tasked with completing the same set of tasks using the same version of the product, aiming to identify as many usability issues as possible (Baxter et al, 2015). The goal of usability testing is to uncover any issues encountered during product use, thereby pinpointing areas for improvement.

### 6.2.4 Field Study

Conducting the evaluation in the field provides a more realistic understanding of how individuals, such as high school students in this instance, will use the product (Baxter et al, 2015). A field study may entail one or multiple visits to the user's environment and can be conducted in various settings, in this case the high school classroom (Baxter et al, 2015). One of the primary advantages of a field study is the opportunity to directly observe users in the environment where the product will be utilized (Baxter et al, 2015).

### 6.2.5 Evaluation Session

In an evaluation session, participants are tasked with completing specific assignments within a condensed timeframe compared to a field study. Following the completion of these tasks, participants provide feedback on the materials through two questionnaires: one individually and one collectively as a group. Additionally, participants share their perspectives on predetermined statements during a group discussion, offering further insights into their experiences and opinions with the materials.

### 6.2.6 Survey

A survey is an extremely effective method for collecting information from a large sample within a relatively short timeframe (Baxter et al, 2015). It proves valuable in initiating research efforts, particularly for new product development, by identifying target users, addressing current pain points or gaining insight into the existing product user population, among other purposes. In this context, a survey is chosen due to its flexibility, allowing participants to complete it at their convenience without the need for a scheduled appointment. This flexibility is especially beneficial considering that reviewing the materials, including the teacher guide, and accompanying materials, may require significant time and attention.

## 6.3 Ethics

Before engaging in any user activities, it was important to inform participants about their legal rights and address ethical considerations. To accomplish this, an ethical request was submitted and approved by the Ethics Commission of Computer & Information Sciences (CIS) of the University of Twente. For each user activity, an ethical request was submitted, ensuring the study's compliance with ethical standards, clarifying the data collection process, utilization in the graduation project, and data retention policies. Information brochures detailing the research were provided to participants to inform them of their rights. Additionally, each participant was required to sign a consent form prior to participating, indicating their agreement to participate and their understanding of how their information would be utilized. In total, there were five ethical requests submitted: the focus group

(230626), the usability testing (240088), the field study (240091), the evaluation session (240215) and the survey (240053). Each request was approved by the Ethics Commission of Computer & Information Sciences (CIS).

## Chapter 7: Essential Game Elements

The first step in designing the lesson series was to determine the essential game elements. To identify the essential game elements from the less essential game elements, a focus group was held.

### 7.1 Goal

The goal was to determine the essential game elements through a focus group, specifically by allowing the participants to rank game elements. To assist the participants, a pre-made list of existing game elements (see Table 5) was provided. This list was based on own experience and knowledge on game design and game elements. This approach allowed the focus group to concentrate on ordering the elements rather than first having to identify and name all the different game elements.

Table 5: Overview of the pre-made game elements.

Aesthetics	Animations	Audio	Avatar	Challenge	Competition
Cooperation	Camera	Collectables	Camera Angle	Drag	Discovery
Decisions	Enemies	Emotional Attachment	Feedback	Fun	Goal
Items	Interactivity	Jump	Leaderboard	Levels	Lives
Light source	Movements	Move	Menus	Obstacles	Outcome
Plot/Storyline	Progress bar	Run	Reard	Rules	Shoot
Turn	Time limits	Theme	Terrain	Walk	

To help the participants become familiar with the various elements of the pre-made list and potentially identify missing ones, a sorting activity was conducted. Each element was written on a separate card for this purpose. Following the sorting, two different card orderings were made: one ordering the elements from basic to advanced in game design, and the other ordering them in the desired sequence for creating a game. The goal of the first ordering was to establish a ranking from basic game elements to advanced ones. For the second ordering, participants were asked to consider the perspective of novice game designers. The aim was to establish a structured framework guiding novice game designers through the game design process effectively, starting with essential parts and progressing to more advanced elements (the desired sequence for game creation).

The objectives of the focus group were the following:

- Obtaining an overview of game elements sorted in different types of categories and naming each category.
- Obtaining an overview of game elements ordered from basic to advanced elements.
- Obtaining an overview of game elements ordered in the desired sequence for game development, considering the perspective of novices in game design.

The following data was collected during the focus group:

- An overview of the sorted cards in different categories with accompanying category names.
- An ordering of all the elements from most basic to most advanced elements.
- An order of all the elements in desired sequence.
- Observational notes during the session.
- An audio-recording of the session as a backup to the ordered cards for argumentation.

### 7.2 Participants

For the recruitment of the participants students at the University of Twente meeting the following two criteria were contacted:

- A) Has experience with Unity.
- B) Is familiar with game design.

The participants were recruited by the researcher using online communication channels such as WhatsApp. The advertisement was kept simple, clear, and concise, stating the purpose, timing, method, and target audience of the study. For the focus group, a minimum of four participants was desired. Although responses were initially low, eventually a total of five participants responded to the advertisement. These respondents were all students at the university aged between 18 and 30 years old, with varying levels of experience in game design and Unity.

### 7.3 Procedure

The focus group was held in a booked room at the University of Twente with a round table to create an equal footing among all the participants. The session started with welcoming participants, a general description of the session itself, the chance to read the information brochure and signing the consent forms. The information brochure and consent form can be found in Appendix A. After this, a general introduction was done where each participant introduced themselves shortly and mentioned their favourite game.

This was followed by sorting the game elements into categories with the focus group. If participants felt that an element was missing, they could add these elements themselves. After sorting the elements, the focus group continued with the ordering of the game elements.

After the sorting and the ordering of the focus group there was a short wrap-up consisting of three questions. These questions helped to identify if a game element was missing, what element was most important, and a summary of the key findings. An overview of this can be found in Table 6, outlining the specific questions, the time for each task and the goal behind each specific question.

Table 6: Overview guide of the Focus Group

Topic	Question	Duration	Goal
Introduction	Please share with us your name and your favourite game.	<5 min.	Get participants talking; getting to know each other, help participants feel comfortable, putting them on the general topic of the focus group
Key topic 1 – Sorting	Sort the game elements in categories.	20 – 30 min	Introducing the participants with the different game elements
	Are there any missing elements?		
Key topic 2 – Ordering	Order the game from most basic element to most advanced element.	20 – 30 min	Ordering of elements from most basic to most advanced. As well as ordering them in the desired sequence that the elements should be used when designing a game.
	Order the game elements in the desired sequence from the perspective of a 15-year-old.		
Wrap-up	Of all the things we discussed which one is most important to you?	Approx. 5 min.	Have participants reflect on discussion/experience; bring closure to discussion.
Summary	Does this summary capture what was said?	Approx. 5 min.	Let’s participants validate/refute key findings

What's missing?	What did we not cover that we should have?	Approx. 5 min.	Determine topics that were of interest to participants but were not already covered.
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## 7.4 Results

The results from the focus group are divided into four main section: the three tasks and a summary of recommendations.

### 7.4.1 Card Sorting

The participants identified the following list of game elements that were missing during the card sorting:

- Click: Clicking from a mouse
- Lock boxes: Virtual containers with randomized rewards that can be obtained through gameplay or purchases.
- Immersion: Level of immersion into a game
- Input: Type of input, such as controller or input a player has
- Motivation: How motivated a person is to play the game
- NPC's: Non-Player Characters
- Progression: The progression in a game
- Puzzles: A type of game, for example, e.g., cooperative, or competitive.

The results of the sorting can be found in Table 7. After participants categorized the different cards, the participants gave each category a name. The participants organized the cards into the following five category names: Player Action, Motivation, Game Elements, Core Pillars, and Game Technologies.

Table 7: Results of sorting the cards

Player Action	Motivation	Game elements	Core pillars	Game Technologies
Click	Competition	Challenge	Aesthetics	Animations
Decisions	Cooperation	Collectables	Feedback	Audio
Drag	Discovery	Enemies	Goal	Avatar
Jump	Emotional attachment	Items	Input	Camera Angle
Movements	Fun	Leaderboard	Levels	Light source
Move	Immersion	Lives	Motivation	Menus
Run	Interactivity	Lock boxes	Theme	Progress bar
Shoot	Progression	NPC's		Terrain
Turn	Reward	Obstacles		
Walk		Outcome		
		Plot/Storyline		
		Puzzles		
		Rules		
		Time Limits		

As can be seen in Table 7, the Player Actions category encompasses all the various actions a player can undertake, for instance movement and decisions. The Motivation category encompasses all aspects related to the player's motivation to engage with a game, including the level of enjoyment, immersion, progression, and reward. The Game Elements category comprises all elements that can be

incorporated into a game to enhance its appeal and engagement. The Core Pillars category includes fundamental elements that form the backbone of a game, such as the aesthetics, feedback mechanisms, clear goals, motivation, and a theme. Lastly, the Game Technologies category focusses on technological aspects within related to the software, such as animations, audio features, an avatar, camera angles, and others, which contribute to the overall game experience.

Based on the sorting and categorizing of the elements, each category was assigned its own colour, as shown in Table 7. In the results of the ordering, in section 7.4.2 and 7.4.3, these colours are also applied to each element to determine whether certain categories are more significant than others or if this is random.

#### 7.4.2 Ordering 1: Basic to Advanced

After sorting the elements into categories, participants were tasked to order the elements from basic to advanced levels. This process involved arranging elements based on their complexity and importance in game design. Notably, participants used the overarching category name “Player Actions” instead of listing all the different cards, such as move, run walk, etc. Moreover, the participants added a new element “difficulty”, regarding the difficulty level of the game. The results of the first card ordering by participants can be found in Table 8. To order the elements, participants created a hierarchy where level 1 represents the most basic elements and level 10 the most complex elements. As can be seen, elements from the category Core Pillars (blue) were ordered as most basic, followed by elements of Player Actions (yellow), Motivation (green) and Game Elements (orange), with the most advanced elements being Game Technologies (pink) elements.

Table 8: Results of ordering game elements from basic to advanced.

Level	Order of elements				
1	Goal		Motivation		
2	Aesthetics		Input		Game Technologies
3	Audio	Theme	Decisions	Rules	Player actions
4	Difficulty	Fun	Challenges		Progression
5	Feedback	Interactivity	Discovery	Immersion	Cooperation
6	Levels	Competition	Reward	Emotional Attachment	Plot/storyline
7	Time limits	Outcome	Lives	Points	Enemies
8	NPC's	Items	Collectables	Puzzles	Menu
9	Animations		Obstacles		Camera Angle
10	Light source	Avatar	Terrain	Progress bar	Leader board

#### 7.4.3 Ordering 2: Desired Sequence

After the first ordering, participants were instructed to rearrange the game elements in their desired sequence for game design. This involved determining which elements were most important and which ones should come later when designing a game. Specifically, it was crucial to consider the perspective of novice game designers. This process resulted in a hierarchy of eight levels, as shown in Table 9. The most critical elements include Theme, Game Mechanics, Input, Avatar, and Game Technologies, followed by Challenges, Motivation, Rules, and Goal (Level 1, 2, and 3).

Table 9: Results from ordering elements in desired sequence

Level	Order of elements								
1	Theme			Game mechanics					
2	Input	Avatar		Game technologies		Interactivity		Decisions	
3	Challenges	Motivation		Rules			Levels		Goal
4	Obstacles	Lives	Items		NPC's	Enemies	Collectables		Points
5	Player actions	Reward	Progression		Feedback		Aesthetics	Menus	Time limits
6	Audio				Plot/storyline				
<i>Below are extra items that are already too complicated for novice game designers</i>									
7	Cooperation	Fun	Competition	Discovery	Emotional attachment		Puzzles	Outcome	Animations
8	Immersion		Light source		Difficulty		Progress bar		Leaderboard

The results from Table 9 differ from Table 8. One key distinction is the reduced importance of elements from the Motivation category (green) in the second ordering. Another notable difference is the emphasis on Core Pillars (blue), Game Elements (orange), and Player Actions (yellow) in ordering 2. During the second order activity, most of the Game Technology (pink) elements are excluded (below the line (levels 7 and 8), along with some Game Elements and the majority of Motivation elements, as shown in Table 9.

#### 7.4.4 Key Observations and Recommendations

One notable observation made by a participant of the focus group was that novice game designers tend to dive too quickly into the making phase without a sufficient consideration for the game's storyline or plot. It was suggested that students should spend more time conceptualizing and planning their games before transitioning to the development phase.

Based on the orderings of the game element cards, a selection of fundamental elements was identified as crucial for guiding high school students in game design. These foundational concepts will form the basis for students to experiment with game creation and core game mechanics, with less emphasis on advanced elements.

#### 7.5 Conclusion

The insights gained from the focus group provided valuable guidance on determining the significance of various game elements. This understanding helped making an informed decision regarding the selection of game elements to incorporate into the materials for the lesson series. By identifying which elements were deemed important and which ones were considered less essential by the participants of the focus group, a selection of elements that are most relevant and beneficial to the learning objectives of the lesson series was made.

The elements that should be incorporated into the lesson series are the top six levels of the second ordering (see Table 9). A selection of these elements is the theme, motivation, rules, decisions, player actions, audio, obstacles, and enemies. As the second ordering focuses on the perspective of a novice game designer, these results and these top six levels are the most relevant to use. Additionally, to avoid overwhelming the students, the decision was made to limit the number of elements. As the participants of the focus group drew a line between level 6 and level 7 in Table 9, this limit was maintained. By defining the elements that need to be included in the lesson series, the next step in the design phase can be undertaken.

## Chapter 8: Design Iteration 1

During the first design iteration, the learning objectives were defined, general decisions were made related to the lesson series and a first draft of the student materials, and the teacher guide were created. The design requirements stated in Chapter 5 were kept into consideration during this iteration. Details regarding the learning objectives, general decisions, the student materials, and the teacher guide can be found below.

The student materials are divided into two sections: game design components and UX components, as mentioned in Chapter 5. Furthermore, the student materials were not only written in Dutch, but also in English. In the report, the English version of the lesson series is presented. The Dutch version was used for evaluations when possible. Some of the evaluations, such as the Evaluation 3 in Chapter 12, an English version was used as not all participants were fluent in Dutch.

### 8.1 Defining the Learning Objectives

The design process of the lesson series began with the identification of the learning objectives, providing a clear direction for further development. To help with determining the learning objectives, the requirements mentioned in section 5.1 (General Requirements) and 5.4 (Teacher Guide Requirements) were considered to help with the direction of the learning objectives. Specifically, making sure that the learning objectives are specific and measurable. To specify the learning objectives for this lesson series, the objectives determined by SLO were examined, as discussed in section 2.2. Based on this examination, the general objective of the lesson series was formulated:

*Students collaboratively and playfully apply UX concepts to design and analyse a game using a tinkering approach.*

This general learning objective encompasses the following subjects:

- Analysing and designing of a digital artifact (Domain P: User Experience + A1)
- Collaboration(A3)
- Creative tinkering approach
- Understanding of UX concepts (Domain P)
- Context of game design (the digital artifact)

Following this, a mindmap was created to illustrate various learning objectives for the lesson series (see Figure 5). The lesson series “User Experience Reader” (Keuzethema, 2023; Docentenhandleiding, 2023) served as inspiration for this process.



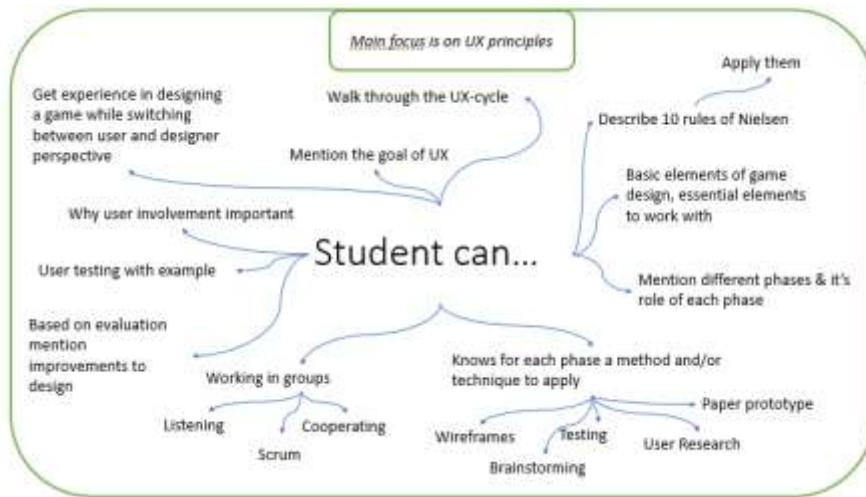


Figure 5: Mindmap of what the student can do after completing the lesson series.

Based on the created mindmap in Figure 5, the learning objectives were further improved and outlined, with some aspects being combined into single learning objectives. The learning objectives can be found in Table 10.

Table 10: Overview of the learning objectives

Learning Objectives	
<i>General learning objectives related to UX</i>	
1	The student can articulate the purpose of UX (User Experience).
2	The student has completed the entire UX-cycle at least three times.
3	The student has gained experience in designing a game, alternating between the perspective of the designer and the intended end user.
4	The student can explain why actively involving end users during game design is necessary to achieve good UX.
<i>UX-cycle and its application</i>	
5	The student can identify the various steps of the UX-cycle and indicate the role of each step.
6	The student can identify and apply two methods (or techniques) for each step of the UX-cycle.
7	Based on the evaluation step, the student can reflect on which aspects need to be changed.
<i>Game design</i>	
8	The student can identify and apply various elements of game design.
9	The student can describe and demonstrate how the essential elements of game design function.
<i>Collaboration</i>	
10	The student can collaborate effectively with a classmate through clear communication, fair distribution of tasks, and ensuring that they perform their work well.

The learning objectives are categorized into four groups, as shown in Tabel 10. The first group consists of general learning objectives related to UX and the actions students must undertake (learning objective 1 to 4). The second group focusses on the UX cycle and students knowing how to apply the UX-cycle (learning objectives 5 to 7). The third group focuses on game design (learning objectives 8 and 9), while the last group emphasizes student collaboration (learning objective 10). As can be read in Table 10, the learning objectives aim to ensure that students, by the end of the lesson series, understand how to analyse and design a game with well-founded arguments from the perspective of the user.

## 8.2 General Decisions Lesson Series

The next step was to make general decisions regarding the lesson series. This included determining the target audience, the duration of the lesson series, and a short description of the lesson series. Each of these topics is discussed below. These decisions were influenced by the design requirements for the lesson series, which will be briefly mentioned in each section.

### 8.2.1 For whom?

The lesson series is intended for students of the Dutch Computer Science course, according to the context design requirement in section 5.1. The Computer Science course is taught in the 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> year. Ideally the lesson series is suited for students who already have some familiarity with programming and general Computer Science concepts. The reason is that they have experience with understanding programs such as Unity and can understand error-codes if necessary. Additionally, given that the lesson series has a student-centred approach, it is important that students can manage the responsibilities associated with the entire task and know when to seek assistance. This means the students will need to be ready for the responsibility and ready to manage them. Therefore, for the lesson series, the decision was made that the intended target audience are fifth year students of Havo or Vwo. However, it might also fit for Vwo 6 students who are also familiar with responsibilities and a broader knowledge of Computer Science.

### 8.2.2 How long?

The lesson series can be completed within five to ten weeks. Five weeks is the minimum required to complete three iterations of the UX cycle, as determined in the student material design requirements (5.3). In a five-week timeframe, there would be an average of one week allocated for each cycle. For this timeframe, an average of three lessons per weeks was taken. Within this timeframe, three weeks would be dedicated to three iterative cycles, and two weeks are dedicated to the introduction and the presentations. A brief overview of this can also be seen in Table 11. However, if teachers wanted to spend more time on the lesson series and topics, the length could be extended up to ten weeks, which is the general length of a period in high schools before an exam week.

Table 11: Overview of lesson series of five weeks

Week	Subject	Description
1	Introduction	Introduction to games, UX, explanation of assignment + UX materials.
2	Iteration 1	First iteration through the design cycle – students create a simple prototype of their game. Explanation of game design materials when students engage in the Ideate step.
3	Iteration 2	Explanation of Unity + downloading Unity and second iteration through the design cycle and reflection.
4	Iteration 3	Third iteration through the design cycle and reflection.
5	Presentations	Presenting the process and final product.

### 8.2.3 Course Description

This lesson series falls under the elective domain P: User Experience. Its' primary objective is to impart the students the principles of designing from the user's experience. This is achieved by tasking the students with designing a game, specifically targeting a certain audience, such as their peers. The approach used is the 'Whole task first' concept, as determined in the design requirements (5.1), wherein students receive the entire assignment upfront, allowing them the entire duration of the lesson series to complete it. Additionally, the lesson series adopts a tinkering approach (5.1), giving students the freedom to explore how to create a game using designated building blocks. The idea

behind applying the tinkering approach is to provide students with more time for the design process while simultaneously learning about game design elements, without it becoming overly complicated or put excessive amount of time in programming the game.

### 8.3 Assignment Description & Assessment Method

In determining the assignment description and assessment method for the lesson series, the learning objectives served as the basis to ensure alignment. Additionally, it was crucial to design the assignment in a manner that clearly communicated the tasks to students while still giving them the freedom to explore and experiment with the materials. Creating this balance was essential in combining the UX design process with the tinkering approach. The assignment itself can be viewed as the seed that initiates student engagement. Given the implementation of the whole-task first concept and the freedom to students, each should be individually challenged to find their optimal workflow.

Below the assignment description intended for high school students is shown. The description first explains the assignment and instructs the students what they need to do. Then, it explains to students how they will be assessed, and lastly, a few tips and suggestions are mentioned to help the students get started or when they feel stuck.

For the assignment, the decision was made to let students work in pairs due to two reasons: this way they could work on one laptop with the Unity template, and it allows students to collaborate and brainstorm together but not have issues with communication of a group. Additionally, to let students show other students what they have created and present their knowledge gained from the lesson series, each pair gives a presentation in the end. To let students keep track of their progress and to be able to grade students on their progress made, a pre-made document was created. In this documents, students write down or show their progress via text or visuals during each UX-cycle. Moreover, at the end of each cycle, an evaluation question is included to help students in reflecting on the cycle. Lastly, the document also provides a draft of a test form with questions on the usability of the game to help students in testing their prototypes.

As the goal of the lesson series is to let students learn about UX and the UX-cycle and considering the set time of a minimum of five weeks for the lesson series, students will not have to create a complete game, but rather a playable prototype of their game which highlights it core concept and purpose. An important note is that the game must be a 3D game because it allows students to build more complex games. For a 2D game, a program such a Scratch would have also worked.

#### **Creating and designing a game from a UX perspective**

In pairs, you will brainstorm and design a 3D game from a UX-perspective (user perspective), going through the design cycle (Design Thinking Process) at least three times, meaning you will also create three versions of your game. The goal of this assignment is for you to learn what User Experience is, how the design cycle works, and why involving the user is important in game development.

The design cycle consists of five steps, and in the accompanying material, you can find explanations of the different steps and what you will need to do at each step. Start at the beginning, namely the Empathize step, and work your way through step by step. At each step, you will need to use one or more methods, which can also be found in the accompanying material.

Throughout the cycle, you will need to keep track of which method and choices you have made at each step. In a provided document, named document\_name.docx, you can name the method used

for each step, explain the choices you have made and showcase your work through text and/or a photo.

#### *Assessment*

At the end of the assignment, you will give a presentation to the class in pairs. In this presentation, you will walk through the entire process from the problem statement to the different versions of the game, of which you will demonstrate the final version. The final version of the product does not have to be a complete game in Unity, but it must be a playable game and clearly demonstrate the idea behind the game. In addition to the presentation, you will also need to submit the document in which you have tracked your process, and based on these two components, you will receive a grade.

#### *Tips and Assistance:*

- Try to have a clearly formulated problem statement so that you can formulate a design goal based on it.
- Both the problem statement and the design goal may change during the design process.
- During each cycle of the design process, you will also create and test a prototype of your game, which can consist of different forms (sketched, paper, Unity, etc.).
- Your classmates will be asked to test your game. It is important to be critical of each other's work but also to give feedback in a polite manner (tips & tops).

As stated, high school students will receive a fill-in document to track their progress and mention their decisions. An example of this document is provided below in Table 12, the complete document can be found in Appendix B.

*Table 12: Part of the fill-in document to track the progress.*

#### **Step 1: Empathize**

Target audience:

*Give a summary of the findings.*

The fill-in documentation will be one of three ways students will be assessed. To aid in the assessment process, an assessment method will be used to make sure that it is clear to both teacher and student how the student will be assessed. The assessment method involves assigning a value to student's work based on predefined criteria (Ten Brinke, 2022). To facilitate this assessment, an assessment form can be beneficial. In this case, a rubric will be utilized because it ensures consistency in evaluating student work, as rubrics are detailed and structured (Jonsson and Svingby, 2007). Rubrics also offer specific feedback on areas for improvement (Brookhart and Chen, 2014), and they can provide formative feedback, aiding students in understanding the grading criteria.

A rubric comprises of three essential components: rows with criteria, columns with different levels, and cells containing specific descriptions (Rusman and Dirkx, 2017). The rubric and grading table can be found in Appendix C. The rubric consists of seven rows: Presentation, Documentation, Product, Game-elements, UX, Reflection, and Collaboration. These rows are based on the learning objectives, some of which have been combined. The rubric contains six columns, ranging from Excellent to

Insufficient, to assess student performance accurately. To determine the actual grade the accompanying grading table can be used where some rows have a higher weighting factor than others, such as the UX topic has a higher weight due to its importance.

## 8.4 Game Design Components

Following the general decisions, the assignment, and assessment method, the next step involved designing the first part of the student materials: the game design components. For the design of the game design components (part of the toolbox), it was important to allow students to experiment and explore with the materials. The first game design component that was developed was the Unity template. After this, additional components were created to help explain Unity and to explain different game elements.

### 8.4.1 Unity Template

To begin, a new scene was created in Unity. The idea behind the template was to provide various premade game elements that the student could easily drag and drop to create the core concept of a game. A fundamental part of most 3D games is a player character capable of movement, so a player object capable of movement with the arrow keys was created. To ensure the player object would not fall due to gravity, a simple plane was used as ground. Following the design of the player and the accompanying script for player movement, other objects with different functions were added. These objects were based on common elements found in many games, such as an collectable item, an enemy type, a camera that followed the player, and a transport platform. The different objects with their respective functions are described in the list below:

- Object with Action (Enemy): This type of object moves randomly within specified variables, and upon collision with the player, the player object is destroyed.
- Collectable: When the player object collides with the collectable object, the collectable object is destroyed. Additionally, a pickup sound can be added upon this action. Furthermore, if an Event Manager and Canvas are added, they can track and update the number of collectables collected by displaying this as text on the screen.
- Player: This object can move around with the arrow keys; it has gravity so when moving off the ground it will keep falling endlessly.
- Camera: This object follows the Player object with a designated offset so the player can be clearly seen.
- Transport\_Platform: This object transports the player object to the position of another object (Transport\_Target) when player object collides with the Transport platform object.
- Particle System: A particle system, which is a standardized object in Unity, was implemented. A particle system looks like an explosion of particles (blocks) that in this case move up and slowly disappear. The particle system has many different possibilities on how it can be used in a game, such as indicating directions, or as health-update affect.
- Simple random standardize objects: Objects such as a plane were added as ground and altered cubes were added to represent walls. These objects don't have any specific functions except preventing the Player-object from passing through them, creating an environment.

In Figure 6, these elements are shown in the Scene view, the top middle panel in Figure 6. The cube represents the Player, the cylinders symbolise the Object\_with\_Action (Enemy) objects, the green spheres represent the Collectable items, the rectangular objects represent Simple Objects (in this case functioning as walls), the flat cylinders signify the Transport objects (Platform & Target), and the floating purple blocks represent the Particle System. In the Hierarchy, which is the top left panel in Figure 6, all the elements that are present in the scene can be found. The different created elements

mentioned above were all made into prefabs<sup>3</sup>, which could be found in the Prefab folder. The Prefab folder, and other folders can be found in the Project Panel, at the bottom right in Figure 6. The top right panel in Figure 6 is the Inspector which showcases for each individual element the specific components, such as the position, the script on that object (including the public variables), and the material.



Figure 6: The Unity Template.

As shown in the Project panel in Figure 6, a total of seven scripts were created to allow all the objects mentioned above to have their specific functions. These different scripts can be found in the Script folder. Each script has its own unique functions for each specific prefab object. A brief overview of the scripts and their functions is provided below:

- Camera\_movement: Controls the Camera-object to follow a specified object, in this case the Player object.
- Collectable: Destroys itself upon collision with a player-tagged object, plays a pickup sound, and updates the count of collected items.
- Object\_with\_action(Enemy): Defines an object that moves within specified speed and range parameters. Upon collision with the player, the player object is destroyed.
- Player: Updates the UIManager count.
- Player\_movement: Manages player movements on the X and Z axes.
- Transport: Moves an object to a different position upon collision with another object.
- UI Manager: Updates the displayed text in the game view.

#### 8.4.2 Explanation Cards

To provide students with the necessary information on game design elements and on how to use Unity, explanation cards on game elements and the Unity environment were created. To decide which elements to include, the results from the focus group were used (Chapter 7). Specifically, the first five top rows of the second ordering were used, since the second ordering specifically focused on the making of a game from a novice perspective. An overview of these game elements can be found in

<sup>3</sup> A Prefab is preconfigured game object in game development that can be easily reused and instantiated throughout the game.

Table 13. In addition to the game elements multiple key Unity elements were included to Table 13 that would be vital for students to understand Unity.

In Table 13, the elements were recategorized and some elements were combined for clarity, while others, such as the element game mechanics, were not used in the end due to their broad definition. In total this resulted into four categories: Game Essentials, Game Elements, Unity, and Not Included Elements. The related game categories, i.e., the first two columns, got a different category name than the names given during the focus group. These category names were not clear for novice designers. The first two categories are both game elements. The distinction between the two is that the Game Essentials include the basic elements each game should have, and Game Elements include the elements a game could have, like an object, item, or player.

Table 13: Overview of the elements for the explanation cards.

Overview Elements			
<i>Game Essentials</i>	<i>Game Elements</i>	<i>Unity</i>	<i>Not Included Elements</i>
Challenges (Progression)	Aesthetics	Audio	Decisions
Goal	Obstacles (Enemies/NPC's)	Camera	Feedback
Input	Movement (Player actions)	Canvas	Game mechanics
Lives (Points)	Menu	Game Objects	Game Technologies
Reward	Items (Collectables)	Inspector	Motivation/ Interactivity
Rules	Player (Avatar)	Materials	Levels
Theme		Prefabs	
Time		Scene view	
		Scripts	

For each of these elements', explanation cards were created, with examples of each card set provided in Figure 7. A comprehensive overview of all the cards and their explanations can be found in Appendix D. There are a total of eight *Game Essential* cards: Challenge, Goal, Input, Lives, Reward, Rules, Theme, Time. Additionally, there are six *Game Element* cards: Aesthetics, Obstacles, Movement, Menu, Items, Player. Lastly, there are nine *Unity* cards featuring: Audio, Camera, Canvas, Game Objects, Inspector, Materials, Prefabs, Scene view.

Each set of cards serves a distinct purpose. The *Game Essential cards* (blue) are designed to prompt high school students to consider various essential elements of the game idea itself, such as the theme of their game. To aid students in this process, each game essential card includes a set of questions at the bottom to stimulate their thinking. The *Game Elements cards* (green) aim to familiarize high school students with the different elements that can be incorporated into a game, such as obstacles ranging from enemies to simple walls. Lastly, the *Unity cards* (red) are intended to assist high school students in getting started with Unity by explaining its different elements and components. In Figure 7 one example of each card set is shown.

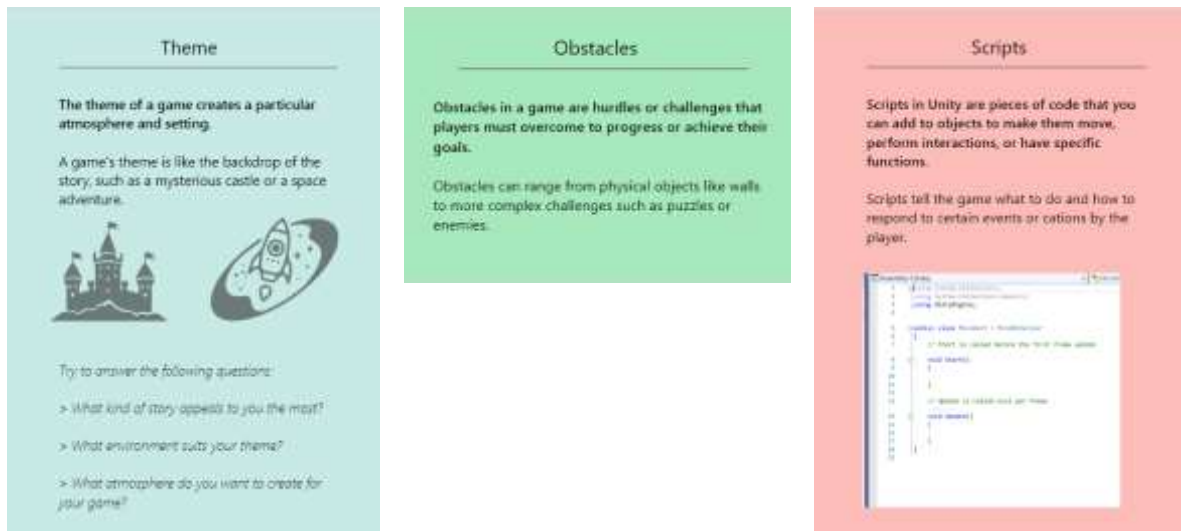


Figure 7: Examples of the different explanation cards for each category: Game-essentials (blue), Game-elements (green) and Unity cards (red).

The general design of the Game Essentials cards includes a short description of the element, followed by an additional sentence, an icon, and a set of help questions at the bottom. The design of the Game Elements includes a short description of the element, followed by an additional explanation sentence. The Unity cards include a short description of the element, followed by an additional explanation and an image illustrating what the element looks like in Unity.

#### 8.4.3 Fill-in Cards

To further help students in the development of their game and help bridging the gap between student's game concept and developing this in Unity, Fill-in Cards were made. These cards, in comparison to the explanation cards above, are more practical cards that students will have to fill in. These fill-in cards focus on aspects of Unity, such as the type of object, the script, the position of the object, etc. By encouraging students to think about the objects in their game and the accompanying components of each object before delving into Unity, they establish a structure of their game, making it easier to begin working in Unity.

In total a set of six different fill-in cards were made. Five cards focus on components of a Unity object and one card focuses on the object itself. The object card is the purple card as shown in Figure 8, on this card students must give the object a name, indicate if it is a prefab, specify if it has an action, and provide a brief description of the object. Additionally, the five component cards consist of the Transform, Collider, Material, Audio Source, and Script components. The cards can be found in Figure 8. The cards are deliberately kept simple and straightforward, containing only essential information to help students familiarize themselves with game objects and their associated components. Students will need multiple sets of these cards for each object in their game.



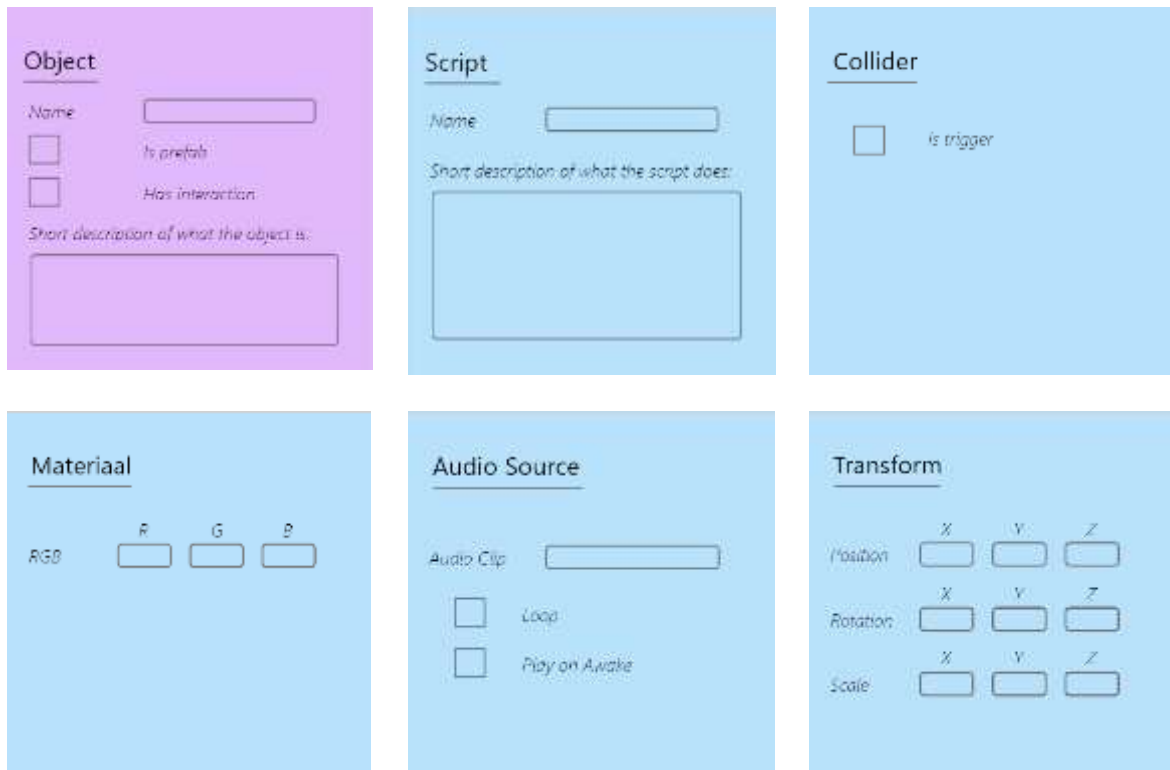


Figure 8: Fill-in cards

## 8.5 User Experience Components

After developing the game design student materials, the second part of the student materials needed to be developed: the UX components. For the design of the user experience components (other part of the toolbox), it was important to allow students to learn and understand the core concepts of UX. The aim of the UX components was to provide high school students with the necessary information about UX to achieve the learning objectives. One of the things included in the learning objectives was the UX design cycle. The specific cycle chosen was the one discussed in Chapter 2: the design thinking process cycle, after this referred to as the UX-cycle. The cycle and findings from Chapter 2 are visually represented in Figure 9. The explanations and the accompanying assignments for each step were also based on Chapter 2 findings. The reason of this design decision was to create a single overview where the different steps of the design cycle would be visible. Moreover, it was important not to only explain but also directly add the goal of each cycle and how to follow these steps. This was necessary as it shows students the assignments without the interference of a teacher. Allowing students to learn on their own terms, some students only will rely on this document, while other student might need additional explanations from the teacher.

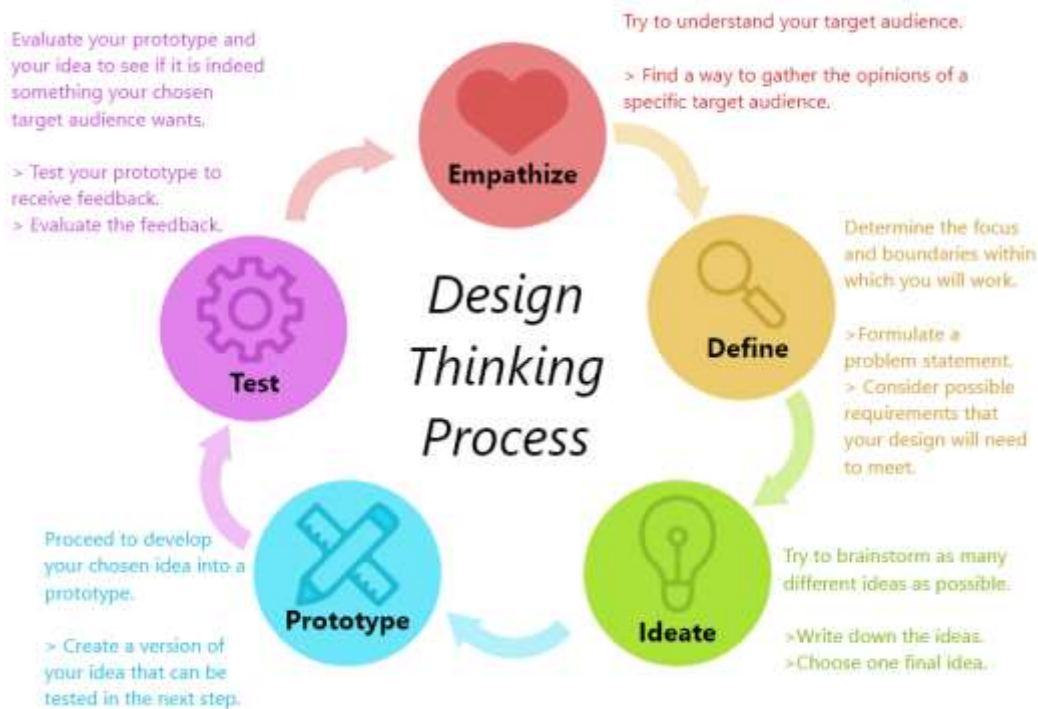


Figure 9: The UX-cycle: Design Thinking Process

In addition to the UX-cycle itself, students will need to use different methods for each step in the cycle. This aligns with one of the learning objectives about students learning different methods to execute each step of the cycle. To assist students with this, various method cards were created for each step. Similar to the design of the game design cards, these cards feature a title, the colour corresponding to the step it relates to, a brief explanation of the method, and an assignment to perform the method. An overview of all these cards can be found in Figure 10 below. The different methods mentioned below are based on Chapter 2 findings and the lesson series discussed in section 2.3.6.

<p><b>Interview</b> </p> <ul style="list-style-type: none"> <li>&gt; Prepare a set of questions you would like to ask but be open in the conversation depending from them.</li> <li>&gt; Always ask 'why?' to uncover deeper meaning.</li> </ul>	<p><b>Observe</b> </p> <ul style="list-style-type: none"> <li>&gt; Observe the users and their behavior within the context of the problem area.</li> <li>&gt; Try to notice if there's a difference between what someone says and what they do.</li> </ul>	<p><b>Demonstrate</b> </p> <ul style="list-style-type: none"> <li>&gt; Ask someone to demonstrate how they approach a task.</li> <li>&gt; Have them go through the steps and explain why they do what they do.</li> </ul>	<p><b>Experience yourself</b> </p> <ul style="list-style-type: none"> <li>&gt; Put yourself in the shoes of your user and experiment firsthand what they go through.</li> </ul>
<p><b>Share Inspiring Stories</b> </p> <ul style="list-style-type: none"> <li>To understand your own data, you can share the most inspiring stories with others.</li> <li>&gt; Think of a user experience that stayed with you or stories that complicated your assumptions.</li> </ul>	<p><b>Personas</b> </p> <ul style="list-style-type: none"> <li>Personas are fictional characters created based on your research to represent different user types.</li> <li>&gt; Describe the needs, behaviors, and goals of your users.</li> </ul>	<p><b>User Stories</b> </p> <ul style="list-style-type: none"> <li>Try to extract the essence from your story by describing it systemically.</li> <li>&gt; If... (who) wants to... (what), so that... (why).</li> </ul>	<p><b>Empathy-map</b> </p> <ul style="list-style-type: none"> <li>This is a method to capture your observations from the research phase and gain insights into the needs of your users.</li> <li>&gt; It consists of four components, referring to what the user says, does, thinks, feels.</li> </ul>

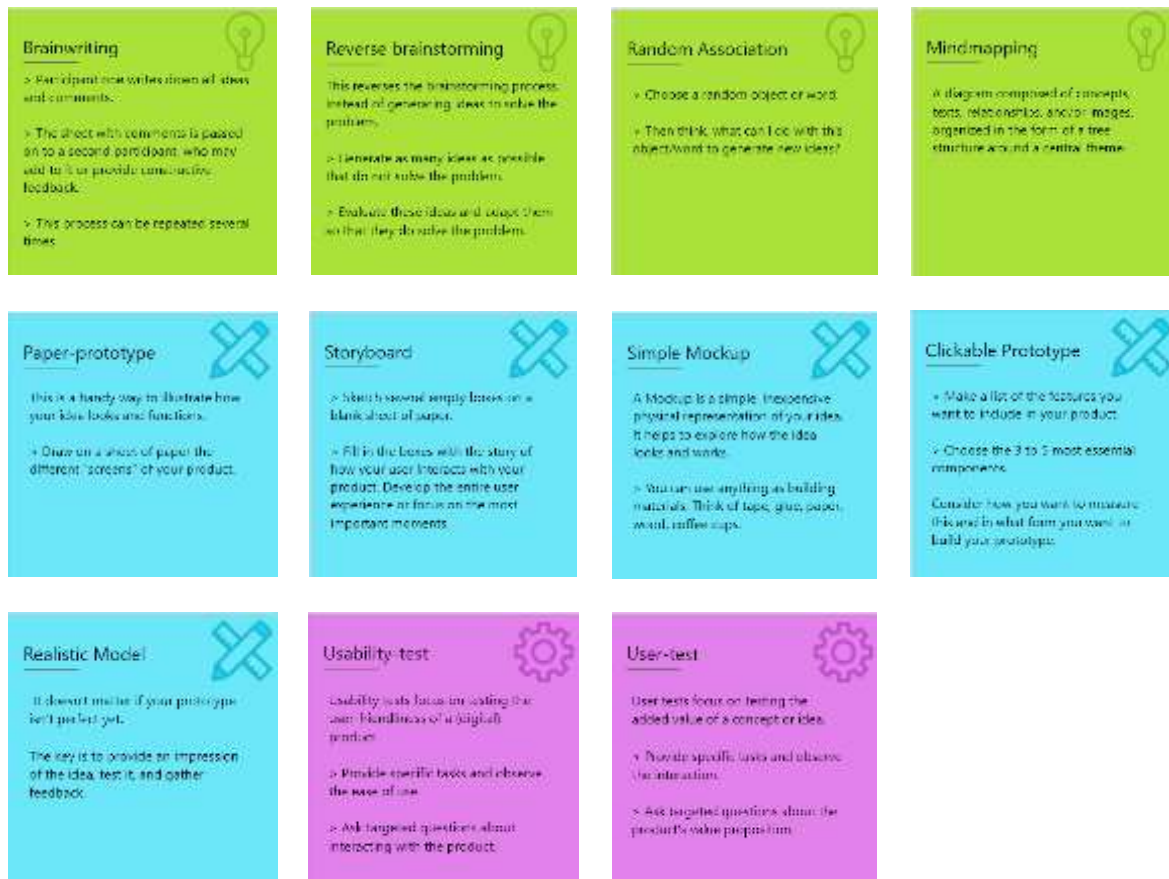


Figure 10: Overview of the UX method cards for each step.

## 8.6 The Teacher Guide

Lastly, a first draft of the teacher guide was developed. A teacher guide contains all necessary information that teachers need to deliver the lesson series. This information includes, among other things, a general lesson description, the learning objectives, the student assignment description, the assessment method, and all the student materials. Sections 8.1 through 8.5 contain all the information that can be found in the teacher guide. The only aspect still missing is a clear interpretation of the role of the teacher and how the teacher needs to perform the role of the facilitator, along with the type of scaffolding exercises and guidance they can offer students. This will be discussed in combination with the complete teacher guide in design iteration 3 (Chapter 10), as the initial changes to the student materials influence the explanations of the student materials in the teacher guide. Moreover, the evaluations with the student materials provided insights into the type of guidance students need and the type of scaffolding exercises that can help them.

## Chapter 9: Evaluation Student Materials 1 & Design Iteration 2

To test the initial design of the game design components, usability tests were conducted with both expert and non-experts in the field of game design and Unity to identify initial issues. Between the expert and non-expert usability test rounds, a redesign was implemented based on the feedback from the experts before proceeding to the second round of usability tests with non-experts.

### 9.1 Goal

The purpose of the usability tests was to test the game design components on understanding and ease of use. The usability test consisted of two rounds, one with several experts on Unity and game design and one with non-experts on Unity and game design. To find these expert and non-expert university students were contacted.

The objectives of the usability test were the following:

- Get an understanding on the ease of use of the game design components.
- Get an understanding on the usability of the game design components.

The following data was collected during the usability test:

- Observations during the performance of the tasks.
- General feedback of the participants based on answers to the interview questions.
- Demographic information of the participants related to their experience with Unity, programming, and game design.

### 9.2 Participants

For the usability test, participants needed to speak and read Dutch, due to the materials being in Dutch. Participants also needed to meet one of the following criteria to participate:

- A) The participant is familiar with Unity and has experience in the building games in Unity.
- B) The participant is unfamiliar with Unity and has no experience in game design but does have an affinity towards technology.

The participants were recruited by the researcher. Participants were recruited using online communication such as WhatsApp groups. The advertisement was kept simple, clear, and short in which it stated the why, when, how, for whom the study is. The number of participants needed for each round was between 3 to 5 participants, so in total between 6 to 10 participants.

As incentive for the study, participants were compensated with food (such as freshly baked cookies). The compensation of food was given at the start to make sure the participant did not feel forced in to finishing the usability test.

### 9.3 Procedure

The usability tests were held on the University of Twente in a booked room, between 26<sup>th</sup> of February and the 9<sup>th</sup> of March. First a short introduction on the research, the reason behind the usability test and the signing of the consent form was done. The consent form together with the accompanying information brochure can be found in Appendix E. After this the actual usability test itself started.

Each participant was given three tasks, each asking the participant to interact with different materials from the game design components. During these tasks, the participant was asked to use the thinking-aloud method to allow for the researcher to understand the participants thought process. For testing the Unity template, a laptop was set-up with the template already open and running.

The tasks the participant needed to preform, the reasons behind them, and the post-interview questions that were asked can be found below in Table 14. In total, the usability test took approximately 45 minutes to complete.

Table 14: Session Guide for the Usability Test

Session Guide Usability Test		
Topic	Task(s)	Goal
<i>Explanation: I'm going to ask you to perform a total of three tasks, and for each task please use the thinking-aloud method. For the first task, you will need the following stack of cards (game essential and game element cards). If you have any questions or uncertainties, please let me know. Otherwise, I will remain silent and take notes.</i>		
Game Design Cards	Think of a simple (3D) game using these cards. Write down/name briefly the objective and one rule of the game.	By asking participants to come up with a game using the cards, they are encouraged to look through and review the cards.
<i>Explanation: As a first step, you have just designed a game, and the next step moves toward creating your game. Here again, I have some cards for you, both explanatory cards about Unity as well as some cards for you to fill in. If you have any questions, feel free to ask.</i>		
Unity Cards	Use the Unity explanatory cards to create one object for you designed game, with corresponding components.	By asking to create one object with appropriate components, participants are engaged with the cards.
<i>Explanation: As final step, we will get started on the computer. In front of you, the Unity program is open. If you have any questions about the general use of Unity, you can refer to the cards.</i>		
Unity Environment	Create your designed game in Unity so that the concept of the game is clear, and it is somewhat playable.	By completing this assignment, participants have the opportunity to bring their design to life in Unity, where it is important to listen to their feedback while carrying out the steps.
<b>Interview Questions</b>		
1.	What was your overall impression?	
2.	How easy was it to perform the tasks?	
3.	Did you encounter any obstacles during use?	
4.	What did you find most useful and why?	
5.	How could you improve the user experience?	
6.	What did you think of the layout and design?	
7.	Did you have trouble finding certain things?	
8.	How would you rate the navigation in Unity?	
9.	Were there any aspects that were confusing?	
10.	Would you recommend these materials to others? Why or why not?	

#### 9.4 Results Expert Usability test

In total, there were four participants for the first round of usability tests with experts. Below, a short summary is provided for each interview question outlining all the feedback gathered from the participants. The section concludes with recommendations to enhance the game design components.

### 9.4.1 Interview Questions

#### 1. Overall impression

Overall, the participants found the game essentials and game elements cards (blue & green cards) to be valuable tools for generating ideas and structuring their game concepts. They appreciated the clarity and the simplicity of the cards, which facilitated the brainstorming process and helped them overcome conceptual hurdles. However, some participants felt that the Unity-cards, both the explanation cards (red cards) as the fill-in cards, were redundant or overly detailed, especially for those already familiar with the platform. While the Unity template provided a helpful starting point for beginners, some participants found it somewhat restrictive, and the template did not entirely align with their game concepts. They emphasized the importance of flexibility and adaptability in game design tools.

#### 2. Ease of tasks

Participants found that generating game design ideas was straightforward and well-supported, although documenting specific tasks proved to be more time-consuming. Working in Unity presented challenges and having additional guidance would be beneficial. While the game-cards provided a clear and focused framework for brainstorming, participants suggested improvements for the fill-in cards such as adding additional components, such as a Rigid body. Despite the challenges with Unity, participants appreciated the clear and understandable nature of the materials. However, they noted that the template may not be suitable for those seeking to code their own games.

#### 3. Obstacles

Due to the limited time of the usability test, the decision was made after the first participant, to give the participants max 10 minutes to work on the Unity template. This led to participants feeling pressured by time constraints, noting that the template steered them towards certain directions that did not align with their original ideas. Some recommended a larger template with more automated elements for easier drag-and-drop functionality, although they acknowledged the challenge of anticipating all potential user needs. While generating ideas was relatively smooth, participants encountered difficulties in implementing them in Unity, despite finding the process logical. They also felt that the fill-in cards became redundant when translating ideas into Unity.

#### 4. Most useful

Participants found the cards to be a helpful refresher, particularly the design cards (green and blue), while the red cards were overlooked due to existing familiarity with Unity. Filling in the fill-in cards provided structure before starting in Unity itself. The blue cards were praised for their usefulness in the design process, while the green ones were deemed less effective. Availability of simple and effective prefabs were appreciated.

#### 5. Improvements UX

Participants suggested a bigger template with more options, including different types of enemies, additional actions, and a wider variety of static objects for more interesting interactions. They found the first two tasks to be fine, highlighting the simplicity as a strong aspect. Regarding Unity, participants suggested having a demo scene or at least a starting scene to understand the capabilities better. Moreover, they suggested adding options with checkboxes to remove errors from the template and avoid having to open scripts.

## 6. Layout & design

Participants generally found the layout and design to be nice, easy, and clear. They noted that the game-element cards (green cards) only had text, which they found a bit disappointing, suggesting it might be nice to include images as well.

## 7. Finding things

Participants did not report having trouble finding certain elements, except some experiencing difficulties with Unity. Other than that, the participants found everything to be very structured and organized.

## 8. Navigation in Unity

Participants had mixed experiences with the navigation in Unity. Some found it fine and logical, while others felt that they were still getting used to it. Suggestions for improvement included adding more descriptive cards and colours to folders for better organization.

## 9. Confusing aspects

Participants generally didn't find many aspects confusing, although some mentioned specific variables in the script that could be clarified, such as the offset.

## 10. Recommending the materials

Participants generally found the game cards useful for brainstorming and sharing ideas, particularly for beginners in game development. However, some noted limitations in terms of genre specificity, such as the inability to create first-person shooter games. Overall, they recommended the cards and the Unity template for beginners, suggesting that additional scripts and prefabs could enhance the options available for design.

### 9.4.2 Summary of Recommendations

Overall, participants from the first round of usability tests expressed high satisfaction and positivity towards the game design cards, including both the game elements and the game essentials. However, they noted that while the fill-in cards were helpful for structuring, they felt somewhat limited in terms of available components and options. Additionally, some participants found the fill-in cards redundant when compared to the task performed in Unity. Regarding the Unity template, the most significant issues were identified, with suggestions made to enhance it by adding more elements to broaden its scope and incorporating additional checkboxes and variables in the inspector. This would allow users of the template to adjust directly within the Unity environment without the need to modify scripts.

## 9.5 Design Iteration 2

Based on the feedback collected from the first usability test, two main game design components underwent redesign: the Unity template and the Fill-in cards.

### 9.5.1 Unity Template

For improving the Unity template, additional functionalities were implemented, including player jumping and running, as well as the option for enemies to chase the player instead of solely wandering back and forth. A folder containing simple objects was added to facilitate the construction of the game environment. Various bugs were addressed, such as script errors related to specific tags, and adjustments were made such as incorporating checkboxes into the scripts, enabling users to easily toggle specific functionalities on or off. For example, in Figure 11, checkboxes for "Walk" and "Jump" are provided under the script section in the bottom right corner.

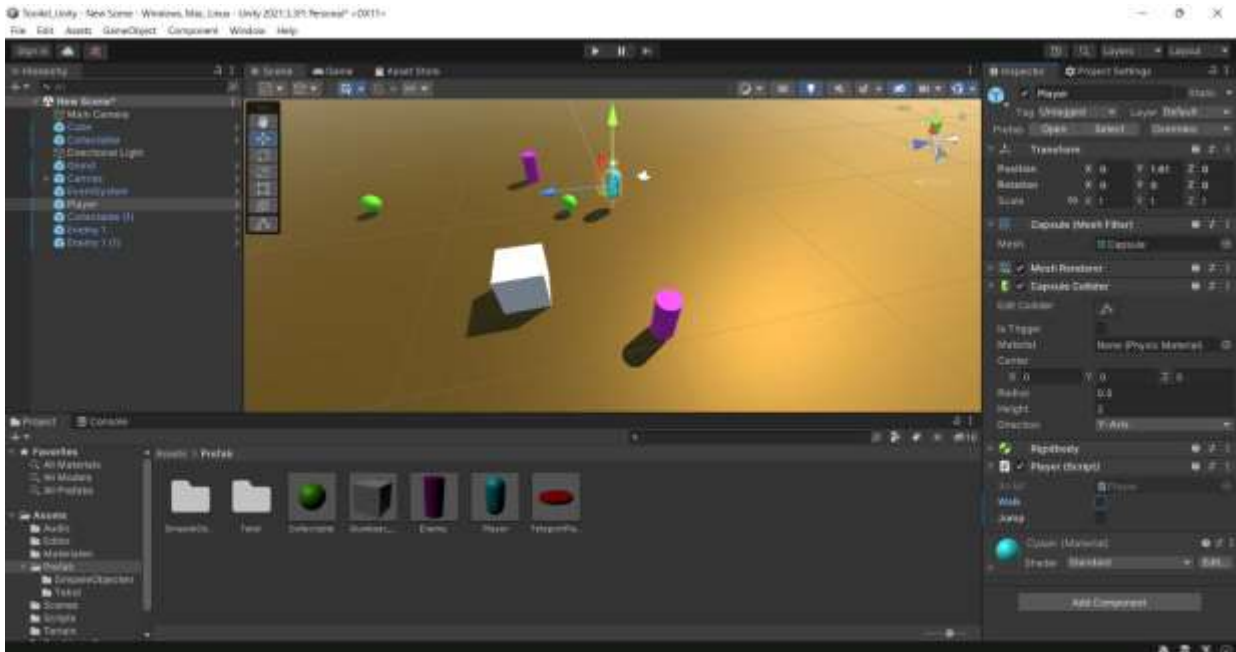


Figure 11: Example view of Unity Template Redesign

Additionally, changes were made to the player object, transitioning from a cube to a sphere, and certain item names were revised for clarity. The particle system was omitted from the template as it did not contribute to the goal of the template. The goal is only to enable students to create a basic game that showcases fundamental elements.

### 9.5.2 Fill-in Cards

Following the feedback from the first round of usability test it became evident that the initial fill-in cards were overly specific and potentially confusing for high school students, particularly those unfamiliar with Unity and its terminology. In response, the fill-in cards were redesigned to adopt a more abstract approach, focusing solely on the object itself and omitting extraneous details as shown in Figure 12.

Name: \_\_\_\_\_

Goal: \_\_\_\_\_

Color: \_\_\_\_\_ Amount: \_\_\_\_\_

Active  Interactive

Moveable  Stationary

Collisionable  Destructible

Collectible  Harmful

Description

Sketch

Figure 12: Redesign of the fill-in card.



The redesigned cards feature fields for the objects' name, goal, colour, and quantity required, along with options to specify its functionality, such as whether the object is active, interactive, moveable, stationary, collisionable, destructible, collectable, or harmful. Additionally, at the bottom of the card space is provided for a description on the left and a sketch on the right.

## 9.6 Results Non-expert Usability Test

In total, there were five participants for the second round of usability tests with non-experts. Below, a summary is provided for each interview question, outlining the feedback gathered from the participants. The section concludes with recommendations for improving the game design components.

### 9.6.1 Interview Questions

#### 1. Overall Impression

Participants generally found the tasks and materials provided to be helpful for brainstorming and developing game ideas. However, some noted challenges with the clarity of certain terms and instructions, particularly in Unity and the fill-in cards. While some felt pushed towards existing game concepts by the game element cards, others appreciated the structure provided by the materials. Overall, there were mixed experiences with Unity. Some participants found it difficult to connect certain elements, but it became manageable with additional guidance.

#### 2. Ease of tasks

Participants generally found the tasks manageable, although some struggled with creativity in the first task and locating certain elements in Unity. The second task was generally easier, while the third task required some adjustment and assistance for successful completion. Some appreciated the specificity provided by the game element cards (green) and found the fill-in cards helpful. Despite initial difficulties, participants generally had a positive experience overall, particularly after receiving guidance and explanations for using Unity.

#### 3. Obstacles

Participants encountered some challenges with specific terms and concepts, such as "collidable", which required clarification. They also found the reading involved in the tasks somewhat cumbersome. Additionally, participants struggled with conceptualizing original game ideas. Despite these difficulties, some participants appreciated the thought-provoking aspects of considering game mechanics.

#### 4. Most useful

Participants found the prefabs provided in Unity to be highly convenient, particularly appreciating the associated scripts. The fill-in cards were deemed valuable for detailing object qualities and effective in visualizing and solidifying game concepts. Experimenting with Unity was considered beneficial, especially when combined with the fill-in cards, as it provided clarity on the necessary elements for game development.

#### 5. Improvements UX

Participants suggested improvements such as refining Unity's interface to include pop-ups for easier customization and displaying Unity shortcuts. They also suggested to extend the time given to work on the final task and providing additional fill-in cards (only one fill-in card was given due to time constraints). While the red Unity cards were considered foundational, participants expressed a need for supplementary materials or a guidebook to better understand essential elements like camera,

player, and walls. Furthermore, structuring the red Unity explanation cards was recommended for enhanced clarity and usability.

#### 6. Layout and design

Participants appreciated the use of colours to differentiate between cards, but some found the text-heavy nature overwhelming, suggesting that learning software programs is better achieved through a hands-on experience rather than extensive reading. While the red Unity cards were available, they did not always address participants' specific questions. The fill-in cards were described as helpful in defining object identities, although some terms needed an additional explanation. Despite some challenges, participants generally found the materials clear.

#### 7. Finding things

Some participants struggled with navigation in Unity, particularly understanding how to use the Inspector.

#### 8. Navigation in Unity

Participants appreciated the clarity of the additional explanation that was provided.

#### 9. Confusing aspects

One participant did not encounter significant issues. Others found the red cards to be somewhat helpful but noted that they did not directly address specific problems. They partially used the Inspector and appreciated the checkboxes within it. Their understanding improved regarding how Unity and its different component's function.

#### 10. Recommending the materials

The materials provided in tasks 2 and 3 were particularly useful for beginners, adding in the understanding of game design concepts. The game essential and game element cards (blue and green cards) contributed to structuring the game concepts. While the participants found the Unity explanation cards somewhat helpful, they preferred using online resources for further information. They emphasized the usefulness of the fill-in cards for considering all game objects and their associated variables and functions. Unity, while enjoyable to work with, was noted to require more guidance beyond the red cards, suggesting a step-by-step guide could be beneficial. Overall, the participants felt more confident using an unfamiliar program and appreciated the clarity of the provided materials.

#### 9.6.2 Summary of Recommendations

Overall, the materials were received with enthusiasm and positive feedback. However, some areas for improvement were identified, including the discovery of a few bugs during use and the need for additional guidance on utilizing Unity beyond what is provided in the existing explanation cards. Moreover, the fill-in cards required further elaboration on terms. An additional list could explain different terms before introducing the fill-in cards to high school students. Additionally, incorporating images into the game element cards could enhance their effectiveness, like the approach used for the game essential cards and Unity cards.

#### 9.7 Conclusion

The goal of the usability tests was to test the ease of the game design components. Based on the results of the first round of usability tests, participants generally found the game essential and game element cards (blue & green) valuable for idea generation and structure game concepts. However,

there were mixed opinions regarding the Unity-related cards (both red instruction and the fill-in cards), with some participants finding them redundant or overly detailed. While the Unity template provided a helpful starting point for beginners, it felt somewhat restrictive.

Following the first round of usability tests, a redesign of the fill-in cards was done, and changes were made to the Unity template. For the fill-in cards, they were made more general and left out the different components of Unity and more object oriented with multiple terms related to actions in Unity and what the object needs to do. The changes in Unity allowed for a more drag-and-drop system by adding a checkbox system in the inspector, instead of letting people make changes to the scripts. Also, different functions to the player were added, such as jumping and running for the player, adding a first-person camera, renaming of certain variables and objects, adding a folder with simple objects such as a wall, floor, and random cube.

In the non-expert usability tests, participants generally found the tasks and materials helpful but encountered challenges with certain terms and instructions, particularly in Unity and the fill-in cards. Some participants struggled with creativity or understanding certain elements in Unity. The prefabs provided in Unity were highly convenient, and the fill-in cards were valuable for detailing object qualities, although some terms were ambiguous. Participants suggested improvements, such as a better step-by-step guide into the user interface, to improve usability. Overall participants found the materials clear but recommended refinements to enhance the usability and understanding.

## Chapter 10: Design Iteration 3

This chapter discusses the refinements made to the game design components based on feedback from the second evaluation round. Moreover, based on these improvements made to the student material game design components, the teacher guide was further worked out into a complete teacher guide including explanations of the student materials and the necessary information to guide the students as facilitator.

### 10.1 Game Design Components

Based on the feedback, enhancements were implemented for the Unity template, the game element cards, the Unity cards, and the fill-in cards. The specific enhancements are discussed per component below.

#### 10.1.1 Unity Template

Several changes were implemented for the Unity template. First, alterations were made to the individual objects “Player” and “Enemy”. Second, two new objects, “Push-object” and “Text”, were added. Third, general alterations were made to the prefabs and scripts. Lastly, a test scene was added to demonstrate the possibilities of all the objects. All these changes are individually discussed below.

## Player

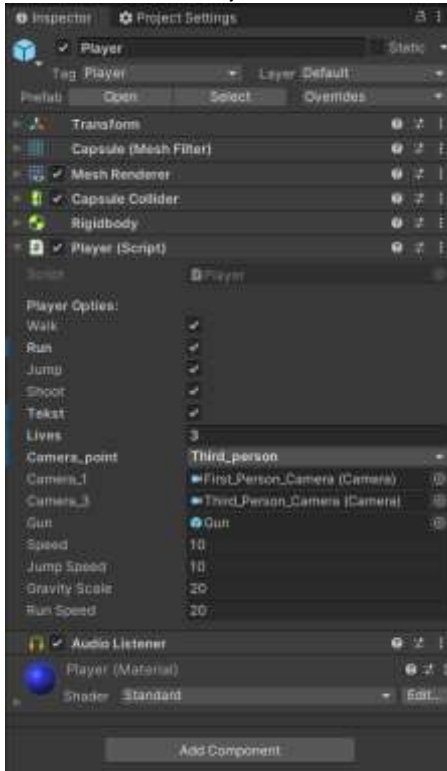


Figure 13: Inspector view of Player Object

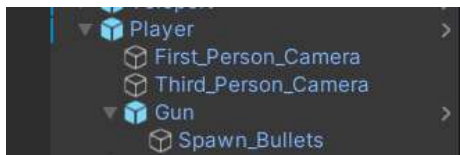


Figure 14: Hierarchy view of Player object

In Figure 13 the inspector view with the components of the “Player” object can be found.

The option “Shoot” was added, allowing items with the specific tag “Destroyable\_object” to be destroyed when hit by the bullet from the gun. To shoot, the “E” key must be pressed.

Player movement was adjusted to enhance movement quality, enabling the player and the camera to turn/rotate on the spot when pressing the “<” and “>” arrows, thereby creating a more immersive experience.

A “Camera\_point” dropdown menu was added, creating the option between first-person or third-person point of view.

A “Tekst” checkbox was added, that needs to be checked when text is checked on the “Collectable” object, as the count update is in the player script.

The “Player” object also serves as a parent object<sup>4</sup>, as can be seen in Figure 14, incorporating different cameras (“First\_Person\_Camera” and “Third\_Person\_Camera”), eliminating the need to add the camera separately and reducing the possibility for error. Additionally, “Gun” object is a child object with its own object “Spawn\_Bullets” object that specifies the spawn position of the bullets.

<sup>4</sup> A Parent Object is an object that contains one or more child objects and can affect their transformations and properties.

## Enemy

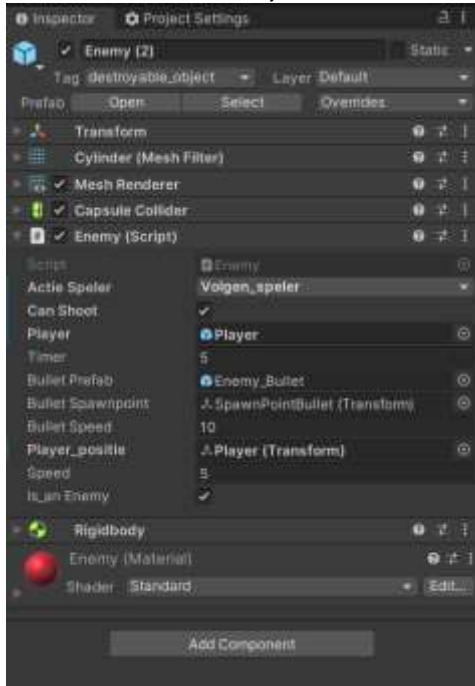


Figure 15: Inspector view of Enemy Object

The "Can Shoot" function was added to the "Enemy" object allowing the enemy to shoot at the "Player" object, see Figure 15. A "Timer" variable, currently set at 5, regulates the time between shots fired by the enemy. Additionally, a "Bullet Speed" variable was added to control the speed of the bullet.

Furthermore, the checkbox "Is\_an\_Enemy" was added. If an user wished to create a buddy that follows them, this checkbox can be deselected. This means that when the "Enemy" object collides with the player, and the box is not checked, nothing happens.

## Push Object



Figure 16: View of object in Prefab Folder

A new interactive object, referred to as "Push\_Object" was added, as depicted in Figure 16. This object can be moved by the "Player" object, simply by walking against it. In response, the object moves and may even rotate on its axis depending on the force applied. This object has the form of a cube in this design iteration.

## Text

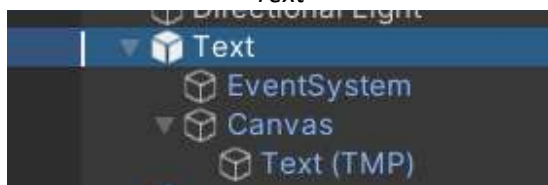


Figure 17: Hierarchy view of Text object

A new empty parent object called "Text" was created, as illustrated in Figure 17. This object includes the "EventSystem", "Canvas", and "Text(TMP)" objects, simplifying the process to add text by simply dragging the "Text" object into the scene, rather than individually adding each object.

## Prefabs



Figure 18: Overview of the Prefab folder

Besides the alterations made to the different objects, changes were also made in the Prefab folder. Figure 18 provides an overview of the Prefab folder, showing all the prefab objects. Four changes were made in the folder:

1. The addition of the “Bullet”, “Enemy\_Bullet”, and “Gun” objects to facilitate the shooting functionality for both the “Player” and “Enemy” objects.
2. The introduction of the “Text” object, as mentioned earlier, replacing the previously used folder “Text” for the needed objects to display text.
3. The removal of the Camera folder, with the first and third-person camera now being child objects of the “Player” object.
4. Lastly, the alteration of the “Teleport” object, which now consists of two objects: the transport platform (yellow flat cylinder) and the destination position (grey flat cylinder) where the object is teleported to.

## Scripts

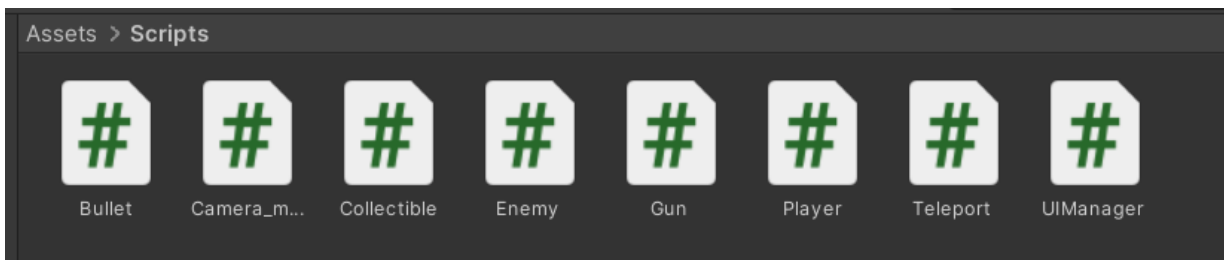


Figure 19: Overview of the Scripts

The scripts were modified to accommodate the addition of new functionalities. Figure 19 illustrates an overview of the scripts. New scripts were added, “Gun” and “Bullet”, and “Player” and “Enemy” scripts were adjusted to incorporate the new functions, e.g., shooting. Additionally, the two separate player scripts were combined into one.

## Test Scene

An additional item was added to the Unity template, the Test\_scene. This scene has all the prefabs already loaded in. The intention of this scene was to allow students to see and test different aspects of the objects and get an idea of the possibilities of the template, as a trigger to give the students inspiration (the seed). In the test scene, everything is loaded and connected appropriately, meaning that students can also see how certain things in the inspector work and which objects need to be loaded in sometimes. The test scene is not created to resemble a game with a specific purpose; rather, it consists of just a ground with all the different elements on it as depicted in Figure 20.



Figure 20: Overview of the Test Scene of the Unity template.

### 10.1.2 Game Elements Cards

Based on the feedback of the usability tests an improvement that was suggested was the addition of images to the game element cards. This adjustment aimed to create a more cohesive visual experience between the game design cards. As a result, the cards were redesigned, as illustrated in Figure 21.

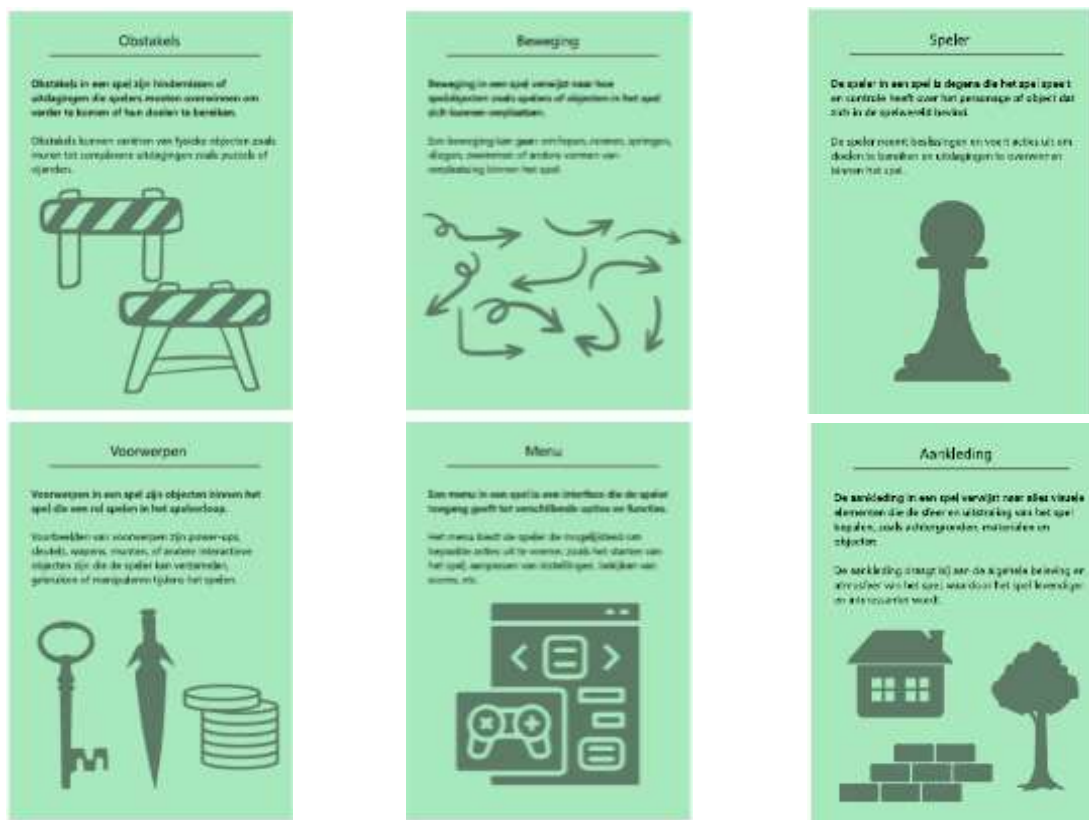


Figure 21: Overview of the redesign of the game element cards.



### 10.1.3 Unity Cards

Based on the feedback from the usability tests, it was noted that while the Unity cards were visually appealing, they were not sufficiently helpful for getting started with Unity. Participants expressed difficulty in finding the necessary information on the cards and suggested the creation of a step-by-step guide instead. As a result, the decision was made to replace the Unity cards with an explanatory video, because the cards were not in any way seen as helpful for what they should do. The video, available on YouTube (<https://youtu.be/eXSYZwPvxWQ>) in Dutch, is divided into three parts:

1. Explanation of Unity Environment: Provides an overview and explanation of the Unity environment, including its various features, shortcuts, and general functionality.
2. Installation of the template in Unity: Briefly demonstrates how to install the template in a new Unity scene.
3. Explanation of Unity template: Discusses the template itself, covering everything from the different prefabs to the available test scene for user experimentation.

Providing the video helps to visualize the actions, the environment, and students can pause and replay as they see fit. This allows for a guided first assignment where students can follow the instructions and at the same time test and try it out as scaffolding exercise.

### 10.1.4 Fill-in cards

Lastly, in response to the feedback received, there were some questions raised regarding the meaning of certain terms on the fill-in cards. Instead of adding more cards to explain these terms, an overview of their meaning will be provided in the teacher guide. This approach allows teachers to clarify the terms to the students or integrate the list as they see fit. Below each term is explained:

- Active when the object performs an action.
- Interactive when there is interaction between this object and another object.
- Movable when the object moves or can be moved by another object.
- Stationary when the object has a fixed position and cannot be moved.
- Collidable when an object can collide with another object.
- Destructible when the object can be destroyed.
- Collectable when the object can be collected.
- Harmful when the object can cause or receive damage.

## 10.2 Teacher Guide

Next to the improvements made to the game design components, a first iteration of the teacher guide was created, including all the necessary items as mentioned in Chapter 4. This included a clear description of the lesson series, an explanation of the teaching methods (tinkering, whole task first, and the role of the teacher), the lesson series learning objectives, a lesson structure, the assessment method, the assignment description, and explanations on the different student materials for the lesson series. The complete teaching guide can be found in Appendix F.

The reason for providing a clear explanation of the teaching methods was to clarify the intentions of the lesson series and the exact function of the teacher as facilitator. A lesson structure was added to the lesson series to include a clear description of how teachers could introduce the different student materials to ensure that students would not be overwhelmed. Additionally, a clear description of all the student materials was provided to justify to the teachers what the elements were about.

## Chapter 11: Evaluation Student Materials 2

To test the materials of the lesson series, both the game design and the UX components, a field study with high school students over a span of two weeks was conducted. This field study consisted of six lessons of 40 minutes in which students were introduced with the materials and students gave their feedback on the materials.

### 11.1 Goal

The purpose of the field study with the high school students was to test the lesson series materials on ease of use and the engagement of students. The field study was done over the course of six lessons of 40 minutes with one Vwo 5 class of twelve students.

The objectives of the field study were the following:

- Get an understanding on the ease of use of the game design components.
- Get an understanding of the ease of use of the UX components.
- Gather a wide view of the opinion on both the materials.

The following data was collected during the field study:

- Feedback of the participants on the materials through an evaluation form + written feedback made during a group's evaluation.
- The filled in materials from the students.

### 11.2 Participants

To conduct the field study, various Computer Science teachers were contacted to inquire about the possibility of conducting a short workshop. Eventually, one Computer Science teacher agreed, and the Vwo 5 class was made available for two weeks. The class consisted of 12 students, all participants were 16 years or older, with mostly male students (10 out of 12). During the lessons, not every student was present for all lessons due to absences such as sickness, so the class size varied between 9 to 12 students each lesson.

### 11.3 Procedure

The field study was held in the classroom at the high school, where the students have their Computer Science class, on the following days: 12<sup>th</sup>, 13<sup>th</sup>, 19<sup>th</sup>, and 20<sup>th</sup> of March. The class was divided into three groups, which were divided over three oval tables. The six lessons were divided as following:

*Lesson 1:* First, the research was introduced, an explanation was provided about the six lessons and the students had to sign the consent form. The consent form with the accompanying information brochure can be found in Appendix G. After this, the general assignment of the six lessons was given: *Students needed to design a game with a UX perspective.* Followed by handing out materials and the students were able to start with step 1, i.e. Empathize of the UX-cycle. Each group received a different method to use (Observe, Demonstrate, or Experience Yourself), to gather insights into their target audience, i.e. their fellow classmates.

*Lesson 2 & 3:* During these two lessons, a double period, students got to work on the next steps of the UX-cycle: step 2 (Define), 3 (Ideate), and 4 (Prototype). Like step 1, students got for step 2 and 3 also different method cards per group, for step 2 (Share Inspiring Stories, Persona's and User Stories) and for step 3 (Reverse Brainstorming, Random Association, Mindmapping), and were tasked to perform the accompanying assignment to that step. In case of step 2 that was to define the problem statement and for step 3 it was to come up with minimal ten different ideas to solve the problem statement. During step 3 the game essential cards and the game element cards were introduced. During step 4,

instead of giving students the method cards, the fill-in cards were introduced, and students were asked to fill in these cards to make their concept of their game more tangible.

*Lesson 4:* The lesson started with each group briefly pitching their different game idea, before continuing to make one of the three games in Unity. Due to the time constraints of the lesson series and problems that could and would occur when downloading Unity, the decision was made that students could tell the researcher as teacher what actions to perform, while Unity was running on the computer and broadcasting to the students. A collaborative way of making the game in Unity.

*Lesson 5 & 6:* During the last two lessons, again a double period. The first part of the lesson, the students continued with the making of the game in Unity. This time students were picked to test the game and mention possible improvements. The second half of the lesson was about the evaluation of the materials and lesson series, first by letting students individually fill in a form and then a groups discussion.

In Table 15 an overview of the collected materials can be found, including the purpose of the materials. As well as a method of evaluation of the gathered materials. In Table 16, the evaluation form that students must individually fill in can be found. In Table 17, the evaluation discussion guide can be found.

*Table 15: Overview of the materials that will be collected.*

<b>Collected materials</b>	
<i>Description of Material</i>	<i>Purpose</i>
Filled in form on the steps of the UX cycle	To gather insights into what the students filled in for each step and what they did during each step (gather their progress)
Brainstorm post-its	Students are not allowed a phone in class, so the post it's of the brainstorm was collected to keep them save and see the ideas students came up with. (Part of the filled in form (1))
Game Object Prototype cards	Like the post-its, as a part of the students making a paper prototype of their concept, the cards were collected to see the first initial prototype of their game. (Part of the filled in form (1))
Made prototype in Unity	Gathering the final made game of one of the three game concepts, allowing students to see what Unity and the template is capable of, and to see one of the three concepts made in "reality".
<b>Evaluating of the materials:</b>	
	One of the main things this graduation project tries to do, is creating an engaging lesson series for students, by checking the work of the students a first determination can be made into their engagement and interest of the assignments, by looking into the creativity, length, amount of work students have done, and possible other insights that can be made by evaluating and going through the collected materials.

Table 16: Evaluation Form

<b>Evaluation Form</b>	
<i>Question:</i>	<i>Response option</i>
The content of the lesson module was relevant to me. I found the topic interesting. I felt motivated to participate in the lessons. I was actively engaged in the assignment during the lessons. I found the level of the lesson module manageable. The lesson module increased my enthusiasm for the topic The lesson materials made me eager to learn more about the topic.	Scale 1 (Strongly Disagree) to 5 (Strongly Agree)
How useful did you find the different method cards of the UX cycle? How useful did you find the game essential cards (blue) and game element cards (green)? How useful did you find the fill-in cards for the prototype? How useful did you find the template in Unity?	Scale 1 (Not useful to almost not useful) to 5 (Very useful)
Were there any steps where you would have liked more assistance? How would you like to receive that assistance?	Open question
What did you like most about the lesson module (Top)?	Open question
What should be changed about the lesson module (Tip)?	Open question
Do you have any other comments, suggestions, or feedback regarding the materials used or the lesson module in general that you would like to share?	Open question

Table 17: Evaluation Discussion Guide

<b>Evaluation Discussion Guide</b>	
The general objective of the discussion is to create a conversation in which students can provide their overall feedback on the materials and assignments given in the lessons.	
<i>Question:</i>	<i>Purpose:</i>
What did you think of the recent lessons?	General impression question, asking what they thought of them.
What did you think of the main assignment? What did you think of the associated smaller assignment?	Specifically, about the assignment and thus also the topic.
What did you think of the UX materials? What did you think of the game design materials? What did you think of Unity?	Focus on determining what they thought of the materials themselves.

Was this a different way of teaching than you normally used to?	Focused on the idea that the materials and assignments are given in such a way as a whole task first concept.
And how did you experience this?	
Were you motivated to participate in the lesson? Why or why not?	Find out about the students' engagement, and ask why, a very possible answer could be because students felt obligated to do so.
What did you think of your own effort? Why?	
Would you recommend this lesson series, if you were to get more time? Why or why not?	Look at the students' level of enthusiasm and their opinion of the lesson series.

## 11.4 Results

The results of the field study are divided into three categories: observations, the evaluation form, and the group discussion. Each is individually discussed below.

### 11.4.1 Observations

Observations from the high school students' participation in the assignments and lessons revealed a mix of positive feedback and suggestions for improvements.

Despite students encountering difficulty initiating tasks due to the rapid pace of instructions, students engaged and participated in the assignments. Students showed an initial struggle to get started, which suggested a potential need for a slower instruction. However, there was not an option to extend the lessons to give the students more time. Providing one-on-one instruction proved beneficial in this case for supporting student groups, effectively accommodating differentiated learning needs.

During the instruction moments, more time was spent on trying to link the relevance and importance of UX to students' current classes and projects. This approach aimed to deepen students' understanding of UX and try to level it to students' interest.

Students received different assignments; observing other students (step 1), determining a problem statement (step 2), brainstorming ideas to solve the problem statement (step 3), to creating a first prototype (step 4) and working together on making and testing the prototype in Unity (step 5). Students struggled mostly with the ideating and thinking of new ideas. It seemed that students were very self-cautious about writing their ideas down or just very unmotivated to participate. With a bit of additional help, students got to work. During this additional help, it was noticed that there was a misinterpretation of the assignment among students. Instead of them coming up with ten different new game ideas, they used the game-cards to differentiate on existing games to make them fitting to their problem statement. This was not a problem, but it did point out that that the phrasing of the assignment from a teacher's perspective is key.

Students used the game design cards during the ideation-phase, and it inspired them and provided structure for the different game elements that are present in a game. Students used them as they saw and as a facilitator it was nice to fall back on the cards to help students prompt them with coming up with more ideas.

After picking the final idea, it was time for the students to work their idea out into a first prototype. Due to the time constraint of six lessons, students only had to use the fill-in cards to do this. The UX method cards for this phase were only briefly described by the facilitator. Each group got six fill-in cards and students divided the cards and the objects and got to work. During this step students discussed more about the idea and the concept.

As last assignment, after some hectic discussion on which of the three games would be made in Unity, the first prototype was made in Unity. During this time students opened-up, and as facilitator that performed the tasks, I tried to ask as many questions as possible to prompt students to look in Unity and tell me certain actions I had to take. Also, I asked questions to make students reflect on the main core concepts and purposes of the game. This took a total of two lessons, and during the second lesson students also got asked to come to the front and test out the game, in which different bugs were found and to some extent difficulty was added to the prototype.

### 11.4.2 Evaluation Form

In total nine students filled in the evaluation form, due to some absences from the students. Each question of the evaluation form is discussed below.

#### 1. Statements of students on the lesson series

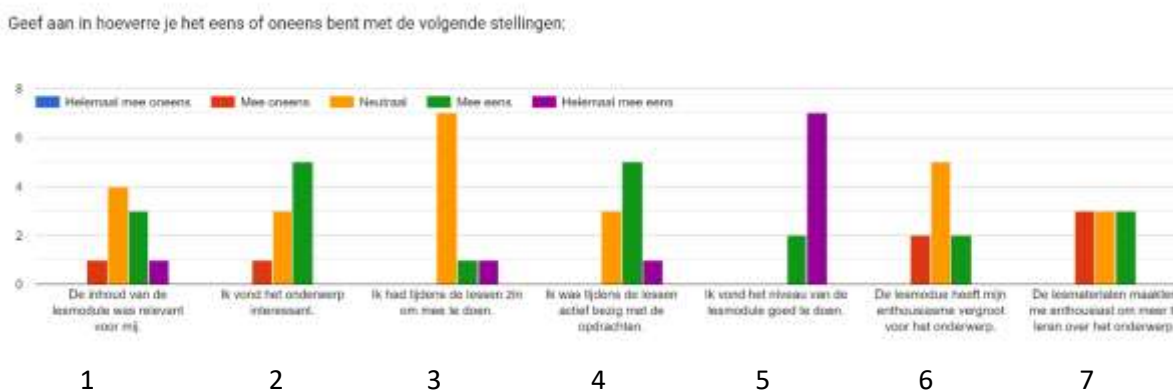


Figure 22: Results of agreement per statement.

The feedback from students regarding the seven statements varied greatly, an overview of this can be found in Figure 22. Only one statement received a clear overall positive agreement, regarding the difficulty level of the lesson series (5). Two statements garnered positive or neutral responses, indicating a willingness to participate (3) and active engagement in the lessons (4). However, opinions were divers on other aspects such as the relevance (1), interest (2), and enthusiasm for the topics (6), as well as the impact of the materials on students' enthusiasm (7), with no clear consensus.

#### 2. Usefulness of the materials

Table 18: Results average score of usefulness for each material

Materials	UX-Materials	Game cards	Fill-in Cards	Unity Template
Average score	3.55	3.55	3.44	4.22

As depicted in Table 18, it shows that all average scores are above 3, implying that, according to this group of students, all materials were deemed useful to some extent. The preference for the Unity template stands out as the most useful material, followed by the UX materials. The game cards were perceived to have similar levels of usefulness, while the fill-in cards were regarded as the least useful among the provided materials.

#### 3. More help

The general response from students regarding whether they wanted more assistance with specific steps was negative; they indicated that the instructions were adequately explained. However, one

student expressed a desire for improved cards for the define and ideate steps to enhance clarity in the method.

#### 4. Most liked (Top)

The aspects of the lesson series that students enjoyed the most included working collaboratively, creating a game, having the opportunity to play and test the game, and developing it using Unity.

#### 5. Least liked (Tip)

Students provided feedback on aspects they would like to see improved in the lesson series. They mentioned the need for improvements in the process of generating ideas, as it was a bit difficult to think of new ideas. Additionally, students expressed a desire to work on developing the game within their own group in a more hands-on experience with Unity, instead of in a class setting.

### 11.4.3 Group Discussion

#### 1. General feedback

The group evaluation did not yield the intended results. It became apparent that a group discussion with high school students was a struggle. Students kept very quiet when questions were asked, and the responses were very short one-word answers. Despite this, during the discussion, students generally found the lessons enjoyable, particularly the opportunity to collaborate in groups.

#### 2. The assignments

Feedback on the assignments was largely positive, with students expressing enjoyment and laughter throughout the process. They acknowledged the educational value of learning to use Unity, UX, and developing game-making skills. However, some students encountered challenges in understanding certain aspects of the assignments, making them appreciative of additional explanations provided by the teacher.

#### 3. The materials

Opinions varied regarding the usefulness of the materials provided. While some students found the UX and game design materials unnecessary, others recognized the practicality of having access to basic game design principles. Suggestions were made proposing the inclusion of examples for generating innovative game ideas, to help with the ideation phase.

#### 4. Teaching method

Students appreciated the collaborative nature of the teaching method, which facilitated teamwork and cooperation. However, there were suggestions for increased interaction, particularly concerning the Unity component of the lessons. Although the teaching method was generally well-received, some students expressed limited interest in the subject matter.

#### 5. Motivation

The absence of grading impacted students' motivation to some extent, with suggestions that a graded component would have further incentivized engagement. Nonetheless, the motivation during the lessons were perceived similar to typical classroom experiences, albeit with a bit more freedom.

#### 6. Recommending of lesson series

Despite various feedback points, students generally recommended the lesson series, naming the opportunity to pursue a more personal interest, gaming, and collaborating in a group, as significant

advantages. The inherently engaging nature of game development was highlighted as motivation factor, although individual interest levels varied. Overall, students found the topics of UX and Unity particularly interesting.

#### 11.4.4 Summary of Recommendations

Based on the information gathered and observations made a few recommendations to further improve the materials were made. Moreover, the insights through the observations and students' interpretations of assignments can be used for the improvements of the teacher guide. One of these improvements is the instructions provided by the teacher on the assignments. Currently, students misinterpreted it or did not really understand what to, so it is important to make them clear. Moreover, some bugs were found during the use, which would be debugged in the final design.

#### 11.5 Conclusion

The aim of this field test consisting of six lessons with high school students was to explore their point of view and learn about how they perceived the topic, materials, their engagement, and motivation during the lessons and towards the materials.

Based on the feedback gathered through observations, a form, and a group discussion the following conclusion can be drawn on these topics. In general, students enjoyed the collaborative nature of the lessons and liked working on something that they also have an interest in outside of school. However, there were areas for improvement identified, particularly in terms of providing clearer instructions, enhancing interactivity, and tweaking the materials.

Regarding the engagement of the students, it's hard to give a concise conclusion since the student's own reflection on the motivation was very diverse and since the field study was only a part of the time the standard lesson series will be.



## Chapter 12: Evaluation Student Materials 3

To further test the materials, both the game design and the UX components, an evaluation session was done with university students that are experts on the topic of tinkering. This way the materials could be tested on the tinkerability of the materials, by doing a similar set-up as with the field study but in a shorter time frame.

### 12.1 Goal

The purpose of the evaluation session with university students was to test the tinkerability of the materials. The evaluation session lasted over the course of four hours in a lecture room at the University of Twente on the 2<sup>nd</sup> of April.

The objectives of the evaluation session were the following:

- Gathering an insight on the tinkerability of the different designed materials for the lesson series.
- Gathering feedback on how to further improve the tinkerability and design of the lesson series materials.

The following data was collected:

- Feedback from students on the different materials, both through evaluation forms and a group discussion.

### 12.2 Participants

To participate in this evaluation session, students at a university were recruited that were experts on the concept of tinkering. The recruiting was done by approaching a professor teaching a course on tinkering on the possibility of giving a guest lecture to evaluate the materials. This course is part of the master program Interaction Technology. The students in this course had different backgrounds of which a fair number of participants was unfamiliar with Unity but was familiar with UX-design. The students of this course also varied in nationality, so an English version of the materials was used. In total 31 participants participated to the evaluation session.

### 12.3 Procedure

Like the field study, the participants received tasks to perform to get experiences with working with the materials within a short time frame. At the start of the session, an introduction was given on who I was, what the session was about, and the consent form and information brochure was handed out for the participants to read and sign. Both documents can be found in Appendix H.

After the introduction, the participants were divided into eight groups, ranging from a group of three to eight persons per group. The participants were not all Dutch-speaking, so the complete session and the materials were translated, except for the video. Instead of making an English video a live demonstration was done to explain the Unity template.

The general assignment given to the participants was to develop a simple game from a UX-perspective for their peers as target audience. To do this a multitude of tasks were given to the participants. The specific tasks and which materials were given for each task, can be found in Table 19 below.

Table 19: Overview of the tasks of the evaluation session

Overview of session tasks		
What?	Description	Materials
Step 1 Empathize and Step 2 Define	Empathize: use one of the method cards to figure out what current problems are participants experience with gaming (may narrow it down how you see fit) Define: the problem statement based on the findings from the Empathize step.	The UX-cycle and the method cards (for all steps).
Step 3 Ideate	Ideate: Come up with minimal ten ideas to solve the defined problem statement.	Game essential and game element cards to help with the process of brainstorming.
Step 4 Prototype (Part 1)	Prototype: Make a first version of your prototype by filling in the Fill-in cards handed out. (A description of how the cards work is given including what the different terms mean).	Fill-in cards
Step 4 Prototype (Part 2)	Prototype: Try to make the core concepts of your game in the Unity template. (First an introduction to Unity is given, like the explanation video).	Unity Template

During the making of the prototype (part 2) the participants were asked to fill in the group's evaluation form as well as the individual form to give feedback on the materials. The individual form asked questions about the tinkerability and a tip and top of the materials. These were similar questions to the individual form of the field study. The group form consisted of open questions on the general usability and ease of use of the materials. These questions were similar to the questions asked during the usability tests. The reason behind two evaluation forms was to gain an understanding of the tinkerability of the materials and tips and tops about the materials, but also ask deeper questions. To make it easier to evaluate all the open questions and to facilitate discussion among the participants, these open questions were asked from a group's perspective.

Below in Table 20 an overview is given of the questions of both evaluation forms with the type of question.

Table 20: Overview of Evaluation forms (Individual & Group).

Individual Evaluation Form	
Question:	Response option
How useful did you find the various method cards and the UX-cycle?	Scale 1 (Not useful to almost not useful) to 5 (Very useful)
How useful did you find the green and blue cards about the game elements?	
How useful did you find the fill-in cards for the prototype?	
How useful did you find the Unity template?	

Indicate to what extent you found the following items tinkerable on a scale from 1 (not tinkerable) to 5 (very tinkerable): * UX cycle & UX method cards * Game Essential cards (blue) *Game Elements (Green) *Fill-in cards for prototype step * Unity Template	Scale 1 (Not tinkerable) to 5 (Very tinkerable)
What material did you like the most? Why?	Open question
What material did you like the least? Why?	Open question
Do you have any other comments, suggestions, or feedback regarding the materials used or the lesson module in general that you would like to share?	Open question
<b>Group Evaluation Form</b>	
<i>Question:</i>	<i>Response Option</i>
What was your overall impression of the materials?	Open question
How easy was it to perform the tasks?	
Did you encounter any obstacles during the use of the materials?	
What material did you find most useful and why?	
How could the overall user experience be improved?	
What did you think of the layout and design of the different materials?	
Did you have trouble finding certain things?	
Were there any aspects that were confusing?	
Would you recommend these materials to others? Why or why not?	
Do you have any other comments, suggestions, or feedback regarding the materials used or the lesson module in general that you would like to share?	

Next to letting the participants fill in the forms a general groups discussion was done at the end to get an idea of the experiences and thoughts of the participants regarding the materials. One general question was asked, and participants could give their opinions to four statements. The question and statements can be found in Table 21.

Table 21: Group Discussion Guide

<b>Group Discussion</b>	
<i>Question:</i>	
1	What is your general impression?
<i>Statements:</i>	
1	The materials were easy to work with.
2	The materials were clear and easy to understand.
3	The materials were tinkerable.
4	It was fun to tinker with the materials.

After the group discussion, participants were thanked for their participation.

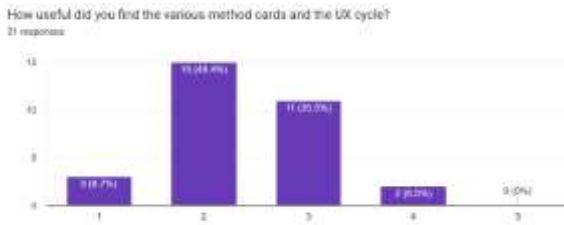
## 12.4 Results

The results of the evaluation session are divided into three categories: individual feedback form, groups evaluation form, and the group discussion. Each is individually discussed below.

### 12.4.1 Individual Feedback Form

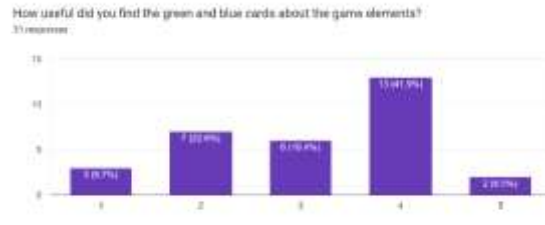
#### 1. Usefulness of the different materials

##### UX Cycle & Cards



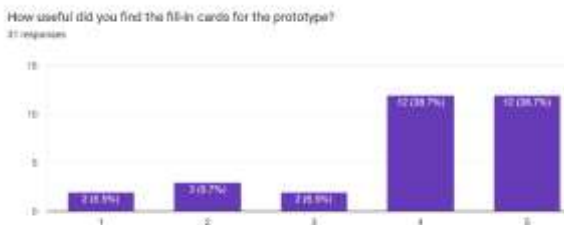
Average score of 2.38

##### Game Cards



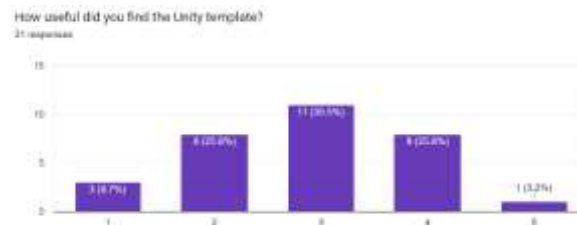
Average score of 3.13

##### Fill-in Cards



Average score of 3.94

##### Unity Template



Average score of 2.87

Figure 23: Overview of the usefulness of the different materials.

Based on the average scores provided, as can be seen in Figure 23, the usefulness of the different materials varied among the participants:

- The UX Cycle & cards: The average score of 2.38 suggests that participants perceived this material as less useful compared to others.
- Game cards: With an average score of 3.13, participants found these cards moderately useful.
- Fill-in cards: Participants rated the fill-in cards the highest, with an average score of 3.94, indicating they found them to be the most useful among the materials evaluated.
- Unity Template: The Unity template received an average score of 2.87, indicating that participants perceived it as somewhat useful but less so than the fill-in cards.

Overall, the fill-in cards were considered the most useful materials, followed by the game cards, the Unity template and finally the UX cycle & cards.

## 2. The tinkerability of the different materials

Indicate to what extent you found the following items tinkerable on a scale from 1 (not tinkerable) to 5 (very tinkerable):

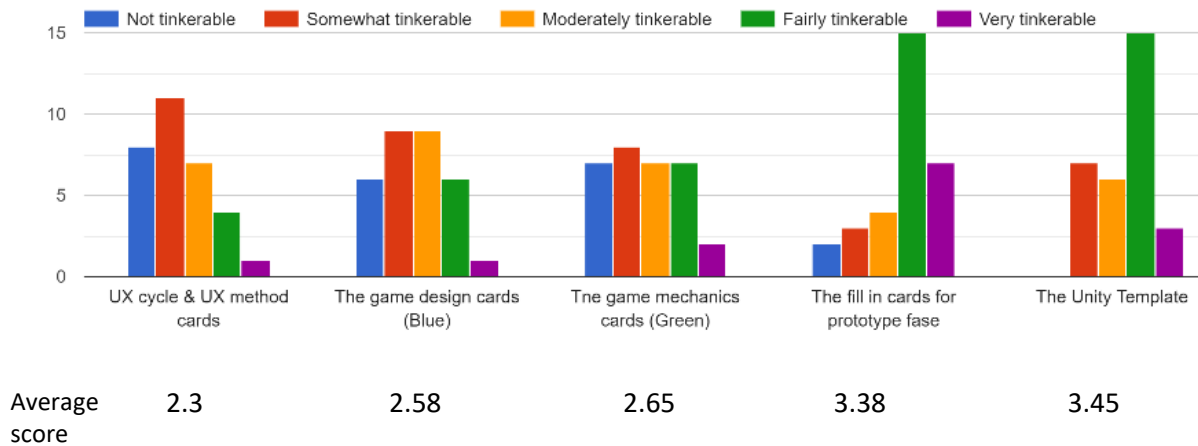


Figure 24: Overview of tinkerability of the different materials

The provided rating for tinkerability, see Figure 24, indicated the following levels of tinkerability:

- UX: Rated at 2.3, indicates that it is somewhat tinkerable.
- The game essential cards (blue): Rated at 2.58, suggesting a moderate level of tinkerability.
- The game element cards (green): Rated at 2.65, indicating a similar moderate level of tinkerability.
- Fill-in cards: received a rating of 3.38, suggesting a higher degree of tinkerability compared to the previous materials.
- Unity: Rated the highest at 3.45, indicating that it is fairly tinkerable compared to the other materials.

In summary, the first three materials, the UX and Game cards (Blue & green) are considered somewhat to moderately tinkerable, while the last two materials, the fill-in cards and the Unity template, are rated as fairly tinkerable.

## 3. Most liked materials

The fill-in cards received the most praise due to their versatility and effectiveness in facilitating ideation and design processes. Participants appreciated the balance between freedom and structure provided by these cards, which aided in sketching, ideation, and translating ideas into Unity. They found the cards easy to understand and particularly valued their ability to make ideas concrete and streamline the design process. Additionally, participants noted that the fill-in cards sparked imagination and offered a practical template for visualizing game elements and mechanics, ultimately making project development easier in later stages.

The game design cards (blue & green cards) were also well-received for their clear information and guidance, which helped participants develop detailed game designs. Despite being less familiar with these cards, participants found them valuable in stimulating idea generation and enhancing game

detail. The cards served as a helpful tool for guiding thinking towards actionable ideas and provided insights into the potential scope and possibilities of game development.

Unity was also mentioned by a few participants as most liked material. They appreciated the opportunity to experiment visually and engage directly with their concepts, making it a material for creativity and exploration.

#### 4. Most disliked materials

Participants expressed dissatisfaction with several materials used in the lessons. The UX cycle & method cards were criticized due to feeling rushed through the materials and lacking a specific guideline or references to game design. Similarly, the game design cards were deemed too specific and not very insightful, failing to assist participants when they encountered challenges in generating ideas. The Unity template got the feedback that due to its complexity and time-consuming instillation process, led to feeling overwhelmed and the participants felt that it was not very useful in the given time frame. Additionally, a few participants mentioned that the fill-in cards were challenging to use for effectively expressing the idea. Overall, dissatisfaction arose from issues related to the complexity, lack of usefulness and difficulty in articulating ideas effectively.

#### 5. Comments, suggestions, or feedback

Participants offered several comments regarding the session and suggested improvements for future iterations. Some suggested exploring alternatives like Godot or Gamemaker instead of Unity for game development. Others proposed restricting game design to 2D to facilitate better experimentation or rather expand the Unity template to allow for more versatile use, a way this could be done is by creating different templates.

Next to this some feedback that was given by a participant, was on the tinkerability of the cards. This participant found the cards themselves not really tinkerable but more the seed for tinkering. Moreover, a participant mentioned that more time and a better idea of the expected result would help, as they came up with an idea that in the end could not be made during this session.

### 12.4.2 Group feedback form

#### 1. Overall impression

There were mixed feelings about the student materials. While some found the game essential and game element cards helpful during the ideation, others felt overwhelmed by the UX method cards and for some participants it was unclear on how to put these cards into practice. Additional feedback was that some of the materials were not used during the session. The materials were considered intuitive but limited in scope, requiring previous knowledge to complete the assignment.

#### 2. Ease of performing tasks

Participants had mixed experiences during the tasks. Some found it easy, while others were uncertain if they fulfilled the task requirements. Some participants struggled initially due to uncertainty of the goal or the practical difficulty of creating the prototype in Unity. One group faced challenges in aligning their idea with the possibilities in Unity. Therefore, it required extra assistance from the facilitator. Students only received 30 minutes to make the concept in Unity. Reflecting on this, it was too short to make a prototype that aligned with students' ideas for the game. Overall, while the intended tasks were straightforward, the creation of a Unity prototype with the available time and template was not possible.

### 3. Obstacles

Participants encountered several obstacles during the tasks. Using Unity itself was identified as a significant obstacle, particularly those unfamiliar with the platform. Additionally, a group missed the initial goal of the tasks, which made it challenging to understand how to use the given student materials. Generating ideas was also experienced as difficult due to the broad goal of “making a game”. Technical issues, such as outdated software versions and difficulties with camera perspective and object placement, further hindered progress. Many participants lacked experience with Unity, adding to the challenges. Finally, logistical issues like installing Unity, opening projects, and navigating in Dutch presented additional hurdles.

### 4. Most useful material

The most useful materials identified were pen and paper for quickly writing down ideas. The game cards sparked the imagination and were beneficial for those with no experience in games, and the basic environment provided in Unity.

### 5. Overall UX

Regarding the overall user experience, participants suggested that the experience could be improved if everyone got the opportunity to individually work in Unity rather than in groups. The participants also suggested to set more parameters to the tasks to keep them simple and straightforward. Additionally, to improve the Unity template more elements should be added for a greater variety in possibilities. On the topic to improve the Unity task, it would be helpful to allocate more time on working in Unity. Finally, they proposed disclosing the limitations of the Unity assets upfront to manage expectations of possibilities of the game effectively.

### 6. Layout & design materials

Participants generally praised the layout and design of the materials, finding them well-made, structured, and intuitive. Some suggested enlarging the cards for better group use, while others found them adequate.

### 7. Finding things

Some participants encountered difficulties in Unity when attempting to create games without programming knowledge. Specifically struggling with finding a specific object, an interactive bar for health. Other participants faced no issues locating items.

### 8. Confusing aspects

Participants found various aspects confusing, particularly when working with Unity. They struggled with where to start and how to generate ideas, lacking clear direction initially. Additionally, a few UI-related issues were mentioned.

### 9. Recommending materials

Six of the eight groups would recommend the materials, noting their usefulness and uniqueness, particularly the fill-in cards. However, some feel that while the basis of the materials is good for familiarizing oneself with UX design, it may not be suitable for designing a game in a single afternoon. Others appreciate the opportunity to experiment with game creation without programming knowledge but found the concept of design thinking overwhelming. While some participants believe the materials are intuitive for those already familiar with gaming environments, it was questioned if others with a lack of necessary knowledge would feel the same.

## 10. Comments, suggestions, or feedback

In total there was one additional suggestion made, and that was that Unity is somewhat challenging for beginners, so exploring an alternative platform may be more beneficial for first-time projects.

### 12.4.3 Group Discussion

#### 1. General impression

Overall, the card materials were praised, especially for beginners in UX, but some felt lost due to the broadness of the assignment, suggesting a need for better specificity of the parameters of the assignment. Feedback also highlighted that the abundance of cards was overwhelming, with many not being utilized, such as the prototype and test method cards. Unity posed challenges, with participants struggling to implement specific aspects of their game, leading to suggestions for multiple templates to offer more flexibility. Introducing Unity earlier in the process would provide a more tinkerable approach, then first coming up with a game idea and realising this is not possible in Unity. Additionally, there were suggestions for more specific assets in Unity to enhance the aesthetic appeal of the environment and improve the overall game experience.

#### 2. The materials were easy to work with

While the materials were generally easy to work with, Unity posed challenges due to its potential for bugs. Some suggested exploring alternative methods, such as physical prototyping, particularly for beginners. However, if Unity is a requirement, then introducing it earlier in process would be beneficial.

#### 3. The materials were clear and easy to understand.

Overall, the materials were clear and easy to understand. Except Unity was not understood as well as designed, as it presented some difficulties.

#### 4. The materials were tinkerable.

While the materials allowed for some tinkering, particularly with the fill-in cards, there was a perceived lack of hands-on experimentation. Many of the materials and cards served more as explanatory tools rather than facilitating tinkering. Furthermore, issues with Unity hindered the ability to engage in meaningful tinkering activities.

#### 5. It was fun to tinker with the materials.

Participants found the topic engaging and enjoyed working with the materials, particularly the realm of UX design. However, some felt that the task of creating a game might be challenging for high school participants with limited gaming experience, as they may struggle to generate ideas without sufficient reference points.

### 12.4.4 Summary of Recommendations

Based on feedback from the individual form, group form, and the group discussion, several suggestions were made to further improve the tinkability of the materials and the lesson series overall. The recommendations focused on the number of materials introduced in a short time span and how to reduce the quantity or extend the time given for students to work with the materials. Currently, not all introduced materials were utilized to their full-extend. Moreover, there were several issues with Unity, ranging from students with wanting to create a game that was not possible with the template to not being able to use it because Unity was not yet installed. Two suggestions to improve this were to demonstrate at the beginning of the lesson series the template's capabilities so students know what they are working with and to ensure all students have downloaded Unity on time.



## 12.5 Conclusion

To evaluate the tinkerability of the materials, an evaluation session was held with university students having expertise in tinkering. The objectives were to gather insights on the materials tinkerability and gather feedback for improvement. Participants engaged in tasks involving the game design and UX components, such as the game cards, fill-in cards and the Unity template. Feedback was collected through individual and group evaluation forms, as well as a group discussion. Results indicated that while the fill-in cards were highly praised for their versatility and effectiveness, Unity posed significant challenges due to its complexity. Participants suggested different improvements to make, such as introducing Unity at the beginning allowing for more tinkerability and narrowing the general assignment to create clearer and a more structured idea of what the goal is. Overall, the materials were generally well-received, but improvements needed to be made to increase the usability and heighten the tinkerability of the lesson series.

## Chapter 13: Evaluation Teacher Guide

A survey was sent to different Computer Science teachers to gather feedback on the teacher guide of the lesson series. The teacher guide included the materials of the design components and UX components with an explanation of the different materials.

### 13.1 Goal

The purpose of the survey with Computer Science teachers was to see if the lesson series is comprehensive, clear, interesting, and usable. The reason to send a survey was that it allowed the participants to decide in their own time to read and provide feedback on the lesson series materials. Moreover, the moderator could not influence the participants as it could be an possibility during an interview.

The objectives of the survey were the following:

- Gathering an insight from teachers on the different materials of the lesson series.
- Gathering feedback on how to further improve the lesson series and its accompanying material.

The following data was collected:

- Feedback from teachers on the different materials, through a survey.

### 13.2 Participants

For recruiting of the participants for the survey, high school Computer Science teachers were contacted. This was done by the researcher and through the help of Ingrid Breymann. Participants were recruited by invite through mail. The invite was kept simple, clear, and short in which it stated the why, when, how, for whom the study is. The number of participants wanted for the survey was a minimum of four. Between the ten and twenty participants were contacted and asked to participate.

### 13.3 Procedure

The feedback was gathered between the 2<sup>nd</sup> and 24<sup>th</sup> of April. Teachers willing to participate in the research, were first sent an email containing an introduction, an information brochure and a consent form they needed to sign. This information brochure and consent form can be found in Appendix I. After receiving the signed version of the consent form, participants were sent three things:

- The teacher guide, as can be found in appendix F, containing all necessary information and materials.
- The Template of Unity as a Unity Package.
- A link to the survey containing the questions to gather feedback on. These questions can be found in Table 22. The survey was divided into six sections, each focussing on different chapters of the teacher guide or general feedback.

Table 22: Survey Questions.

Survey Questions	
<i>Chapter 1 (Description &amp; Purpose) &amp; Chapter 2 (Explanations)</i>	
How clearly is the purpose of the lesson series described?	Scale <i>very unclear (1)</i> to <i>very clear (5)</i>
Do you have any suggestions to make the purpose clearer?	Open
How clear are the following aspects: <ul style="list-style-type: none"><li>• Whole task first</li><li>• Tinkering</li></ul>	Scale <i>very unclear (1)</i> to <i>very clear (5)</i>

	<ul style="list-style-type: none"> <li>Role of teacher</li> </ul>	
	How could the explanations be further improved?	Open
<i>Chapter 3 (Learning Objectives)</i>		
	On a scale of 1 to 5, how clearly are the learning objectives formulated?	Scale <i>very unclear (1) to very clear (5)</i>
	Are there specific learning objectives that you believe need clarification? (Provide the numbers of the learning objectives)	Open
	On a scale of 1 to 5, indicate how feasible you find each learning objective: (the ten learning objectives)	Scale <i>very unfeasible (1) to very feasible (5)</i>
	Explain your answer to the previous question: why are the learning objectives feasible or not feasible?	Open
	On a scale of 1 to 5, indicate how relevant each learning objective is: (the ten learning objectives)	Scale <i>very irrelevant (1) to very relevant (5)</i>
	Explain your answer to the previous question: Why are the learning objectives relevant or not relevant?	Open
	Do you have any suggestion to better align the learning objectives with the SLO objectives?	Open
<i>Chapter 4 (Lesson structure)</i>		
	On a scale of 1 to 5, how much added value does Chapter 4 bring?	Scale <i>No added value (1) to very valuable (5)</i>
	On a scale of 1 to 5, how clear is the description to give the lessons?	Scale <i>very unclear (1) to very clear (5)</i>
	Are there aspects of the lesson structure that need further explanation?	Open
	Any other suggestions or improvements?	Open
<i>Chapter 5 (Assessment Method)</i>		
	On a scale of 1 to 5, how well does the assessment method align with the learning objectives?	Scale <i>Not at all (1) to Excellent (5)</i>
	On a scale of 1 to 5, how clear is the assessment method?	Scale <i>very unclear (1) to very clear (5)</i>
	On a scale of 1 to 5, how much do you agree with the weighting factors of the different criteria?	Scale <i>Strongly disagree (1) to strongly agree (5)</i>
	Are the most important skills and competencies evaluated using the assessment method?	Open
	Are there aspects of the assessment method that can be improved?	Open
<i>Chapter 6 (Student Material)</i>		
	On a scale of 1 to 5, how clear is the description of the assignment?	Scale <i>very unclear (1) to very clear (5)</i>
	Are there specific parts of the assignment that still need clarification?	Open
	Do you have suggestions to improve the assignment description?	Open
	On a scale of 1 to 5, how clear was the explanation of the different materials: <ul style="list-style-type: none"> <li>The UX materials</li> <li>Game design materials</li> <li>Fill-in document for students</li> </ul>	Scale <i>very unclear (1) to very clear (5)</i>
	Do you have suggestions to clarify the explanation of the materials?	Open
<i>General Feedback</i>		
	How clear did you find the teacher's guide?	Scale <i>very unclear (1) to very clear (5)</i>

	What could be clearer in your opinion?	Open
	Any other feedback you would like to share about the teacher's guide?	Open
	What was your overall impression of the lesson series?	Open
	Any other feedback you would like to share about the lesson series?	Open
	Would you be interested in giving this lesson series yourself? Why or why not?	Open

### 13.4 Results

In total, five responses were collected, ranging from participants that used to teach Computer Science, to current teachers with lots of experience or teachers to-be who are currently working on becoming a Computer Science teacher. The results of the survey are summarized and divided into the six sections of the survey itself and a concluding section of recommendations to improve the lesson series.

#### 13.4.1 Chapter 1 (Description & Purpose) & Chapter 2 (Explanations)

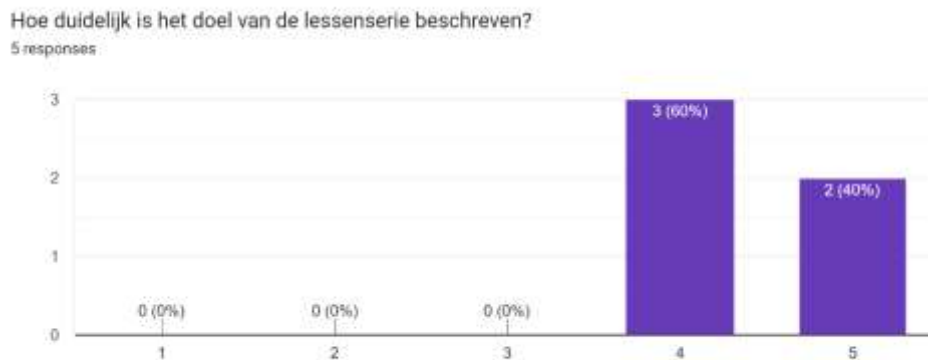


Figure 25: Clarity of the lesson series goal

As shown in Figure 25, the clarity of the lesson series goal was very high, with an average score of 4.4. Feedback to make the goal clearer was to add information from chapter 3 (learning objectives) as additional information. While the information is clear, it leaves questions regarding the specific learning goals for the students. Moreover, content-wise some parts of the lesson series might pose challenges for Havo-level students, prompting students to ask clarifying questions. There are also some opportunities for textual improvements, such as reducing of commas for clearer readability. Also, the number of lessons could be specified (including the length of the lesson). This will improve readability instead of stating the number of weeks (each week might have different number of lessons).

Hoe helder is de uitleg over de volgende onderdelen van hoofdstuk 2:

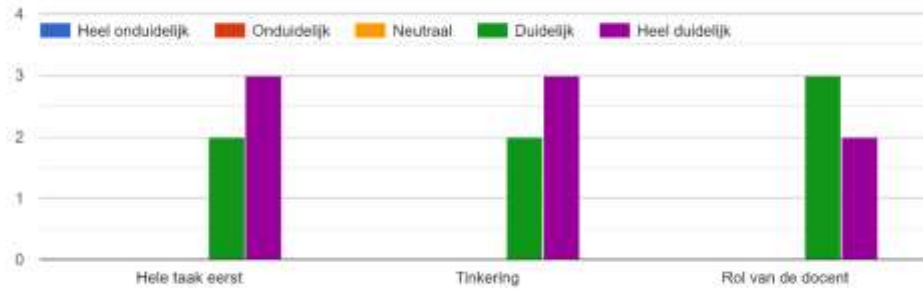


Figure 26: Clarity Explanations Chapter 2

As depicted in Figure 26, the clarity of all three sections of the explanations chapter were clear. Feedback given on possible further improvements was that it was already clear or that the tinkering was a bit unclear, but with the explanation of chapter 2 and the cards made for the students this became clear.

### 13.4.2 Chapter 3 (Learning Objectives)

Op een schaal van 1 tot 5, hoe duidelijk zijn de leerdoelen geformuleerd?

5 responses

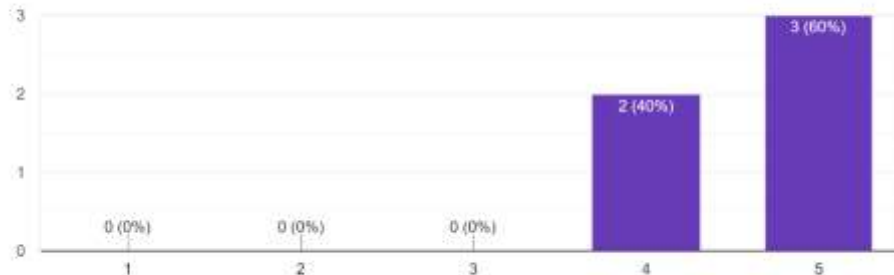


Figure 27: Clarity of Learning Objectives

Regarding the clarity of the learning objectives, an average score of 4.6 was given, meaning that the learning objectives were clear, see Figure 27. Additional feedback to the clarity of the learning objectives was that it is nice that the learning objectives align with Blooms Taxonomy. However, the question was raised on how can be ensured that students reach the level of understanding for certain objectives (5,6, and 8) and not just memorize information. Moreover, the clarity and measurability of the learning objectives are uncertain, and there might be some objectives missing according to one respondent. Questions were raised regarding the inclusion of terms like “has gained experience” in learning objectives and concepts like “role of a step” and “explaining the necessity of involving the end user” were deemed important but the phrasing was questioned.

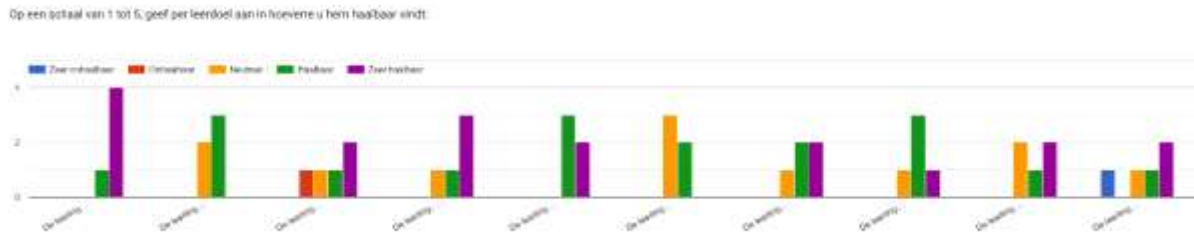


Figure 28: Feasibility of the learning objectives.

In Figure 28, the scores for the feasibility of the learning objectives are shown. For two of the ten learning objectives a unanimous agreement was given that they were feasible (1 and 5). For the other learning objectives also neutral scores, unfeasible and very unfeasible scores were given. Among the participants there was doubt about the feasibility of the learning objectives in the set time frame. Moreover, for the feasibility of learning objective 2, it is questionable that by wanting students to go through the UX-cycle three times they might rush through the cycle and not take their time. Also, the feasibility of learning objective 6 was mentioned in regard to if students will be able to independently reach this objective. Lastly, two learning objectives also received an unfeasible answer, i.e. learning objectives 3 and 10, because they are quite difficult to measure.

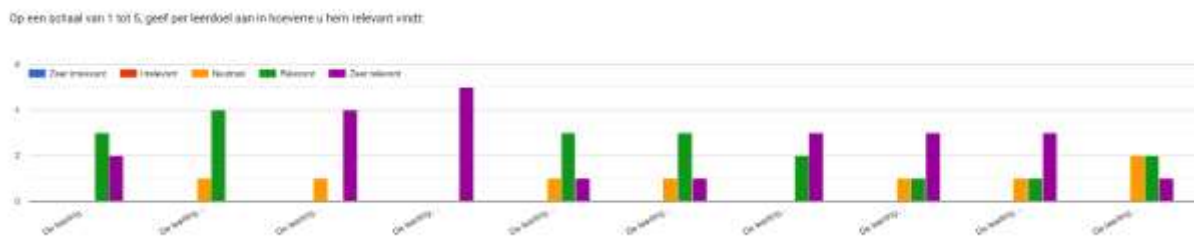


Figure 29: Relevance of the learning objectives.

All learning objectives were to some extent by some respondents perceived as relevant or highly relevant, as can be seen in Figure 29. For six of the ten learning objectives one neutral response was given and for learning objective ten two neutral responses were given. The reason behind these neutral responses is that one of the respondents found it hard to give an opinion on the relevance of them. For the last learning objective, the other respondent found that it fits less with the UX domain and more with Domain A, general skills. Another respondent indicated that it is very important for students to realize that the customer is king. By using tools and learning to apply them, it is furthermore very useful in various application areas, making the learned knowledge more broadly applicable. Other respondents mentioned that the learning objectives were relevant and perfectly achievable.

Suggestions to better align the learning objectives with the final terms of SLO were that the final terms themselves are quite ambitious and general, and these have been well defined. Furthermore, it is indicated that it captures the essence but drafting learning objectives is a difficult and major point of discussion. When drafting learning objectives, it involves making choices and supporting reasons, so it is also difficult to assess whether these learning objectives are sufficient.

### 13.4.3 Chapter 4 (Lesson Structure)

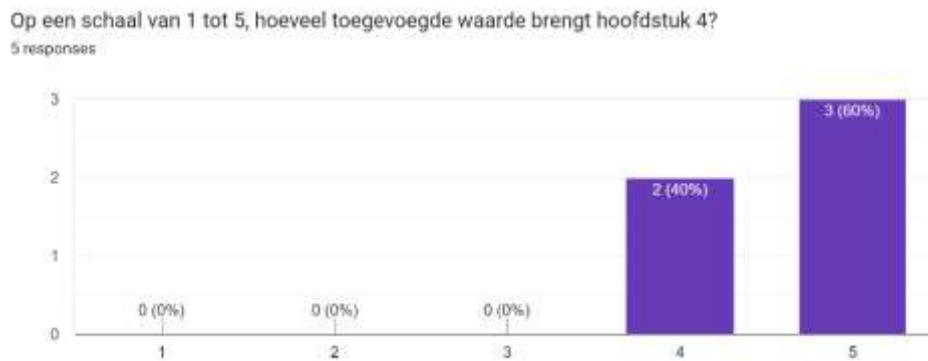


Figure 30: How much added value of chapter 4.

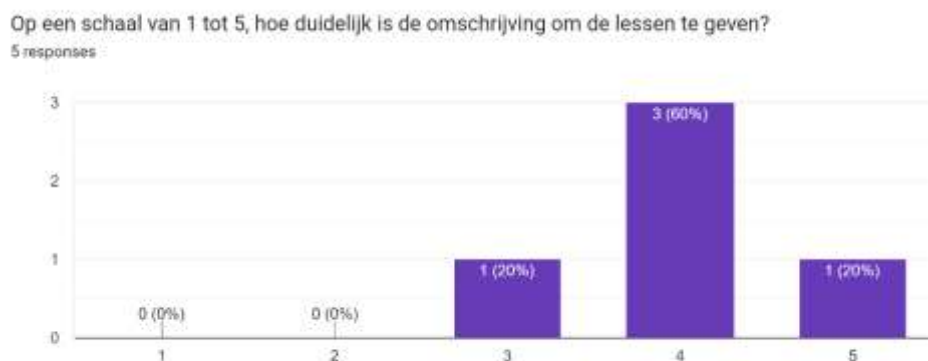


Figure 31: Clarity of description to give the lessons.

Figures 30 and 31 show that both the added value of chapter 4 was high, and that the description was clear, with average scores of 4.6 and 4.0. For aspects that needed further explanation a respondent recommended clearer instructions for finding the teaching materials. The chapter suggests items like fill-in cards and a UX-template, but there is no reference to these materials. Additionally, a general study guide with an overview of all the lessons and the goals of each lesson would also be beneficial. Moreover, a respondent pointed out that the lesson explanations are too general, making it challenging for a colleague to deliver the lesson solely based on the teacher's guide. They recommended providing additional materials like PowerPoint presentations with explanations to enhance the understanding.

Other general feedback regarding the lesson structure chapter was a small typo in the blue "Theme" card. It also suggested to include a paragraph about common mistakes made by students for teachers, providing clarity on misconceptions and ways of explanation that might lead to them. Additionally, it is recommended to alter the opening question prompting students to think more like designers than users. The current openings question is: "Why do we find these games enjoyable?", and instead it might be more useful to ask: "What should an attractive game entail?"

### 13.4.4 Chapter 5 (Assessment Method)

Op een schaal van 1 tot 5, hoe goed sluit de beoordelingsmethode aan op de leerdoelen?  
5 responses

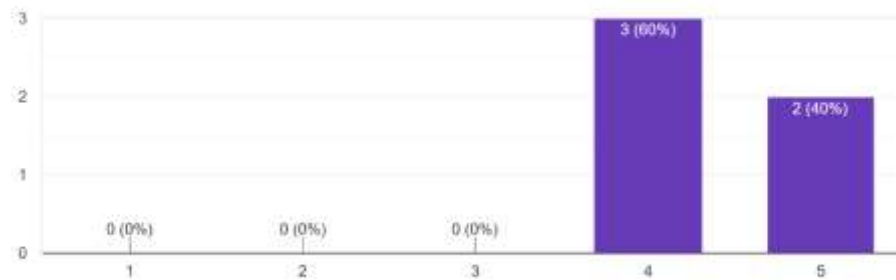


Figure 32: Alignment of assessment method with learning objectives.

The alignment of the assessment method with the learning objectives was perceived as well with an average score of 4.4 on a scale of one to five on how well they fit, as shown in figure 32.

Op een schaal van 1 tot 5, hoe duidelijk is de beoordelingsmethode?  
5 responses

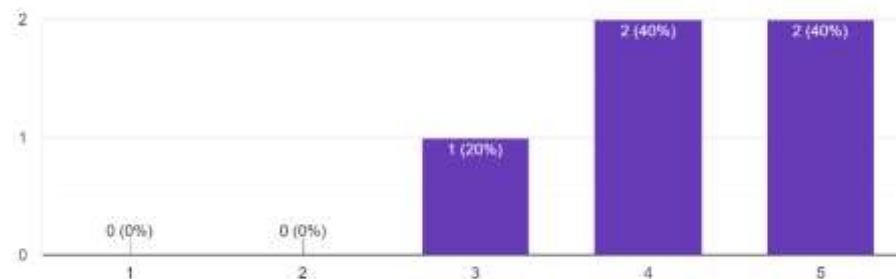


Figure 33: Clarity of assessment method.

In Figure 33 can be seen that also the clarity of the assessment method was high, with an average score of 4.2.

Op een schaal van 1 tot 5, hoe eens bent u het met de wegingsfactoren van de verschillende criteria?  
5 responses

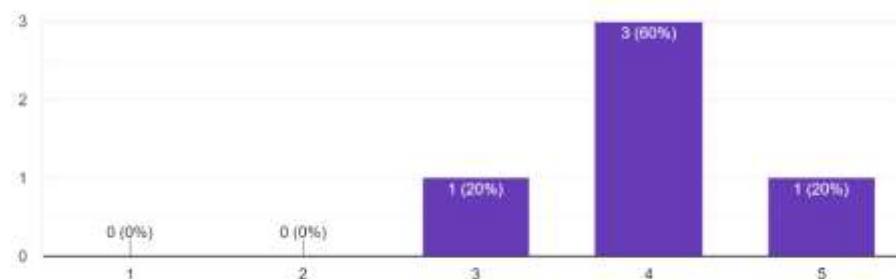


Figure 34: Agreement with weighting factors.



As can be seen in Figure 34, the agreement level regarding the weighting factors was also high with an average score of 4.0.

Regarding the question of the most important skills were evaluated with the assessment method all feedback was positive and in agreement. A positive comment was that it was an excellent rubric.

Regarding the question asking for possible aspects of the assessment method that could be improved two respondents gave extensive feedback. The focus of this feedback was on three topics: the assessment of the presentation, the UX points, and the levels of the rubric. Regarding the presentation, it was unfortunate that the ability to convey the content and enthusiasm over the product are not included in the presentation criteria. Regarding the UX topic, it is unfortunate that to get to the ten students have to do more than required according to the learning objectives. This is specifically focused on learning objective 2, on the number of times they must go through the UX-cycle.

Regarding the levels of the rubric, one respondent found a rubric with six levels too much and impractical for teachers to use. Each level should distinctly differ from the others, with minimal overlap, especially considering that various aspects often need to be evaluated for each objective, leading to potential confusion in assessment.

#### 13.4.5 Chapter 6 (Student Materials)

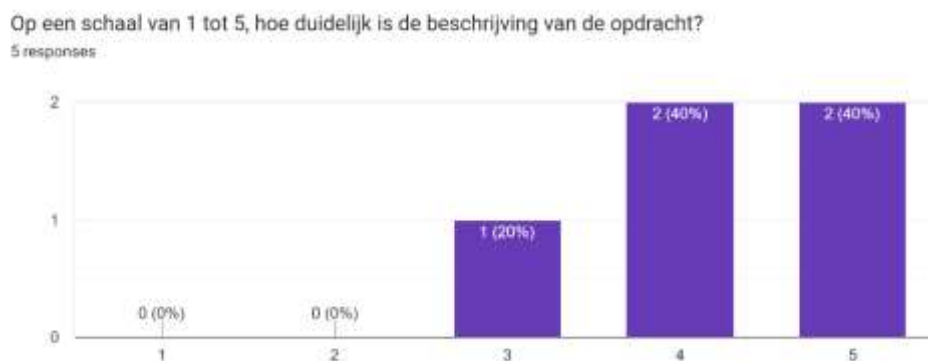


Figure 35: Clarity of the student assignment.

As can be seen in Figure 35, the student assignment scored high on its clarity, with an average score of 4.2. Specific elements of the assignment that could be improved are the length of the sentences in the assignment, clarifying what the difference is between a complete game and playable game, and the size of the complete assignment is quite big. Moreover, currently students are graded on their documentation and presentation, not the product the students make. Whereas it might be nice to add the product itself to the grading.

One suggestion for improvement, referred to the assignment description, was to create a more interesting and clear assignment card that clearly indicates the goal description and intended outcome without it being a lot of text.

Op een schaal van 1 tot 5 hoe duidelijk was de uitleg over de verschillende materialen?

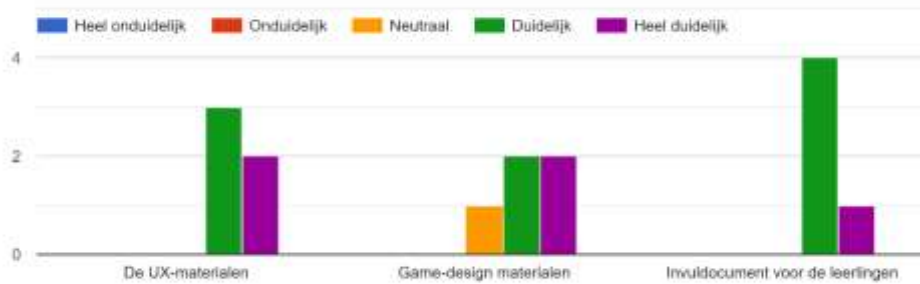


Figure 36: Clarity explanation of student materials.

The clarity of the UX-materials and the fill-document of the students were both regarded as clear, see Figure 36. The Game-design materials however was also regarded as neutral by one respondent. This respondent also suggested the game design materials could be broader since the respondent found the current amount to be a bit sparse.

### 13.4.6 General Feedback

In hoeverre vond u de docentenhandleiding duidelijk?

5 responses

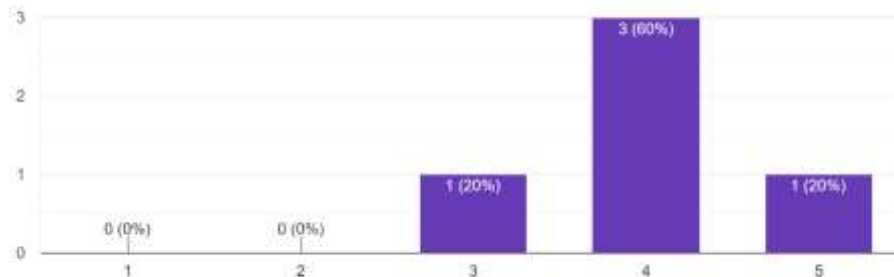


Figure 37: Clarity of teacher guide

The teacher guide in general was perceived as clear, see Figure 37, with an average score of 4.0. Suggestions as to what could be clearer, was by adding more materials, or adding a clear lesson overview with the lessons and the content per lesson. Other feedback regarding the teacher guide was that one of the respondents would want to use the lesson series possibly if the quality of the cards was a bit higher.

Regarding the general impression of the lesson series, four out of five respondents were very positive and commented on the workability and set-up. One respondent however mentioned that it would be a though challenge but expects students to really enjoy it. Therefore, the respondent also anticipates no problems with students achieving the learning objectives. The lesson series is well-structured and allows enough room for personal interpretation and application of one's own style. Sometimes, a bit more tips and guidance could be provided, but is not crucial.

All respondents, except one who is retired, would all be interested into teaching this lesson series. One reason mentioned was because it is a nice way to teach students about this topic.

#### 13.4.7 Summary of Recommendations

The feedback suggests several recommendations for further improving the lesson series. Firstly, there is a need to think and maybe alter the length of the lesson series, since it now is particularly questionable if it is doable in five weeks. Secondly, the wish was mentioned, to have more guidance and materials, such as clearer study guide and additional explanations to aid teachers in delivering the lesson series effectively by, for example, providing PowerPoint presentations. Thirdly, there are concerns about the feasibility of certain learning objectives within the time frame, suggesting a need for adjustments to ensure attainability. Additionally, there are suggestions to enhance the assessment method, particularly in including factors like conveying content and enthusiasm, and reconsidering the levels of the rubrics. Lastly, improvements to student materials are recommended, focusing on the assignment description, and possibly expanding the game design materials. Overall, while the lesson series is well-received, there is room for enhancements to clarity, feasibility, assessment, and student materials.

#### 13.5 Conclusion

The goal of the survey was to evaluate the lesson series from the perspective of Computer Science teacher and learn about its usability, understandability, and possible desirability to use the lesson series and accompanying materials. Through the method of a survey, Computer Science teachers from different levels were asked to give feedback on the different chapters of the teacher guide, the accompanying materials, and the general impression. Based on the feedback from the respondents, different implementations and improvements can be made to the lesson series to make it more suitable for both the teachers and the students. Examples of such improvements include the altering the assignment description making it more concise and clearer, reevaluating the learning objectives, and altering the length of the lesson series to make the learning objectives more feasible.

## Chapter 14: Final Design

With feedback from the three evaluation sessions, some changes were made to finalize the design of the lesson series. Below, the final design of the lesson series is discussed in detail. The chapter is divided into general changes made to the lesson series, game design components, the UX components and the teacher guide.

### 14.1 General Changes to the Lesson Series

There are two changes that were made that influenced the complete lessons series. First, a suggestion was made during the evaluation session, that it would be nice to first know the possibilities of the Unity template before starting to come up with ideas. Because currently students must come up with an idea, but in the end, it turned out it could not be made with the Unity template. This is not very nice for the high school students, so it was decided that the Unity template should be introduced at the start of the lesson series. It can be done in the shape of a demonstration, video, scaffolding exercise, etc., to really allow students to get an idea of the possibilities instead of feeling disappointed when wanting to make a game that is not possible with the template.

The second change was the length of the lesson series. Currently, the length of the lesson series was set between five to ten weeks. However, after the two-week field study and feedback from the survey, the feasibility of a five-week lesson series was questioned. Especially with the learning objective of wanting to go through the UX-cycle three times and allow the students time to explore and work with the different UX methods per step. Instead of determining the length of the lesson series in weeks, a lesson overview was made per lesson. Based on this, the new length of the lesson series is 18 lessons, which can range from 6 weeks (3 lessons per week) to 9 weeks (2 lessons per week) depending on the number of lessons that students have per week.

### 14.2 Game Design Components

This section focuses on explaining the final design of the Unity template and briefly discusses the card elements, including both the explanation and fill-in cards. Regarding the explanation of the Unity template, it will specifically delve into the various prefab elements and all their functionalities, as well as the complete template, covering different items and folders.

#### 14.2.1 Unity Template

No significant changes were made to the Unity template itself, despite feedback from the evaluation session suggesting the creation of more objects or different templates. The rationale behind this decision is that the goal of the lesson series is to allow students to learn about UX by designing a game. The game itself does not need to be complete, but rather serves as a functional prototype that enables students to become familiar with Unity. However, a final bug was discovered in the “Push\_object” functionality, as it was not moving. This was rectified by adding a Rigid body and applying gravity to it.

Figure 38 offers an overview of the different prefabs that will be discussed. Figures 39 to 46 provide a detailed discussion of the various prefab objects, outlining the components they possess, including script options. Following this the materials, scripts and test scene are discussed.



Figure 38: Overview of the Prefab folder with the different prefab objects.

### Bullet

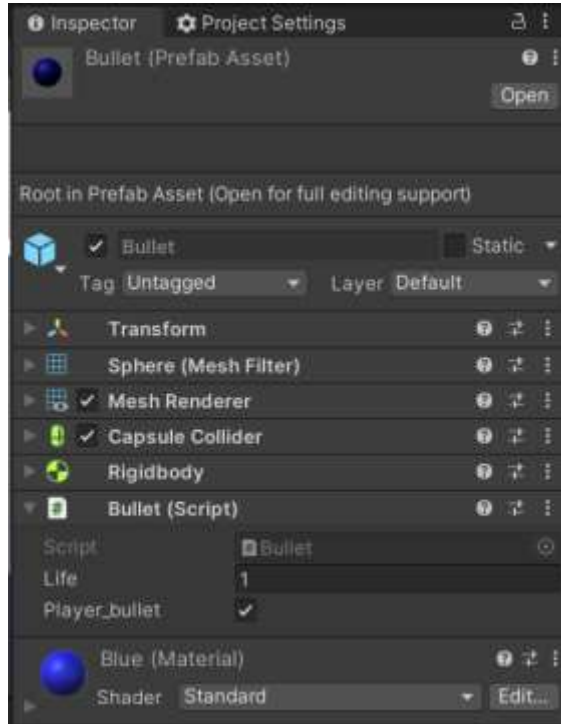


Figure 39: Inspector view of Bullet

### Enemy Bullet

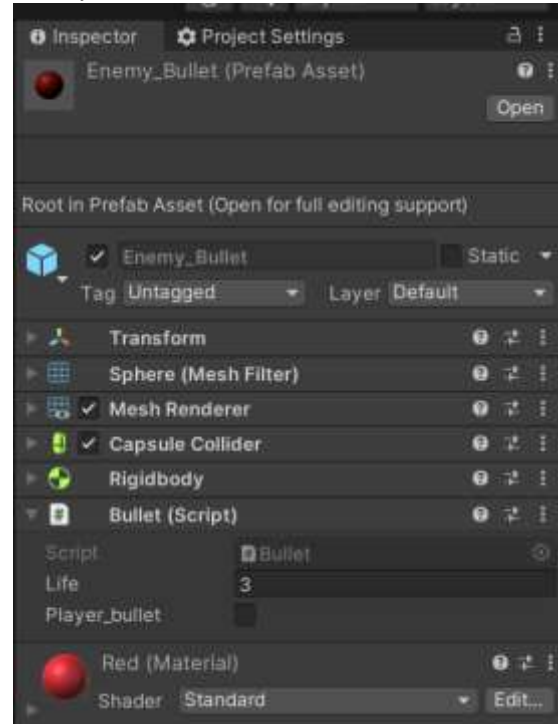


Figure 40: Inspector view of Enemy\_Bullet

The “Bullet” object is equipped with both a collider and a Rigidbody, as can be seen in Figure 39. In this instance, gravity is disabled to ensure the bullet travels in a straight path. Additionally, the “Bullet” object is accompanied by a Bullet script and a blue material. The Bullet script contains two variables:

- Life: represents the duration for which the bullet remains active, specified by a numerical value.
- Player\_Bullet: presented as a checkbox, must be selected if the bullet belongs to the player and deselected if it belongs to the enemy object.

While the “Bullet” and “Enemy\_Bullet” objects share similarities, there are three key distinctions: the “Bullet” is coloured blue, while the “Enemy\_Bullet” is red; the duration of the “Life” variable; and the status of the “Player\_bullet” checkbox, which is selected for the “Bullet” object. This difference can also be seen in Figures 39 and 40.

## Enemy

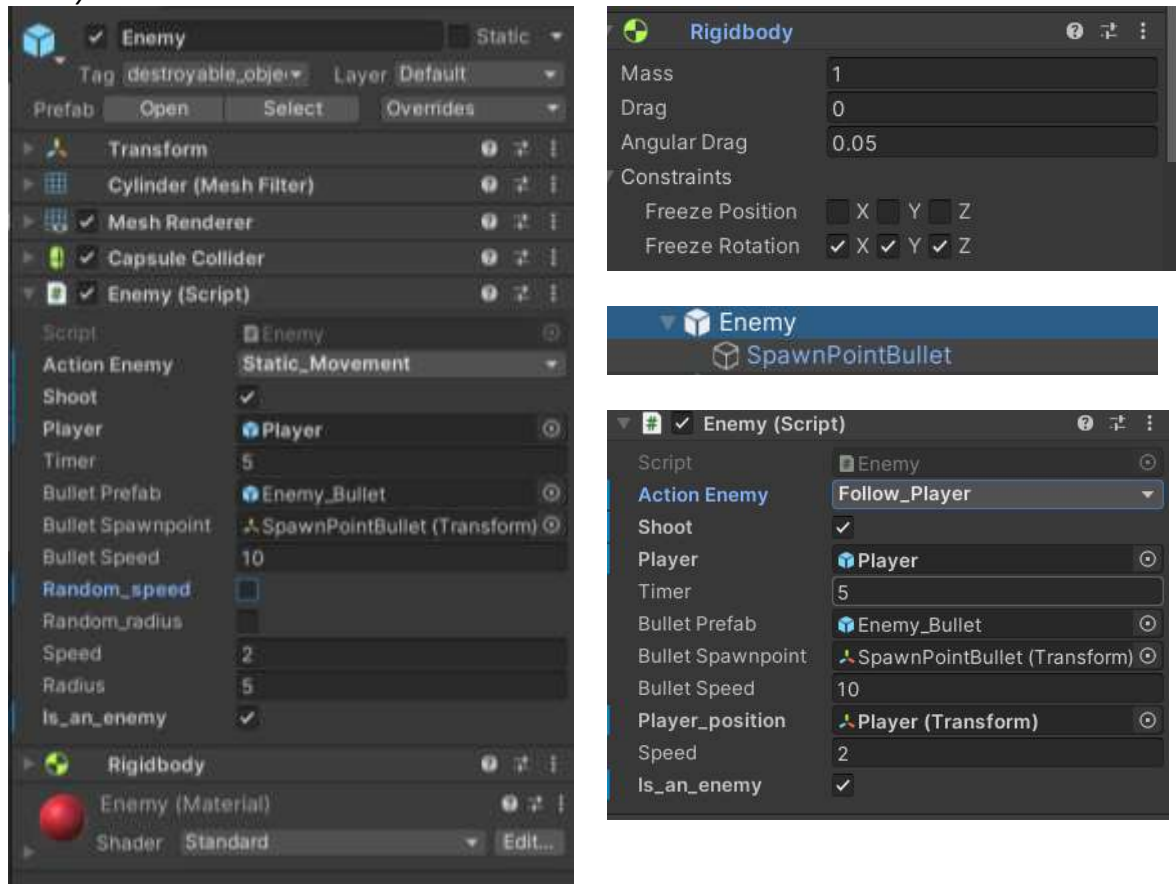


Figure 41: Overview of the Enemy Object

The “Enemy” object, as shown in Figure 41, consists of several components: a collider, an Enemy script, a Rigidbody, and an Enemy Material (Red colour). In this configuration, the gravity is enabled in the Rigidbody, and rotations are frozen on the X, Y and Z axes. Additionally, the “Enemy” object serves as the parent object for the “SpawnPointBullet” object, which functions as an empty object designated to provide a spawn point for bullets.

The Enemy script features numerous variables, each of which will be briefly discussed:

- **Action Enemy:** This dropdown option determines the type of movement the object has, offering a choice between static movement (Static\_Movement) along a straight line or tracking and following the “Player” object (Follow\_Player).
- **Shoot:** If checked, the enemy shoots at intervals toward the “Player” object.
- **Player:** This variable indicates the object “Player”.
- **Timer:** Regulates the time interval between shots fired.
- **Bullet Prefab:** Refers to the bullet shape itself, represented by the “Bullet\_Energy” object.
- **Bullet Spawnpoint:** This designates the position where the bullet is spawned, represented by the “SpawnPointBullet” object.
- **Bullet Speed:** Indicates the speed of the bullet.
- **Is\_an\_enemy:** A checkbox option; when selected, it results in the destruction of the “Player” upon collision or shooting. Otherwise, the “Enemy” solely pursues and follows the “Player”.
- **Speed:** Determines the speed of the “Enemy” objects movement.

- Player\_Position: Only appears if the Follow\_Player option is chosen, requiring knowledge of the position of the “Player” object.
- Random speed: Only appears if the Static\_movement option is chosen, providing the “Enemy” object with a random speed. If checked, the variable Speed disappears.
- Random radius: Only appears if the Static\_movement option is chosen, imparting a random radius to the “Enemy” object.
- Radius: Only appears if the Static\_movement option is chosen and Random\_radius is not checked. Gives the radius of the movement of the “Enemy” object.

### Player

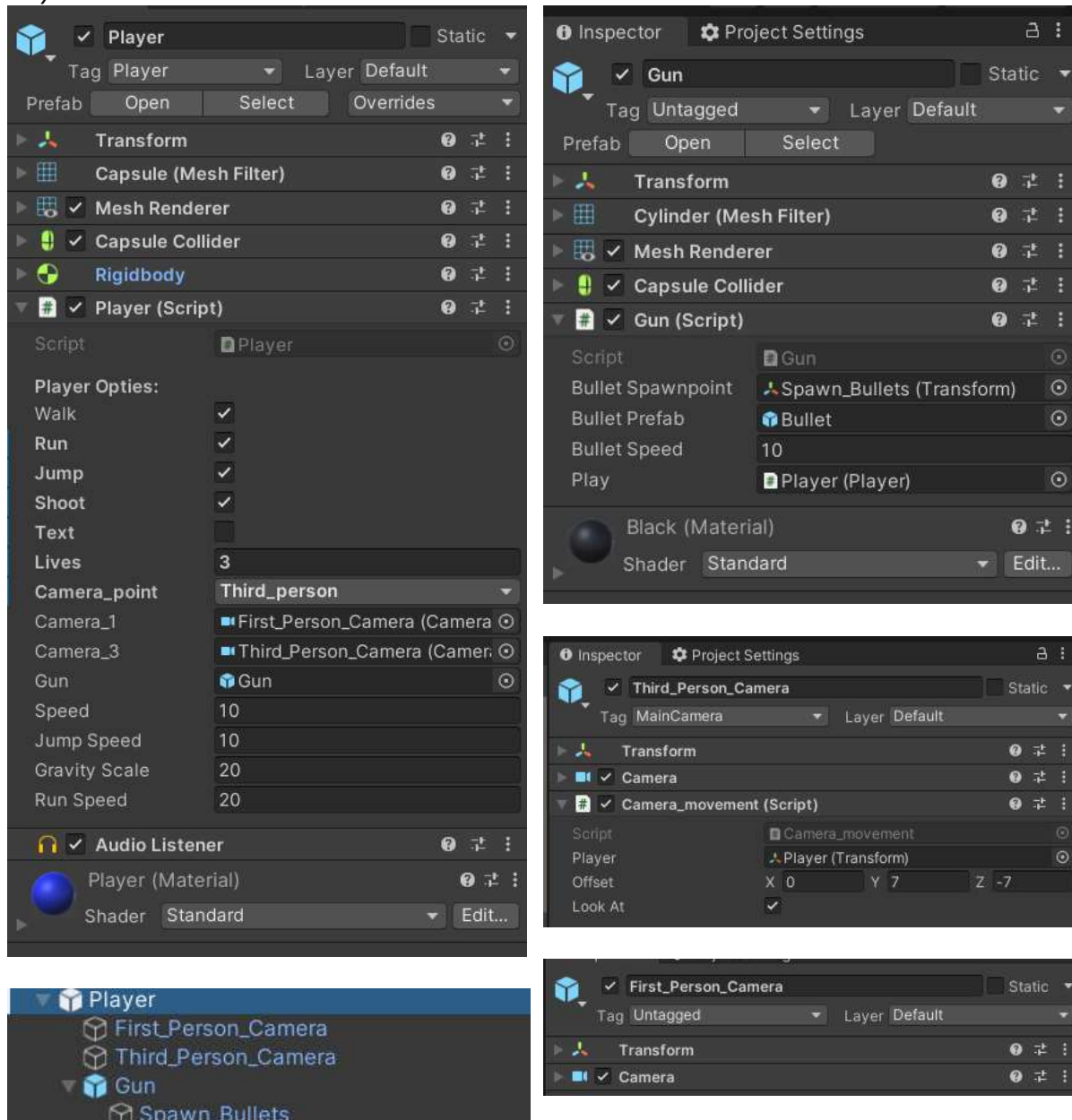


Figure 42: Overview of the Player object

The “Player” object, as shown in Figure 42, consists of the following components: collider, Rigidbody, Player script, audio listener, and player material (blue). The object serves as the parent object for the following objects: “First\_person\_camera”, “Third\_person\_camera” and “Gun”. “Gun” is a parent object of “Spawn\_Bullets”. Similar to previous instances, the “Spawn\_bullets” object sole function is to give

the bullets a spawn point and a directional orientation for the bullets. For the rigidbody of the “Player” object, gravity is enabled, and rotation is restricted on the X, Y, and Z axes, to prevent the capsule from the capsule object tipping over during movement. The “Player” object features an audio listener to enable sound play.

The Player script features numerous variables, each of which will be briefly discussed:

- Walk: When checked, the “Player” can move around by using the A-W-S-D keys or the arrow keys.
- Run: When checked, the “Player” can move with a higher speed by holding SHIFT.
- Jump: When checked, the “Player” can jump, by pressing the spacebar.
- Shoot: When checked, the “Player” can shoot by pressing the E-key or right-mouse button.
- Text: Needs to be checked when the text checkbox of the “Collectable” object is checked.
- Lives: This variable indicates the player’s remaining lives before being destroyed. After losing a life, the player object respawns at its original starting position.
- Camera\_Point: A dropdown menu determine the games perspective: first or third.
- Camera\_1, Camera\_3 and Gun are three variables requiring the objects of these respective items.
- Speed: Appears when Walk is checked, indicating the speed of the players movement.
- Run Speed: Appears when Run is checked, indicating the running speed.
- Jump Speed and Gravity Scale: appear when Jump is checked, controlling the jump height and gravity.

The “Third\_Person\_Camera” features the Camera\_movement script. The Camera\_movement script consists of two variables:

- Player: The “Player” object the camera must follow.
- Offset: The offset of the camera regarding the player, on the X, Y, and Z, axes.

The “Gun” object also features certain features: a collider, a Gun script, and a black material. The Gun script includes four variables:

- BulletSpawnPoint: Indicates the spawn point of the bullets.
- Bullet Prefab: Specifies the prefab object for the player bullet.
- Bullet Speed: Determines the speed of the bullet.
- Play: Initiates the Player script.



### Collectable

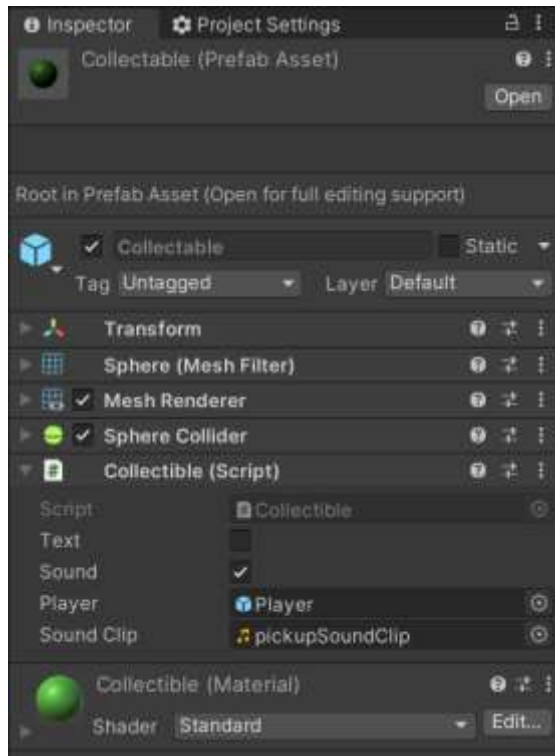


Figure 43: Inspector view of Collectable object

### Teleport

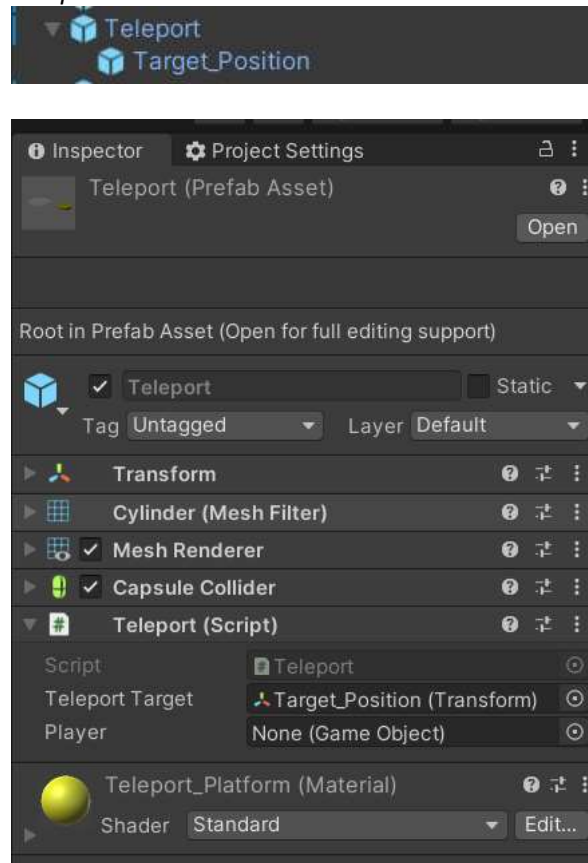


Figure 44: Inspector view and hierarchy of Teleport Object

The “Collectable” object, as depicted in Figure 43, features a collider which is a trigger, a Collectable script, and collectable material (green). The Collectable script consists of four variables:

- Text: When checked, it counts and updates the number of collected collectables (provided the “Text” object is included in the scene and the “Text”-variable is checked in the “Player” object.
- Sound: When checked, sound is played when the collectable object is picked up.
- Player: Indicates the object capable of picking up the collectable item, in this case “Player” object.
- Sound Clip: Appears when Sound is checked, allowing the upload of a file specifying the sound to be played.

The “Teleport” object has a collider, Teleport script and teleport\_platform material (yellow), as depicted in Figure 44. Additionally, the “Teleport” object acts as the parent of the “Target\_Position” object. It possesses two public variables:

- Teleport target: Specifies the position of the destination where the object is to be transported, in this case, the “Target\_Position” object.
- Player: Indicates the game object capable of being transported, in this instance the “Player” object.

### Push Object

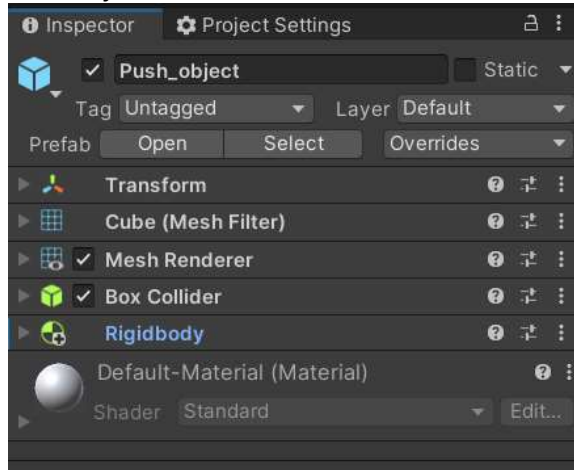


Figure 45: Inspector view of Push\_Object

### Text

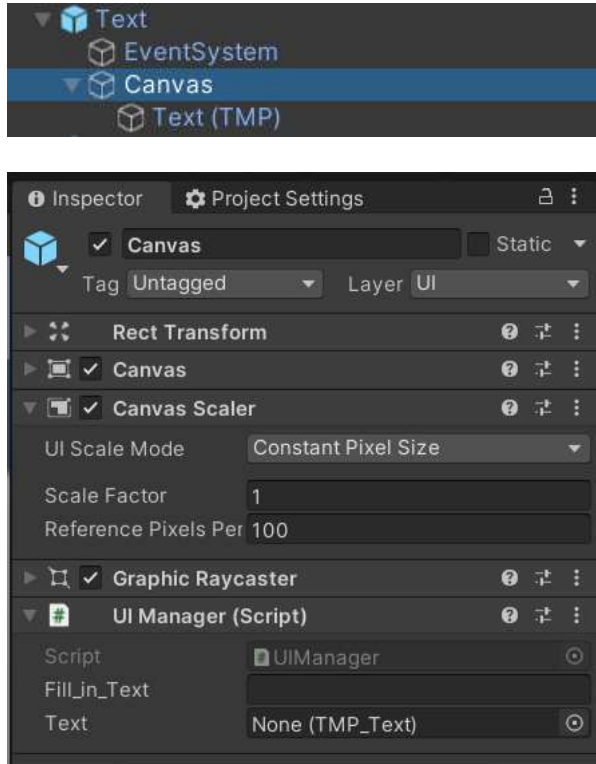


Figure 46: Inspector view and hierarchy of Text Object

The “Push\_object”, see Figure 45, includes a collider, Rigidbody and default material (grey). In the rigidbody the gravity is enabled; without it, the object remains stationary.

The “Text” object, see Figure 46, serves as an empty parent, with two child objects: “EventSystem” and “Canvas”. The “Canvas” object, in turn, is the parent object of the “Text (TMP)” object. All three objects are preexisting, each with its own components. The only modification made is the addition of the UIManager script to the “Canvas” object. This script incorporates two public variables:

- Fill\_in\_Text: This variable is used to input the text to be displayed, specifically for counting collectables.
- Text: This variable requires the “Text (TMP)” object.

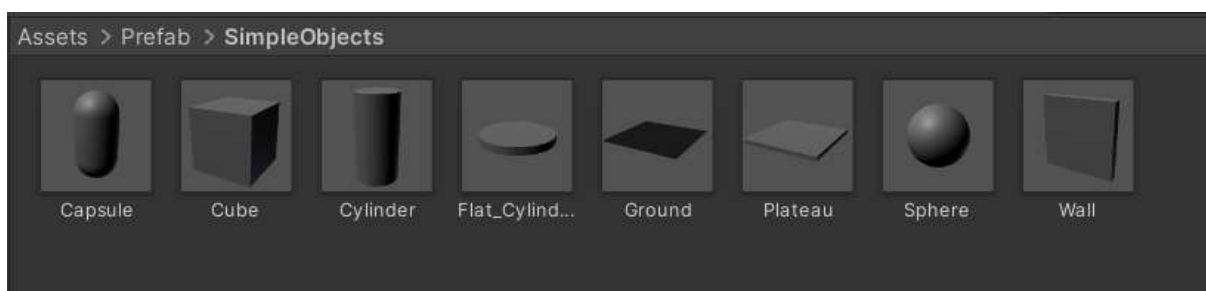


Figure 47: Overview of the Simple Objects Prefabs

In Figure 47, an overview of the added simple objects can be seen, all having the default material. These objects can be easily dragged into the scene or into the Hierarchy. All these objects are all basic objects.

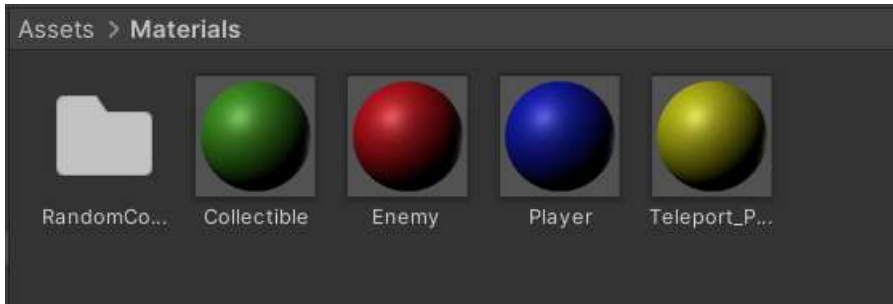


Figure 48: Overview of the Materials Folder

In Figure 48, an overview of the Materials folder is shown. In the Materials folder there is a folder with Random Colours, as well as the different materials used for the prefabs.

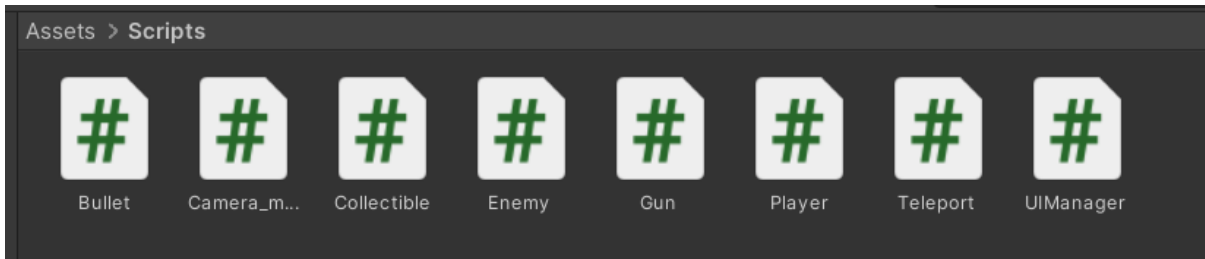


Figure 49: Overview of the Scripts Folder

In Figure 49, an overview of the Scripts folder is shown, displaying the different scripts. These scripts have not been changed since design iteration 3. The complete scripts code can be found in Appendix J.



Figure 50: Test Scene

In Figure 50, the Test Scene is shown. As depicted in the Hierarchy, various objects have been grouped under different empty parent objects: Environment, Collectables and Enemies. This arrangement makes the hierarchy clearer and more organized. Under the Environment, the walls and the ground can be found. Similarly, under Collectables, various collectable elements are located, and the same

applies to Enemies and their associated objects. The Enemies are programmed with different functions such as static movement and following the player, and all other functionalities are enabled (shooting, running, sound, text) to showcase the range of possibilities.

#### 14.2.2 Game Design Cards & Fill-in Cards

The feedback from the evaluations on the game design cards and the fill-in cards was generally very positive. Although some high school students felt that they did not add much value, considering the observations from the field study, where high school students actively used the cards during ideation and prototype steps of the UX-cycle, it is evident that they do serve a purpose. Additionally, participants in the evaluation session were positive about the cards, though they suggested giving them more distinctive colour differences, as the shades of blue and green used were quite similar. Regarding the fill-in cards, the feedback was overwhelmingly positive, with no suggested changes or alterations mentioned.

To summarize, no clear changes were made into the design of the cards. They were kept the same as in design iteration 3, with two different categories of design cards and one type of fill-in card available for students. These cards help students understand different elements of a game and form their game into various objects, making the transition to Unity smoother and offering a structured overview of their game concept.

#### 14.3 UX Components

Based on the feedback received, no significant changes were required for the UX materials. While the materials themselves are well-designed, there is room for improvement in their application. It is essential to carefully consider the best way to utilize the UX materials. The intention behind the cards was to allow high school students to choose the method they preferred for each UX step. However, both during the field study and evaluation session, time constraints limited the exploration and application of the different method cards.

Moving forward, it is crucial for teachers to allocate sufficient time for students to work on each step and ensure they complete the chosen method assigned to the UX step. For instance, if students opt to create a persona to help define their problem statement, they should have ample time to do so. Teachers can facilitate this process by guiding students on how to design a persona. Clear instructions on the use of UX materials will help ensure their appropriate utilization.

#### 14.4 Teacher guide

Lastly, some significant changes were made to the teacher guide based on the feedback from the evaluation sessions. The changes made are discussed per chapter of the teacher guide.

##### *Chapter 1 & Chapter 2*

Only a few changes were made to the chapters 1 and 2. The only alteration was changing the length of the lesson series and the week overview of the lesson series. Instead of showing two different schemes and possibilities of choosing the length of the lesson series, this now has been set at 18 lessons. This makes the lesson series itself a bit stricter but allows for more specific information to help teachers be able to give the lesson series. Nevertheless, teachers are still free to lengthen the lesson series if they want to give students more time.

##### *Chapter 3*

Regarding the learning objectives mentioned in chapter 3 some alterations were made. Some were small changes in the phrasing of the learning objective. Others were more specific, such as learning

objective 2, which previously stated that students needed to go through the UX-cycle a least three times. The number of the cycles is reduced to two. This allows more time on going through the different steps of the cycle and not on rushing through it. The third cycle is however included in the overview in chapter 3 but is in such a brief way this might be left out, depending on the teacher's choice.

#### *Chapter 4*

In Chapter 4, the biggest alterations were made. This is mostly due to the comments from the survey stating that with this information it might still be hard to give the lesson series, meaning there is a lack of information. Therefore, a description and purpose of the lesson was added to the lesson overview. This allows for a clear understanding of the requirements for each lesson. Moreover, it was mentioned to add more materials such as PowerPoint presentations, to give more clarity to the lesson series and the materials. This was done by adding one general presentation in which all materials of the lesson series are explained, which can be found in Appendix K. The reason for only one presentation was to help teachers with explaining the materials while keeping the focus on the student centred and whole task first approaches.

#### *Chapter 5*

Some small changes were made to the rubrics. It incorporates changes from the learning objectives and the feedback from the survey on the grading of the topic presentations. The number of levels of the rubrics was criticized as being too much, however after careful consideration the decision was made to keep the six levels. Fewer levels meant a less clear differentiation between the grades of students.

#### *Chapter 6*

Regarding the student materials one major change was made, and that was the description of the assignment for the students. The assignment description used a lot of commas and long sentences while it is nicer to have a shorter and simpler assignment description for the students.

Based on all the feedback and changes made, the complete and final version of the teacher guide, including the different student materials, can be found in Appendix L. Along with the Unity template package, teachers and students should be able to conduct a UX lesson series with a tinkering approach, allowing students to design a game.

## Chapter 15: Discussion

For the development of the lesson series, Unity was chosen as the 3D software platform for game development. This decision stemmed from comparing four popular software platforms and considering Unity's widespread use among Computer Science teachers. However, Unity comes with its own set of challenges. Specifically, it is prone to errors and bugs. This meant that multiple rounds of testing of the Unity template helped in identifying and addressing issues that arose. While many bugs were resolved during testing, it is crucial that students are equipped to understand error messages or that the teachers possess sufficient Unity/programming knowledge to troubleshoot. Alternatively, students can seek assistance by commenting on the Unity explanation video, allowing the researcher as the designer to provide support.

The decision to use Unity raised questions during the evaluation regarding Unity's suitability for the lesson series intentions, particularly concerning its complexity within the given timeframe. Experts suggested that Unity might be too intricate for the allotted time, prompting further testing with the intended target audience, high school students. This testing will provide insights into the usability of the Unity template and identify any necessary improvements, such as implementing additional elements like a health bar.

Throughout the development process, various evaluations were conducted primarily in small groups, providing qualitative feedback on the game design components. However, the other materials, the teacher guide, and the UX components, received less evaluation, leaving uncertainties about potential improvements needed. Additionally, the materials were only tested with Vwo students, raising questions about their suitability for Havo students, who may require more structure and guidance.

During the evaluations, one of the vocal points was the student engagement, unfortunately based on the field study conclusive findings could not be made. To assess student engagement effectively, the full lesson series should be given without time constraints, allowing students to work at their own pace.

In developing the teacher guide, previous teaching experience and research on creating rubrics for practical assignments proved invaluable. Establishing clear learning objectives at the beginning of the lesson ensured a purposeful design process aimed at achieving these objectives. This ensured a clear understanding of the purpose of the lesson series, guiding the creation of materials aimed at achieving these objectives. Thus, determining the learning objects played a pivotal role in the design process.

Developing a lesson series with both a tinkering approach and the whole task first concept proved to be very fruitful as they complemented each other quite well. Both the tinkering approach and the whole task first concept are student-centred lesson series in which students must take on a significant amount of responsibility. Students can't rely on a more traditional form of instruction with abundant information from the teacher. It requires them to adopt a proactive attitude. Therefore, it is questionable whether this lesson series method will suit every class, making it important for teachers to support student accordingly to help them learn how to deal with the responsibilities.

Combining the tinkering approach with the UX topic presented its own set of challenges during the design of the lesson series. This was primarily due to the structured nature of the UX-cycle, which needed to be balanced with the freedom necessary for students to explore and experiment through tinkering. To address this, the decision was made to separate the game materials from the UX materials. The game materials were specifically designed to facilitate experimentation and exploration, ensuring that the structure of the UX cycle was not compromised while still allowing for a tinkering

approach. However, this approach requires teachers to carefully balance the implementation of the different materials when teaching the lesson series.

Finally, integrating the game design elements with the UX materials posed significant challenges. This difficulty stemmed primarily from the need to merge various topics, including the game design cards, fill-in cards, Unity template, and UX cycle and method cards. It required considerable time to devise the optimal approach for introducing these materials to students gradually, rather than overwhelming them with everything at once.

## Chapter 16: Conclusion

The aim of this research was to develop an engaging UX lesson series through a tinkering approach. In this lesson series, students learn about UX elements via game design. Before developing the lesson series, it was important to research existing UX lesson series. This helped to understand how a lesson series with a tinkering approach could be developed, and the essential elements of such a series, including student materials, teaching methods, and the teacher guide could be identified. Throughout this research, various insights were gained, particularly through the critical review of existing lesson series to determine their effectiveness.

Based on these findings, design requirements were established, focusing on three categories: the teacher guide, the materials, and general requirements for tinkerability. With these design requirements in mind, the first iteration of the lesson series was developed, comprising:

- The Game Design Components: Focus on Unity and game design materials, i.e. the explanation cards and fill-in cards.
- The UX Components: Cover the UX-cycle (Design Thinking) and accompanying methods for each step of the cycle.
- The Teacher Guide: Emphasizes general and teaching-specific elements such as learning objectives, timelines, assignments, and assessment methods.

After the initial version of the materials, two rounds of usability tests were conducted with both experts and non-expert students in Unity and game design to gather initial feedback for improving the game design components. Subsequently, two redesign iterations were performed. After these redesigns, three more evaluations were conducted with high school students, tinkering experts, and Computer Science teachers. These evaluations focused on the usability, tinkerability, and executability of the lesson series with the provided information in the teacher guide. Based on their positive feedback and some suggestions for improvements, the final design was created.

Four types of design requirements were defined: general requirements, designing for tinkerability requirements, student materials requirements, and teacher guide requirements. All general requirements were integrated into the lesson series. For tinkerability, the requirements for the seed, toolbox, discovery, and scaffolding were met. However, the flow and playground requirements remain uncertain or unexplored. Most student materials requirements were achieved, except for one uncertain aspect: whether the lesson series indeed increases student motivation and engagement. The alignment between UX and game design materials was the trickiest requirement to accomplish, but feedback from various evaluations clarified that they align well. The design requirements for the teacher guide were met, including goals, target audience, content, language and style, learning objectives, and facilitation.

Developing a UX lesson series with a tinkering approach was challenging and required time and effort not only to create something appealing to students, but also fit the demands of the SLO (Curriculum Development Foundation). It required careful consideration of various factors, including the target audience, learning objectives, and material choices. Throughout the design process, several challenges were encountered, such as balancing UX and game design materials and ensuring the engagement and usability of the materials. However, by incorporating feedback and conducting multiple rounds of evaluations, a final design was achieved that meets the objectives of the lesson series while providing an engaging and accessible learning experience for students. This lesson series promises an innovative way to integrate UX education with hands-on tinkering, allowing students to learn actively.



## Chapter 17: Recommendations

Based on the findings during the development of the lesson series, it is important to consider the following recommendations for further research.

The first recommendation focuses on evaluating student engagement. As mentioned, there was limited information gathered regarding the effectiveness of the lesson series in increasing student engagement. To address this gap, a comparison can be made between a more traditional lesson series and the developed lesson series. This comparative analysis would provide insight into the impact of the lesson series design and approach on student engagement.

The second recommendation focuses on the evaluation of the lesson series itself. While the lesson series was tested during the research, it was not evaluated within a realistic timeframe. Conducting a field study under realistic conditions would allow for a comprehensive assessment of the ease of use and interaction with all materials of the lesson series. Moreover, it should also be tested with both Havo and Vwo, and not only with the Vwo class to see if a Havo class might need more information or support.

The third recommendation builds upon the previous two by emphasizing the need for additional testing of the Unity template among high school students. This testing would focus on assessing the usability and understandability of the template. If a more elaborate version of the template should be developed based on further research, it is important to consider the potential pitfalls of Unity. To help with this, it is crucial to establish clear goals for the Unity template to prevent it from becoming overly complex.

Furthermore, the game design materials could be further expanded. A potential suggestion for this could be to integrate the lesson series materials with an existing lesson series material on game design. These materials may offer broader and more in-depth explanations of various game elements, enhancing the overall learning experience.

With these recommendations, this lesson series, and further lesson series that aim to incorporate the three main topics covered in this lesson series – i.e. UX, tinkering, and game design – can be developed effectively. This research will help in the development of lesson series that allow for a more playful and experimental manner of learning.

## Chapter 18: Reflection

Designing the lesson series was a hard task, as it required careful consideration of numerous aspects. Not only did I invest significant time in designing the Unity template, but I also used considerable time to create various explanation cards, design the UX materials and crafting the entire assignment with its accompanying information.

As the sole designer of all the materials and the lesson series, I found it relatively straightforward to determine the content to be covered. However, translating this understanding into actionable information for teachers proved to be more challenging. It required to carefully articulate what teachers would need to effectively deliver the lesson series to their students.

One of the most rewarding aspects of this research was the opportunity to apply the knowledge I gained from my two master's studies. Combining insights from both Interaction Technology and Education science enabled me to create a lesson series that integrated principles from multiple disciplines.

Moreover, I am grateful for the numerous opportunities I had to teach and test the materials. Teaching a high school class for two weeks provided valuable firsthand experience, allowing me to observe how student engaged with the materials. Additionally, taking over a four-hour lecture to gain insights from tinkering experts was an enriching experience that further refined the lesson series.

Overall, the process of designing and implementing the lesson series was challenging yet fulfilling, and in provided valuable opportunities for personal and professional growth.

## Remarks

Given the challenges associated with dyslexia, ChatGPT was employed as a valuable tool to enhance the overall quality of this research paper. It was exclusively used for improving the paper's grammar and was not involved in shaping the paper's content.

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## Appendix A: Focus Group Information Brochure and Consent

### Information Brochure - User Experience Lesson Series on Game Design

I would like to invite you to participate in a research study for my Master's Thesis in Interaction Technology. The focus of this study is the design of a User Experience lesson series employing a tinkering approach for game design. Before you decide, it is important to understand the purpose of the research and what your involvement would entail. Please take the time to read the following information carefully, and feel free to ask questions if anything is unclear or if you require more details.

#### **WHO I AM AND WHAT THIS STUDY IS ABOUT**

My name is Rochelle Spaargaren, and this study aims to gain insights into different game elements, identifying their importance and added values. The results from this focus group will be used to create a prioritized list for the development of a tinkering toolbox, enabling students to easily experiment with creating a game in Unity.

#### **WHAT WILL TAKING PART INVOLVE?**

This study involves participating in a focus group where you will share your opinion on the topic in a group context. It is important to feel comfortable expressing your views in front of others. The study will focus on two sub-topics: key game elements and prioritizing these elements. The study will take place on campus and is expected to last approximately 1 to 1.5 hours. The focus group session will be audio recorded as a backup to the notes taken during the study.

#### **WHY HAVE YOU BEEN INVITED TO TAKE PART?**

You have been selected to participate because of your familiarity with Unity and game design elements.

#### **DO YOU HAVE TO TAKE PART?**

Participation in this study is entirely voluntary, and you have the right to refuse, decline any question, or withdraw at any time without any consequence.

#### **WHAT ARE THE POSSIBLE RISKS AND BENEFITS OF TAKING PART?**

A benefit of participating is the receiving of a freshly baked cookie. No physical or psychological harm should occur, but if you feel otherwise, please inform the session facilitator.

#### **WILL TAKING PART BE CONFIDENTIAL?**

All collected data will remain confidential and will not be shared beyond the researcher and involved employees in the master's thesis. After the study, all personalized data will be destroyed to ensure confidentiality. The data will be summarized in the thesis report.

#### **HOW WILL INFORMATION YOU PROVIDE BE RECORDED, STORED AND PROTECTED?**

Data will be collected through written notes and audio recording, with the recording serving as an additional resource. The recording will only be accessible to the researcher. The data will be used for the thesis report. Participants have the right to request access, rectification, or erasure of personal data. The data will be stored securely on a private drive, and at the recording will be deleted at the end of the thesis.

## WHAT WILL HAPPEN TO THE RESULTS OF THE STUDY?

The gathered results and data will be used in the final report of the thesis.

## WHO SHOULD YOU CONTACT FOR FURTHER INFORMATION?

For any further information you can contact the researcher: Rochelle Spaargaren ([r.spaargaren@student.utwente.nl](mailto:r.spaargaren@student.utwente.nl))

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 Angelika Mader, Angelika Mader, the supervisor, through the email [a.h.mader@utwente.nl](mailto:a.h.mader@utwente.nl).

Additionally, you can contact the Secretary of the Ethics Committee of the Faculty of Electrical Engineering, Mathematics and Computer Science at the University of Twente through [ethicscommittee-cis@utwente.nl](mailto:ethicscommittee-cis@utwente.nl)

## Consent Form for Ordering of Game Elements Focus group

*Please tick the appropriate boxes*

### Taking part in the study

I have read and understood the study information dated [\_\_/\_\_/\_\_\_\_], 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.

Yes No

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 an audio-recording as well as written notes which will be made during the session. The audio recording will be used as back-up for the written notes and the recordings will be destroyed at the end of the master thesis.

### Use of the information in the study

I understand that information I provide will be used for the Interaction Technology Master thesis on “*Developing an engaging UX lesson series using a tinkering approach*”. The information in the thesis will be summarised and kept confidential.

I understand that personal information collected about me that can identify me, such as [e.g., my name or where I live], will not be shared beyond the researchers and employees involved in this master thesis.

### Consent to be Audio Recorded

I agree to the audio recording of the focus group session on the ordering of game elements.

### 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:**

For any further questions you can contact Rochelle Spaargaren through the email:

[r.spaargaren@student.utwente.nl](mailto:r.spaargaren@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, Angelika Mader, the supervisor through the email [a.h.mader@utwente.nl](mailto:a.h.mader@utwente.nl).

Additionally, you can contact the Secretary of the Ethics Committee of the Faculty of Electrical Engineering, Mathematics and Computer Science at the University of Twente through [ethicscommittee-cis@utwente.nl](mailto:ethicscommittee-cis@utwente.nl)

## Appendix B: Fill-In Document Process

### Stap 1: Empathize

Doelgroep:

*Samenvatting van de bevindingen.*

### Stap 2: Define

Probleemstelling:

Ontwerpeisen:

### Stap 3: Ideate

*Foto van alle ideeën:*

Gekozen idee + argumentatie waarom:

### Stap 4: Prototype

*Foto van prototype + korte omschrijving.*

### Stap 5: Test

*Samenvatting van bevindingen:*

Wat ga je aanpassen en waarom:

### Evaluatie

Wat waren de drie meest leerzame fouten die je gemaakt hebt tijdens de afgelopen ronde:

## Test Formulier

*Te gebruiken om feedback over je ontworpen prototype te krijgen.*

*Vul de volgende tabel in om snel en kort en feedback te verkrijgen:*

	1	2	3	4	5
Hoe gemakkelijk was het om het spel te begrijpen? (1= Zeer moeilijk, 5 = Zeer makkelijk)					
Hoe duidelijk waren de doelstellingen van het spel? (1=Zeer onduidelijk, 5 = zeer duidelijk)					
Hoe intuïtief waren de bedieningselementen en acties in het spel? (1=zeer verwarrend, 5=zeer intuïtief)					
Hoe tevreden was je met de algehele gebruikerservaring van het spel? (1=zeer ontevreden, 5 = zeer tevreden)					
Hoe waarschijnlijk is het dat je dit spel opnieuw zou spelen of aan anderen zou aanbevelen? (1= zeer onwaarschijnlijk, 5= zeer waarschijnlijk)					

*Voor specifiekere uitleg, stel volgende open vragen:*

- 1) Als je iets zou kunnen veranderen aan het spel om het beter te maken, wat zou dat dan zijn en waarom?

- 2) Wat waren volgens jou de sterkste punten van de gebruikerservaring van het spel? En waarom?

- 3) Waren er verwarrende aspecten? Waarom waren deze verwarrend?

- 4) Zou je dit spel aanraden aan anderen of zelf nog een keer willen spelen? Waarom wel of niet?

## Appendix C: Assessment Method

### Rubric

	Uitstekend (>9)	Goed (8)	Ruim Voldoende (7)	Voldoende (6)	Matig (5.5)	Onvoldoende (<5)
<b>Presentatie<sup>5</sup></b>	De leerlingen geven een presentatie waarbij stemgebruik en non-verbale vaardigheden uitstekend gebruikt worden om duidelijk en uitgebreid de inhoud van de presentatie over te brengen.	De leerlingen geven een presentatie waarbij stemgebruik en een groot deel van non-verbale vaardigheden wordt gebruikt om duidelijk en uitgebreid de inhoud van de presentatie over te brengen.	De leerlingen geven een presentatie waarbij de inhoud duidelijk verteld wordt waarbij een aantal stemgebruik en non-verbale vaardigheden worden toegepast.	De leerlingen geven een presentatie waarbij de inhoud redelijk duidelijk wordt waarbij een aantal stemgebruik en non-verbale vaardigheden worden toegepast.	De leerlingen geven een presentatie waarbij de inhoud niet helemaal duidelijk verteld wordt waarbij stemgebruik en non-verbale vaardigheden bijna niet wordt toegepast.	De leerlingen geven een presentatie waarbij de inhoud onduidelijk of onvoldoende verteld wordt en leerlingen stemgebruik en non-verbale vaardigheden slecht tot niet toepassen.
<b>Documentatie</b>	De leerlingen hebben uitgebreid hun voortgang en keuzes opgeschreven waarbij ze elke keuze duidelijk toelichten met meerdere argumenten op basis van onderzoek/testen/etc. waar bij er een kritisch geanalyseerd is.	De leerlingen hebben uitgebreid hun voortgang en keuzes opgeschreven waarbij ze elke keuze duidelijk toelichten met argumenten op basis van onderzoek/testen/etc.	De leerlingen hebben hun voortgang en keuzes opgeschreven waarbij ze bij sommige keuzes duidelijke argumenten op hebben geschreven.	De leerlingen hebben hun voortgang en gemaakte keuzes kort opgeschreven.	De leerlingen hebben kort hun voortgang opgeschreven en maar slechte argumenten en onderbouwing.	De leerlingen hebben hun voortgang niet of nauwelijks bijgehouden en niet of nauwelijks een onderbouwing.
<b>Product</b>	Het product sluit perfect aan op de leerlingen hun geformuleerde probleemstelling en de game is uitgebreid en vormt een geheel.	Het product sluit goed aan op de leerlingen hun geformuleerde probleemstelling en is speelbaar waarbij de game veel verschillende elementen.	Het product sluit aan op de leerlingen hun geformuleerde probleemstelling en de game is speelbaar met meerder game-elementen.	Het product sluit aan op de leerlingen hun geformuleerde probleemstelling en is speelbaar al wel erg minimalistisch.	Het product sluit deels aan op de leerlingen hun geformuleerde probleemstelling en is slecht speelbaar.	Het product sluit slecht aan op de leerlingen hun geformuleerde probleemstelling en is niet of slecht speelbaar.
<b>Game-elementen</b>	De leerlingen tonen begrip, interesse, en uitgebreide kennis over de elementen zowel gegeven als andere elementen. Kunnen beargumenteren waarom de ene belangrijker is dan de ander en wat de invloed van de elementen op de gebruiker is.	De leerlingen tonen begrip te hebben op de game-elementen die ze hebben gebruikt en de essentiële types, kunnen deze uitgebreid uitleggen, en kunnen beargumenteren waarom de ene belangrijker is dan de ander.	De leerlingen tonen begrip te hebben op de game-elementen die ze hebben gebruikt en de essentiële types en kunnen deze uitgebreid uitleggen.	De leerlingen tonen een begrip te hebben op de game-elementen die ze hebben gebruikt en essentiële types en kunnen deze in het kort uitleggen.	De leerlingen tonen een begrip te hebben van de elementen maar kunnen de elementen onvoldoende uitleggen.	De leerlingen tonen weinig tot geen begrip op de elementen en kunnen het ook niet uitleggen.

<sup>5</sup> Stemgebruik: luid genoeg, toon variatie, articuleert goed, vloeiend en enthousiast te presenteren  
 Non-verbaal: Oogcontact houden, natuurlijke wijze van gebaren, ontspannen houding, en een goede uitstraling  
 Inhoud: duidelijke en heldere structuur, interactie, duidelijke beheersing van onderwerp, goed gebruik van visuele hulpmiddelen, is volledig in wat hij verteld.

<b>UX</b>	De leerlingen zijn meer dan drie keer door de ontwerpcyclus gegaan waarbij ze kritisch gereflecteerd hebben en gebruikt hebben gemaakt van meer dan drie verschillende methodes.	De leerlingen zijn drie keer uitgebreid door de ontwerpcyclus gegaan waarbij ze kritisch gereflecteerd hebben en gebruik gemaakt van meer dan twee verschillende methodes.	De leerlingen zijn drie keer door de ontwerpcyclus gegaan waarbij ze bij elke stap hebben stilgestaan en een meer dan twee methodes per stap hebben gebruikt.	De leerlingen zijn kort drie keer door de ontwerpcyclus heen gegaan en hebben bij elke stap steeds dezelfde twee methodes gebruikt.	De leerlingen hebben bij het doorgaan van de cyclus niet elke keer bij elke stap in de ontwerpcyclus stilgestaan en hebben maar één methode per stap gebruikt.	De leerlingen zijn niet drie keer door de cyclus gegaan en hebben de methodes niet of verkeerd gebruikt.
<b>Reflectie</b>	De leerlingen hebben kritisch gereflecteerd tijdens het proces en hebben op basis daarvan aanpassingen gemaakt.	De leerlingen hebben gereflecteerd tijdens het proces en konden aanpassingen benoemen.	De leerlingen hebben af en toe tijdens het proces gereflecteerd maar hebben er niet duidelijk iets mee gedaan.	De leerlingen hebben in totaal een keer duidelijk gereflecteerd maar er vervolgens niks mee gedaan.	De leerlingen hebben niet duidelijk gereflecteerd.	De leerlingen hebben niet gereflecteerd.
<b>Samenwerking</b>	De leerlingen communiceerde onderling erg goed, konden elkaar goed aanvullen en toonde initiatief en eigenaarschap in hun taken.	De leerlingen communiceerde onderling erg goed, konden elkaar goed aanvullen en helpen waar nodig, verdeelde taken eerlijk en namen initiatief in het starten met taken.	De leerlingen communiceerde onderling erg goed, konden elkaar goed aanvullen en helpen waar nodig was en verdeelde taken eerlijk en voltooid hun werk op tijd en goed.	De leerlingen hadden een goede communicatie onderling, verdeelde de taken eerlijk en zorgde beide dat ze hun werk op tijd en goed voltooiden.	De leerlingen luisterde naar elkaar maar er was sprake van een miscommunicatie of de taken waren oneerlijk verdeeld.	De leerlingen luisterde slecht naar elkaar of hadden een miscommunicatie of de taken waren oneerlijk verdeeld.

### Cijferbepaling

Onderwerp	Weefactor	Deelcijfer
Presentatie	1x	
Documentatie	1x	
Product	2x	
Game-elementen	2x	
UX	4x	
Reflectie	1x	
Samenwerking	1x	
Eindcijfer ( <i>Totaal/120 x 10</i> )		

## Appendix D: Game Design Explanation Cards

### Thema

---

Het thema van een spel geeft een bepaalde sfeer en setting.

Een thema van een spel is als de achtergrond van het verhaal, zoals een mysterieus kasteel of een ruimteavontuur.



Probeer de volgende vragen te beantwoorden:

- > Welk soort verhaal spreekt je het meeste aan?
- > Welke omgeving hoort bij jou thema?
- > Welke sfeer wil je creëren voor je spel?

### Doel

---

Het doel van een spel is wat je probeert te bereiken tijdens het spelen.

Het kan zijn dat je de hoogste score wilt behalen, andere spelers wilt verslaan, of misschien een specifieke missie wilt voltooien.



Probeer de volgende vragen te beantwoorden:

- > Wat is het ultieme doel van mijn spel?
- > Is het doel helder naar de speler?
- > Hoe kan de speler het doel behalen?

### Regels

---

De regels van een spel geeft aan wat er wel en niet kan en mag in het spel.

Regels bepalen hoe je een spel speelt, wat je doelen zijn en hoe je wint of verliest.



Probeer de volgende vragen te beantwoorden:

- > Wat zijn de basisregels van het spel?
- > Hoe kun je het spel winnen of verliezen?
- > Met hoeveel kun je het spel spelen?

### Input

---

De input van een spel zijn interacties die een speler heeft met het spel.

Er zijn verschillende soorten manieren waarop een speler interactie kan hebben met een spel; waaronder toetsen indrukken of muis beweging.



Probeer de volgende vragen te beantwoorden:

- > Welke soorten input zijn er in het spel?
- > Hoe beïnvloedt de input de acties in het spel?



## Uitdaging

De uitdaging van een spel verwijst naar de moeilijkheden die spelers moeten overwinnen om hun doelen te bereiken.

Deze uitdagingen kunnen variëren van het verslaan van vijanden tot het oplossen van puzzels en het behalen van hogere scores.



Probeer de volgende vragen te beantwoorden:

> Wat zijn de obstakels die je moet overwinnen in het spel?

> Op welke manier nemen de uitdagingen toe naarmate je verder komt in het spel?

## Beloning

De beloning in een spel is wat je krijgt als je een uitdaging hebt overwonnen of een doel hebt bereikt.

Een beloning kan bijvoorbeeld punten, voorwerpen of toegang to een nieuw niveau zijn.



Probeer de volgende vragen te beantwoorden:

> Wat zijn beloningen die je kunt verdienen in het spel?

> Hoe motiveert de beloning om verder te spelen?

## Levens

Levens in een spel zijn de kansen die je hebt om fouten te maken voordat je verliest.

Bij elk verlies van een leven kom je dichterbij het einde van het spel.



Probeer de volgende vragen te beantwoorden:

> Heeft het hebben van levens een toegevoegde waarde?

> Wat gebeurt er als alle levens verliest?

## Tijd

Tijd in een spel is de hoeveelheid tijd die je hebt om taken uit te voeren voordat het spel eindigt.

Tijd kan als een beperking werken die je dwingt om snel te handelen en beslissingen te maken. Tijd kan ook werken als een bijhoudende factor zijn.



Probeer de volgende vragen te beantwoorden:

> Hoe voelt het om te spelen tegen de klok?

> Wat is de toegevoegde waarde van tijd bijhouden?

> Waarvoor dient de tijd?

## Obstakels

---

Obstakels in een spel zijn hindernissen of uitdagingen die spelers moeten overwinnen om verder te komen of hun doelen te bereiken.

Obstakels kunnen variëren van fysieke objecten zoals muren tot complexere uitdagingen zoals puzzels of vijanden.

## Beweging

---

Beweging in een spel verwijst naar hoe spelobjecten zoals spelers of objecten in het spel zich kunnen verplaatsen.

Een beweging kan gaan om lopen, rennen, springen, vliegen, zwemmen of andere vormen van verplaatsing binnen het spel.

## Voorwerpen

---

Voorwerpen in een spel zijn objecten binnen het spel die een rol spelen in het spelverloop.

Voorbeelden van voorwerpen zijn power-ups, sleutels, wapens, munten, of andere interactieve objecten zijn die de speler kan verzamelen, gebruiken of manipuleren tijdens het spelen.

## Menu

---

Een menu in een spel is een interface die de speler toegang geeft tot verschillende opties en functies.

Het menu biedt de speler de mogelijkheid om bepaalde acties uit te voeren; zoals het starten van het spel, aanpassen van instellingen, bekijken van scores, etc.

## Speler

---

De speler in een spel is degene die het spel speelt en controle heeft over het personage of object dat zich in de spelwereld bevindt.

De speler neemt beslissingen en voert acties uit om doelen te bereiken en uitdagingen te overwinnen binnen het spel.

## Aankleding

---

De aankleding in een spel verwijst naar alles visuele elementen die de sfeer en uitstraling van het spel bepalen, zoals achtergronden, materialen en objecten.

De aankleding draagt bij aan de algehele beleving en atmosfeer van het spel, waardoor het spel levendiger en interessanter wordt.

## Scripts

Scripts in Unity are pieces of code that you can add to objects to make them move, perform interactions, or have specific functions.

Scripts tell the game what to do and how to respond to certain events or actions by the player.



```
using UnityEngine;

public class Player : MonoBehaviour
{
    // Start is called before the first frame update
    void Start()
    {
    }

    // Update is called once per frame
    void Update()
    {
    }

    void OnDestroy()
    {
    }
}
```

## Inspector

De inspector in Unity is het venster waarin je de eigenschappen en instellingen van geselecteerde objecten in de scène kunt bekijken en aanpassen.

Naam van het object

Positie en grootte van het object

Collider registreert botsingen tussen objecten

Materiaal geeft het object een kleur, etc.

Toevoegen van componenten zoals een script.



## Prefabs

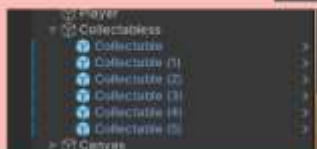
Prefabs in Unity zijn vooraf gemaakte objecten die je kunt hergebruiken in je spel.

Prefabs kunnen allerlei dingen bevatten, zoals modellen, scripts en instellingen, en maken het gemakkelijk om consistente elementen toe te voegen aan je spel.



De Prefabs kun je vinden in het mapje Prefab.

Er zijn huidig drie Prefabs aangemaakt.



Prefabs zijn te herkennen aan hun blauwe kleur in de Hierarchy

## GameObjecten

Game Objecten in Unity zijn de bouwstenen van je spel.

Game Objecten kan van alles zijn, van karakters en objecten tot lichten en audio, en je kunt ze gebruiken om je spel te maken en te laten werken.



## Materialen

Materialen in Unity bepalen hoe objecten eruit zien en aanvoelen in je spel.

Materialen bevatten eigenschappen zoals kleur, textuur en glans, waarmee je de visuele aspecten van je spel kunt aanpassen.

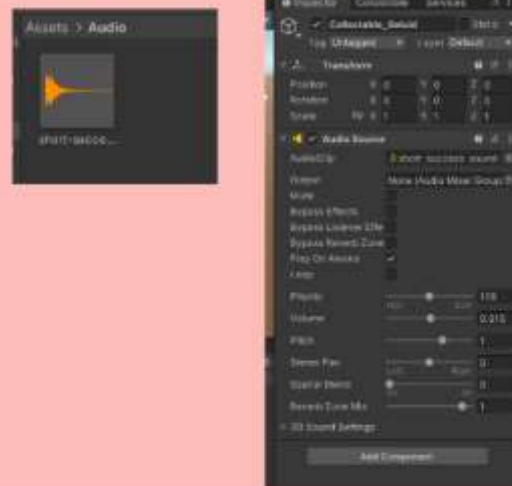


Er zijn momenteel drie materialen elk met een andere naam. In de inspector kun je de kleur, smoothness, etc. aanpassen tot het gewenste materiaal.

## Audio

Audio in Unity verwijst naar geluidseffecten en achtergrondmuziek die je aan je spel kunt toevoegen.

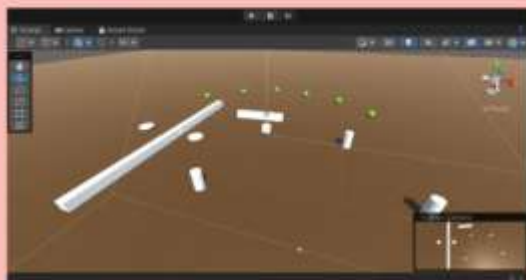
De audio maakt het spel levendiger en kan de sfeer versterken.



## Scene View

In Unity verwijst de Scene View naar het venster waarin je de scenes van je spel kunt bekijken en bewerken.

In de scene view kun je objecten plaatsen, verplaatsen en aanpassen om je spelwereld te creëren.



Door op Play te klikken kun je het spel testen. Rechts boven in kun je van view switchen tussen Scene en Game.

## Canvas

In Unity is een Canvas een element dat wordt gebruikt om gebruikersinterfaces te maken in een spel.

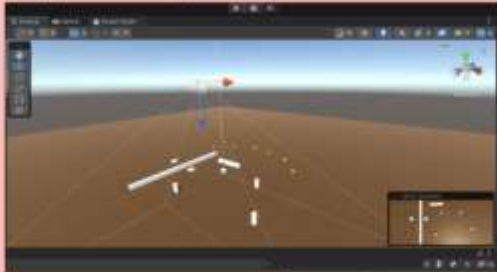
Het Canvas is een plat vlak waarop UI-elementen zoals knoppen, tekst en afbeeldingen kunnen worden geplaatst en bewerkt.



In dit geval staat rechts boven in beeld: *Coins: 0*. Dit blijft in beeld tijdens het hele spel en plakt zich als waren over het spel heen.

## Camera

In Unity is een Camera een virtuele camera die wordt gebruikt om het zicht van de speler in het spel te bepalen.



De Camera stelt de speler in staat om vanuit verschillende perspectieven door de spelwereld te kijken.

In dit geval volgt de camera de speler met een afwijking, te vinden onder de Offset.



## Appendix E: Usability Test Information Brochure and Consent

### Informatie Brochure

Graag nodig ik u uit om deel te nemen aan een onderdeel van mijn onderzoek voor mijn afstudeeropdracht voor mijn master Interaction Technology aan de universiteit van Twente. Voordat u een beslissing neemt, is het belangrijk dat u begrijpt waarom het onderzoek wordt gedaan en wat het inhoudt. Neem u tijd om de volgende informatie aandachtig door te lezen. Als er onduidelijkheden zijn of u meer informatie wenst kunt u vragen stellen.

#### **WIE BEN IK EN WAAR GAAT DIT ONDERZOEK OVER**

Mijn naam is Rochelle Spaargaren en ik ben bezig met het afronden van mijn master Interaction Technology. Dit onderzoek zal onderdeel uitmaken van mijn afstudeeropdracht waarvoor ik een lessenserie aan het ontwerpen ben over het onderwerp User Experience (UX) voor Vwo en Havo 5 leerlingen. De resultaten van dit onderzoek zullen gebruikt worden om het ontwerp van de lessenserie te verbeteren en zullen ook gebruikt worden in het verslag.

#### **WAT HOUDT DEELNEMEN IN?**

Het onderzoek bestaat uit een usability test waarbij u gevraagd wordt om een aantal taken uit te voeren. Terwijl u deze taken uitvoert wordt u gevraagd om hard op na te denken. Na het uitvoeren van deze taken zijn er nog een paar korte vragen om u feedback te krijgen. Het uitvoeren van de usability test zal ongeveer een half uur duren.

#### **WAAROM BENT U GEVRAAGD OM DEEL TE NEMEN?**

U bent uitgekozen om deel te nemen aan het onderzoek vanwege een van de volgende twee redenen:

- A) U hebt ervaring in Unity met het maken van games en hebt al vaker ook games gemaakt.
- B) U heeft geen ervaring met Unity

#### **MOET U DEELNEMEN?**

Deelnemen aan het onderzoek is compleet vrijwillig en u heeft het recht om deelname te weigeren, een/elke vraag te weigeren en u kunt zich op elk moment terugtrekken zonder enige consequentie.

#### **WAT ZIJN MOGELIJKE GEVAREN EN VOORDELEN AAN DEELNEMEN?**

Er zijn geen lichamelijke of psychische risico's verbonden aan uw deelname.

#### **IS DEELNAME VERTROUWELIJK?**

De verzamelde gegevens blijven vertrouwelijk en worden niet gedeeld buiten de onderzoeker en begeleiders betrokken bij de afstudeeropdracht. Aan het einde van het onderzoek zullen alle verzamelde en gepersonaliseerde gegevens vernietigd worden om de vertrouwelijkheid te waarborgen. In het verslag zullen de gegevens samengevat en anoniem benoemd worden.

#### **HOE WORDT DE INFORMATIE DIE U VERSTREKT GEREGRISTEERD, OPGESLAGEN EN BESCHERMD?**

De informatie zal verzameld worden door middel van geschreven feedback samen met een audio opname. Deze zullen alleen toegankelijk zijn voor de onderzoeker zelf. De verzamelde gegevens zullen worden gebruikt voor het eindverslag van de afstudeeropdracht.

Als deelnemer heeft u het recht om te verzoeken om inzage, rectificatie of verwijdering van persoonsgegevens. De gegevens worden veilig opgeslagen op een eigen schijf en zullen zodra deze niet meer nodig zijn voor de afronding van het onderzoek verwijderd worden.

### WAT GEBEURT ER MET DE RESULTATEN VAN HET ONDERZOEK?

De verzamelde resultaten en data worden gebruikt voor de verbetering van het ontwerp van de lessenserie en zal dan ook opgenomen worden in het verslag van de afstudeeropdracht.

### MET WIE MOET U CONTACT OPNEMEN VOOR MEER INFORMATIE?

Voor meer informatie kunt u contact opnemen met de onderzoeker: Rochelle Spaargaren ([r.spaargaren@student.utwente.nl](mailto:r.spaargaren@student.utwente.nl)).

Als u vragen heeft over uw rechten als onderzoeksdeelnemer, informatie wilt inwinnen of zorgen over dit onderzoek wilt bespreken met iemand anders dan de onderzoeker, kunt u contact opnemen met Angelika Mader ([a.h.mader@utwente.nl](mailto:a.h.mader@utwente.nl)), de hoofd-begeleider van de afstudeeropdracht.

Daarnaast kunt u contact opnemen met de secretaris van de ethische commissie van de Faculteit Electrical Engineering, Mathematics and Computer Science van de Universiteit Twente via [ethicscommittee-cis@utwente.nl](mailto:ethicscommittee-cis@utwente.nl).

### Consent Form Usability test

**Gelieve de juiste vakjes aan te vinken:**

**Ja Nee**

#### Meedoen aan het onderzoek

Ik heb de onderzoek informatie gedateerd [\_\_/\_\_/\_\_\_\_] gelezen en begrepen of het is mij voorgelezen. Ik heb de mogelijkheid gehad vragen te stellen over het onderzoek en deze vragen zijn beantwoord naar mijn voldoening.

Ik stem er vrijwillig in mee om deel te nemen aan dit onderzoek en ik begrijp dat ik kan weigeren vragen te beantwoorden en dat ik me op elk moment kan terugtrekken uit het onderzoek, zonder dat ik hiervoor een reden voor hoeft op te geven.

#### Gebruik van de informatie van het onderzoek

Ik begrijp dat de informatie die ik deel zal worden gebruikt als onderdeel van de afstudeeropdracht. De informatie die ik deel zal in het verslag samengevat en vertrouwelijk gehouden worden.

Ik begrijp dat persoonlijke verzamelde informatie dat mij kan identificeren zoals mijn naam, niet gedeeld zal worden buiten de betrokken onderzoekers en begeleiders van de afstudeeropdracht.

Hierbij geef ik toestemming tot het laten opnemen van een audio-opname.

#### Handtekeningen

\_\_\_\_\_  
Naam deelnemer

\_\_\_\_\_  
Handtekening

\_\_\_\_\_  
Datum

Ik heb informatie brochure nauwkeurig voorgelen aan de potentiële deelnemer en, naar mijn beste vermogen, ervoor gezorgd dat de deelnemer begrijpt waar hij vrijwillig mee instemt.

\_Rochelle Spaargaren\_\_\_\_

Naam onderzoeker

\_\_\_\_\_

Handtekening

\_\_\_\_\_

Datum

**Onderzoek contactgegevens voor meer informatie:**

Voor verdere vragen kunt u per e-mail contact ([r.spaargaren@student.utwente.nl](mailto:r.spaargaren@student.utwente.nl)) contact opnemen met Rochelle Spaargaren.

**Contactgegevens voor vragen over uw rechten als onderzoeker/deelnemer**

Als u vragen heeft over uw rechten als onderzoeker/deelnemer, informatie wilt inwinnen, vragen wilt stellen of zorgen over dit onderzoek wilt bespreken met iemand anders dan de onderzoeker, kunt u contact opnemen met Angelika Mader, de begeleider van de afstudeeropdracht, via de e-mail [a.h.mader@utwente.nl](mailto:a.h.mader@utwente.nl).

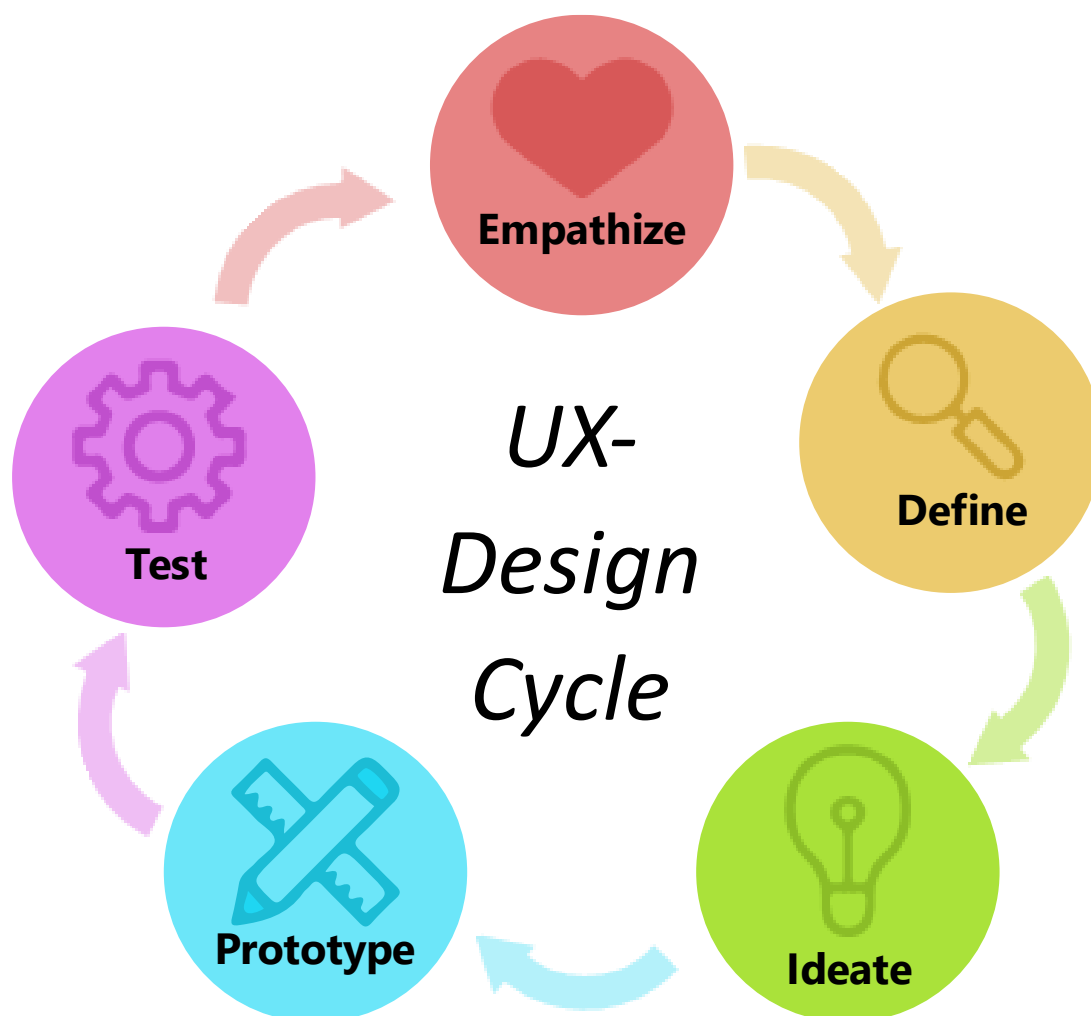
Daarnaast kunt u contact opnemen met de secretaris van de ethische commissie van de Faculteit Electrical Engineering, Mathematics and Computer Science van de Universiteit Twente via [ethicscommittee-cis@utwente.nl](mailto:ethicscommittee-cis@utwente.nl).



## Appendix F: Teacher Guide

### Het bedenken en ontwerpen van een game met de UX-cyclus (Domein P)

#### Docentenhandleiding



#### *Samenvatting*

*In deze docenthandleiding is de benodigde uitleg en materialen te vinden om de lessenserie 'Het bedenken en ontwerpen van een game met de UX-cyclus' als docent uit te kunnen voeren. De lessenserie gebruikt twee methodes: 'hele taak eerst' en 'tinkering'. Bij de hele taak eerst en tinkering staan leerlingen centraal in hun eigen leerproces en heeft de docent een faciliterende rol. De materialen zijn op zo'n manier ontwikkeld dat leerlingen met behulp van de UX-cyclus en game design gerelateerde materialen leren over UX, doormiddel van het maken van een game, bestaande onder andere uit een Unity-template waarin leerlingen een 3D spel kunnen maken zonder zich eerst te moeten verdiepen in het programmeren in Unity.*

## **Inhoud**

1. Beschrijving en doel van lessenserie
  - 1.1. Introductie op lessenserie
  - 1.2. Insteek van de lessenserie
  - 1.3. Onderwerpen van de lessenserie
  - 1.4. Overzicht lessenserie
2. Toelichtingen
  - 2.1. Hele Taak Eerst
  - 2.2. Tinkering
  - 2.3. Rol van de docent
3. Leerdoelen
4. Lessen indeling
  - 4.1. Introductie lessen User Experience
  - 4.2. Introductie Invulkaartje en UX-template
5. Beoordelingsmethode
6. Leerlingmateriaal
  - 6.1. De opdracht
  - 6.2. UX materialen
  - 6.3. Game design materialen
  - 6.4. Documentatie van leerlingen

### Bronnen

Appendix A: UX Materialen

Appendix B: Game design materialen

Appendix C: Invuldocument Leerlingen Documenteren Proces

## 1. Beschrijving en doel van de lessenserie

### 1.1 Introductie op lessenserie

In deze lessenserie worden leerlingen stap voor stap geïntroduceerd met User Experience (UX) en worden ze vertrouwd met het ontwerpproces waarbij ze leren ontwerpen vanuit de gebruikerservaring. In deze lessenserie, wordt dieper ingegaan op de essentiële concepten van UX, zoals gebruikersgericht ontwerp, bruikbaarheid, en de algehele gebruikerservaring. Deze kennis krijgen leerlingen doormiddel van zelfstandige deelname aan het ontwerpproces bij het ontwerpen van een game.

De lessenserie richt zich niet alleen op het overbrengen van de theoretische en praktische kennis, maar ook op het stimuleren van creativiteit en kritisch denken van de leerlingen. Door middel van het gebruiken van de 'hele taak eerst' concept leren ze niet alleen de basisprincipes van UX, maar ontwikkelen ze ook vaardigheden die belangrijk zijn bij het ontwerpen en analyseren van producten. Daarnaast worden leerlingen aangemoedigd om samen te werken, hun ideeën te delen en feedback te geven op elkaars werk, wat bijdraagt aan een interactieve en collaboratieve leeromgeving.

### 1.2 Insteek van de lessenserie

Deze lessenserie behandelt het keuzedomein P: User Experience. Het hoofddoel van deze lessenserie is om leerlingen de principes van ontwerpen vanuit het perspectief van de gebruiker bij te brengen. Dit wordt bereikt door ze een game te laten ontwerpen, specifiek gericht op een bepaalde doelgroep, bijvoorbeeld hun eigen klasgenoten. De benadering is gebaseerd op de 'hele taak eerst' concept, waarbij leerlingen aan het begin gelijk de hele opdracht krijgen waar ze de volledige lessenserie de tijd voor krijgen om uit te voeren. Daarnaast wordt in de lessenserie ook een tinkering aanpak gebruikt, waarbij ze de vrijheid krijgen om zelf te ontdekken hoe ze een game moeten maken met zogenoemde bouwblokken. De gedachte hierachter is dat leerlingen meer tijd kunnen besteden aan het ontwerpproces en ondertussen ook informatie leren over game designelementen zonder dat het te ingewikkeld gebracht wordt of dat ze veel tijd verliezen in het programmeren van de game.

Deze lessenserie is ontworpen voor Havo 5 en Vwo 5 en kan tussen de 5 en 10 weken in beslag nemen, waarbij 5 weken het minimum is. Hoe langer de tijd voor deze lessenserie genomen wordt, des te groter de prototypes van de games van de leerlingen zal worden.

### 1.3 Onderwerpen van de lessenserie

Deze lessenserie behandelt diverse onderwerpen, waaronder wat User Experience (UX) is en waarom het van belang is bij het ontwerpen van digitale producten. Daarnaast worden de volgende specifieke onderwerpen behandeld:

1. **De ontwerpcyclus:** Elke stap van de ontwerpcyclus wordt behandeld, waarbij voor elke stap verschillende methoden en technieken beschikbaar zijn voor leerlingen om toe te passen.
2. **Game designelementen:** Leerlingen zullen inzicht krijgen in de essentiële elementen van game design, waardoor ze in staat zijn gebruiksvriendelijke games te ontwerpen.
3. **Unity:** Leerlingen zullen bij het maken van een prototype van hun game ook in aanraking komen met Unity en leren over de basisprincipes van het werken met dit platform, waardoor ze essentiële vaardigheden verwerven voor het ontwikkelen van digitale games.

### 1.4 Overzicht lessenserie

Zoals eerder vermeld, kan de lessenserie tussen de 5 en 10 weken duren, afhankelijk van de diepgang en de omvang van het eindproduct. Hieronder, in tabel 1, is een kort overzicht gemaakt

voor een lessenserie van 5 weken. Verder op in hoofdstuk 4 zal er dieper per les/week ingegaan worden op wat er behandeld moet worden en welke materialen daarbij worden gebruikt.

Tabel 1: Kort overzicht van de lessenserie over 5 weken

Week	Onderwerp	Beschrijving
1	Introductie	Introductie games/UX, uitleg opdracht + UX-materialen.
2	Iteratie 1	Eerste keer door de ontwerpcyclus – leerlingen maken simpel prototype van hun spel. Uitleg over game designmaterialen wanneer leerlingen bezig gaan met de Ideate-stap.
3	Iteratie 2	Uitleg Unity + downloaden Unity en tweede keer door de ontwerpcyclus en reflectie.
4	Iteratie 3	Derde keer door de ontwerpcyclus en reflectie.
5	Presentaties	Presenteren van het proces en eindproduct.

Dit schema geeft een overzicht van de wekelijkse activiteiten, waarbij elke week een specifiek onderdeel wordt behandeld. Als er meer tijd beschikbaar is, kunnen de iteraties van de ontwerpcyclus uitgebreider worden behandeld, waardoor er meer diepgang en detail aan het eindproduct kan worden gegeven. Een voorbeeld van hoe dit gedaan kan worden is te vinden in de tabel 2, hieronder:

Tabel 2: Kort overzicht van de lessenserie over 10 weken

Week	Onderwerp	Beschrijving
1	Introductie	Introductie games/UX, uitleg opdracht + UX-materialen.
2	Iteratie 1	Eerste keer door de ontwerpcyclus met het maken van een papieren prototypen en testen.
3	Iteratie 2	Uitleg over Unity + tweede keer door de ontwerpcyclus en reflectie; waarbij leerlingen bezig gaan met het maken van hun game in Unity, hierbij kunnen ze puur alleen de template gebruiken samen met andere materialen om hun game te verwerklijken.
4		
5		
6	Iteratie 3	Derde keer door de ontwerpcyclus en reflectie; waarbij leerlingen hun game verder kunnen uitwerken in Unity en functies zelf kunnen proberen toe te voegen met zelfgeschreven scripts of meer aankleding toe te voegen.
7		
8		
9		
10	Presentaties	Presenteren van het proces en eindproduct.

## 2. Toelichtingen

In deze lessenserie wordt gebruik gemaakt van twee andere manieren van lesgeven dan regulier: de 'hele taak eerst' en 'tinkering'. In dit hoofdstuk wordt eerst ingegaan op de twee verschillende methodes om context te geven wat ze precies inhouden. Daarna wordt er uitleg gegeven hoe deze twee methodes de rol van de docent beïnvloed.

### 2.1 Hele Taak Eerst

Een traditionele les begint met uitleg, gevolgd door het toewijzen van deeltaken aan leerlingen, en eindigt met een gehele taak in de vorm van een toets of praktische opdracht. Bij de benadering van de 'hele taak eerst' wordt dit omgedraaid, waarbij aan het begin van de les de volledige taak wordt gegeven. Leerlingen gaan dan zelfstandig aan de slag met de stof en de gehele taak, terwijl de docent op maat begeleiding biedt. Enkele voordelen van de 'hele taak eerst' benadering zijn dat leerlingen inhoudelijk gemotiveerd raken voor de komende leerstof, dat ze concreet weten wat ze aan het einde moeten kennen en kunnen, dat het meer uitdaging biedt aan gevorderde leerlingen vanaf het begin, en dat het goed aansluit bij het concept van tinkering.

Bij de 'hele taak eerst' benadering wordt de introductie van nieuwe lesstof gestart door direct de gehele taak te presenteren. Dit houdt in dat een bestaande opdracht of taak naar voren wordt gehaald en als uitgangspunt wordt genomen voor de les. Hierbij kunnen alle instructies en hulp die normaal tijdens de les worden gegeven, als ondersteuning bij het volbrengen van de gehele taak worden beschouwd. Geef elke leerling vervolgens alleen de hulp die ze nodig hebben, door selectief bepaalde onderdelen weg te laten.

### 2.2 Tinkering

Tinkering is een speelse, experimentele, en iteratieve benadering waarbij deelnemers voortdurend hun doelen heroverwegen, nieuwe paden verkennen en nieuwe mogelijkheden bedenken (Resnick & Rosenbaum, 2013). Om leerlingen te laten tinkeren, is het essentieel dat ze bouwblokken hebben om mee te experimenteren. Een voorbeeld van de bouwblokken is het programma Scratch, waar er blokjes zijn gemaakt voor verschillende programma functies en leerlingen met slepen een werkend programma kunnen maken. Door te werken met deze bouwblokken leren leerlingen over het onderwerp. Tinkering is populair binnen STEM-gerelateerde vakgebieden (Science, Technology, Engineering, and Mathematics), omdat de aanwezigheid van bouwblokken onderwerpen zoals programmeren en elektronica tastbaarder maakt voor leerlingen.

Tinkering sluit goed aan op de 'hele taak eerst' benadering omdat het de leerlingen in staat stelt te experimenteren met de materialen, in dit geval materialen die beschikbaar zijn gesteld voor het maken van een game met behulp van de UX-cyclus. Aangezien de leerlingen direct al weten wat de gehele taak is, kunnen ze hiermee experimenteren en deze verkennen. Bovendien vertoont tinkering vergelijkbare concepten met UX en de UX-cyclus, waarvan het iteratieve concept er een van is. Zowel bij UX als tinkering draait het om het ontwerpen en snel testen van ideeën om te zien of ze werken. Door te experimenteren met verschillende benaderingen en het omgaan met mislukkingen kunnen leerlingen waardevolle inzichten opdoen.

### 2.3 Rol van de docent

Voor deze lessenserie staat de student centraal in het leerproces en heeft de docent een faciliterende rol die studenten begeleidt om zelfstandig te verkennen en te ontdekken. Als docent vervul je deze rol en streef je naar een balans tussen het helpen van leerlingen bij het overwinnen van obstakels, het geven van feedback en het handhaven van een zekere afstand, zodat leerlingen

zelf tot de nodige oplossingen kunnen komen (Ryoo et al., 2015). Het is belangrijk voor de docent om samen te werken met de leerlingen en niet te proberen het werk voor hen te doen, zodat de leerlingen zelf tot de nodige oplossingen kunnen komen (Ryoo et al., 2015).

Als docent heb je drie primaire doelstellingen voor deze lessenserie, zoals uiteengezet door Gutwill en collega's (2015):

1. **Ontsteek de initiële interesse:** Het eerste doel van de docent is om de initiële interesse van leerlingen te wekken, hen te motiveren om aan het leerproces te beginnen en te starten met de taak.
2. **Handhaaf de betrokkenheid van de leerlingen:** Het is cruciaal voor de docent om de actieve deelname van leerlingen gedurende het leerproces te handhaven. Dit betekent dat leerlingen betrokken en geïnteresseerd blijven in het onderwerp of de activiteit.
3. **Verdiep begrip en betrokkenheid:** Een andere belangrijke rol van de docent is om het begrip en de betrokkenheid van leerlingen te verdiepen. Dit houdt in dat de docent leerlingen begeleidt om een dieper begrip van het onderwerp te ontwikkelen en hun toewijding aan het leerproces te bevorderen.

Door deze drie doelstellingen op vaardige wijze in evenwicht te brengen, speel je als docent een sleutelrol in het creëren van een effectieve en boeiende leeromgeving.

### 3. Leerdoelen

De doelstelling van deze lessenserie zijn gebaseerd op de twee eindtermen van domein P: User Experience, zoals hieronder gegeven:

*Analyse: De kandidaat kan de relatie tussen ontwerpkeuzes van een interactief digitaal artefact en de verwachte cognitieve, gedragsmatige en affectieve veranderingen of ervaringen verklaren.*

*Ontwerp: De kandidaat kan voor een digitaal artefact de gebruikersinteractie vormgeven, de ontwerpbeslissingen verantwoorden en voor een eenvoudige toepassing implementeren.*

Het hoofdlerdoel van deze lessenserie is:

*De leerling kan UX-concepten omschrijven, toepassen en verantwoorden bij het ontwerpen van een game in duo's waarbij gebruik wordt gemaakt van een tinkering aanpak.*

Op basis van dit hoofdlerdoel zijn de volgende 10 leerdoelen geformuleerd voor de lessenserie, te vinden in tabel 2. De leerdoelen zijn op te delen in drie onderwerpen: UX gerelateerd, game design gerelateerd en algemene vaardigheden.

De leerdoelen zijn gecategoriseerd gebaseerd op de 6 niveaus van Blooms Taxonomie (Andreev, 2023):

- Onthouden = kunnen ophalen van informatie
- Begrijpen = vaardigheid om adequaat betekenis te geven aan informatie
- Toepassen = kennis in nieuwe situaties toe te passen
- Analyseren = informatie op te delen in onderdelen zodat de structuur kan worden begrepen en bestudeerd
- Evalueren = om de waarde van iets te kunnen beoordelen in relatie tot een bepaald doel
- Creëer = om met behulp van het geleerde nieuwe ideeën, oplossingen, producten te ontwikkelen.

Tabel 3: Overzicht van de leerdoelen van de lessenserie

	<i>Leerdoel</i>	<i>Niveau</i>
1	De leerling kan benoemen wat het doel van UX (User Experience) is.	Onthouden en Begrijpen
2	De leerling heeft de hele UX-cycle minimaal drie keer doorlopen.	Toepassen
3	De leerling heeft ervaring opgedaan met het ontwerpen van een game waarbij er gewisseld is tussen het perspectief van de ontwerper en de beoogde eindgebruiker.	Toepassen
4	De leerling kan uitleggen waarom het actief betrekken van de eindgebruikers tijdens het ontwerp van een game noodzakelijk is voor het bereiken van een goede UX.	Begrijpen
5	De leerling kan de verschillende stappen van de UX-cycle benoemen en aangeven wat de rol is van elke stap.	Begrijpen
6	De leerling kan twee methoden (of technieken) benoemen en toepassen voor elke stap van de UX-cycle.	Begrijpen en toepassen
7	De leerling kan gebaseerd op de evaluatiestap reflecteren op welke onderdelen er veranderd moeten worden.	Analyseren en Evalueren
8	De leerling kan diverse elementen van game design benoemen en toepassen	Begrijpen en toepassen

9	De leerling kan beschrijven en aantonen hoe de essentiële elementen van game design functioneren.	Begrijpen
10	De leerling kan goed samenwerken met een klasgenoot door middel van goede communicatie onderling, het eerlijk verdelen van de taken en het zorgen dat ze hun werk goed doen.	Toepassen



## 4. Lessen indeling

In dit hoofdstuk wordt een indeling van wat er per les behandeld wordt beschreven. Hierbij is uitgegaan van dat de leerlingen gemiddeld 3 lessen per week hebben. Voor de specifieke indeling van de lessen is er veel vrijheid voor eigen interpretatie en invulling als docent.

### 4.1 Introductie lessen User Experience

Het is belangrijk om tijdens de eerste lessen een concrete uitleg te geven van wat leerlingen moeten doen, wat de verwachtingen zijn en een uitleg van de materialen en stappen die ze moeten ondernemen.

Tijdens de eerste lessen worden er veel dingen behandeld, van de opdracht, de lesmethode, de verschillende materialen, de documentatie, etc. Om leerlingen een zo'n helder mogelijke uitleg te geven zodat ze daarna zelf snel aan de slag kunnen is in de tabel 3, hieronder, een uitwerking van de les te vinden.

Tabel 4: Overzicht indeling eerste lessen

Onderwijsfuncties	Docenten acties	Leerlingen acties
<i>Peilen beginsituatie/ activeren voorkennis</i>	Opent met de vraag gerelateerd aan “wat is een leuke game om te spelen?” na een aantal antwoorden, door met “waarom vinden we dit leuke games?”  <i>Doormiddel van het vragen wat leerlingen leuke games vinden en waarom beginnen leerlingen al na te denken over hun eigen gebruikerservaring met games.</i>	Leerlingen geven antwoord op de vraag en ondertussen schrijft docent dit op, op een whiteboard.
<i>Presenteren kennis en werkwijze</i>	Vervolgens uitleg geven over wat de bedoeling van de aankomende lessen is. Hierbij beginnen met uitleg van de opdracht – deze ook met de leerlingen doornemen, laat hierbij ook gelijk de materialen zien (alleen de UX-materialen) + invul document die ze moeten invullen.	
<i>Aan de slag</i>	Docent loopt ondertussen rond, zorgt dat iedereen in groepjes zit en waar nodig geeft extra uitleg waar nodig als leerlingen niet goed weten hoe ze verder moeten.	Leerlingen vormen groepjes van twee en gaan aan de slag met de opdracht.  Laat leerlingen starten met de eerste twee stappen (Empathize en Define)
<i>Presenteren kennis en werkwijze</i>	Wanneer leerlingen de eerste twee stappen bijna helemaal hebben afgerond, introduceer de game-design element kaarten. Op deze manier krijgen leerlingen niet in één keer te veel informatie.	
<i>Aan de slag</i>	Laat leerlingen vervolgens aan het werk gaan met het brainstormen en bedenken van ideeën.	Leerlingen zijn bezig met Ideate & Prototype en test.

## 4.2 Introductie Invulkaartje en UX-template

Aangezien leerlingen drie verschillende prototypes van hun game gaan maken, kan het zijn dat je als docent ervoor kiest om de Unity-template en invulkaarten pas bij de tweede iteratie ronde uit te leggen. Op deze manier kunnen leerlingen eerst alleen bezig zijn met de UX-cyclus en methode kaarten. Zo kunnen ze hun spel vormgeven en eventueel al verbeteren op basis van een test voordat ze bezig gaan met het spel maken in Unity.

Voordat Unity wordt geïntroduceerd is het verstandig om leerlingen eerst de invulkaartjes te geven, zodat ze de verschillende objecten van hun game vast kunnen uitschrijven en structuur geven aan hoe ze het spel zullen maken in Unity. Geef leerlingen dan ook even de tijd om deze in te vullen voordat je begint aan de uitleg van Unity.

Voor het uitleggen van de Unity template is een filmpje beschikbaar waar alle stappen behandeld worden, waaronder het installeren van Unity, het downloaden en open van de template, en de werking van de template.

## 5. Beoordelingsmethode

Voor de beoordeling van de opdracht is het essentieel om te controleren of de leerlingen voldoen aan de bovengenoemde tien leerdoelen. Om dit te beoordelen is een rubriek opgesteld met in totaal zeven onderwerpen, zoals weergegeven in Tabel 5. De rubriek bestaat uit zes niveaus, variërend van uitstekend tot onvoldoende. Naast elk van deze niveaus wordt ook een cijferindicatie vermeld.

Tabel 5: Beoordelingsrubriek van de opdracht

	Uitstekend (>9)	Goed (8)	Ruim Voldoende (7)	Voldoende (6)	Matig (5.5)	Onvoldoende (<5)
<b>Presentatie</b> <sup>6</sup>	De leerlingen geven een presentatie waarbij stemgebruik en non-verbale vaardigheden uitstekend gebruikt worden om duidelijk en uitgebreid de inhoud van de presentatie over te brengen.	De leerlingen geven een presentatie waarbij stemgebruik en een groot deel van non-verbale vaardigheden wordt gebruikt om duidelijk en uitgebreid de inhoud van de presentatie over te brengen.	De leerlingen geven een presentatie waarbij de inhoud duidelijk verteld wordt waarbij een aantal stemgebruik en non-verbale vaardigheden worden toegepast.	De leerlingen geven een presentatie waarbij de inhoud redelijk duidelijk verteld wordt waarbij een aantal stemgebruik en non-verbale vaardigheden worden toegepast.	De leerlingen geven een presentatie waarbij de inhoud niet helemaal duidelijk verteld wordt waarbij stemgebruik en non-verbale vaardigheden bijna niet wordt toegepast.	De leerlingen geven een presentatie waarbij de inhoud onduidelijk of onvoldoende verteld wordt en leerlingen stemgebruik en non-verbale vaardigheden slecht tot niet toepassen.
<b>Documentatie</b>	De leerlingen hebben uitgebreid hun voortgang en keuzes opgeschreven waarbij ze elke keuze duidelijk toelichten met meerdere argumenten op basis van onderzoek/testen/etc. waar bij er een kritisch geanalyseerd is.	De leerlingen hebben uitgebreid hun voortgang en keuzes opgeschreven waarbij ze elke keuze duidelijk toelichten met argumenten op basis van onderzoek/testen/etc.	De leerlingen hebben hun voortgang en keuzes opgeschreven waarbij ze bij sommige keuzes duidelijke argumenten op hebben geschreven.	De leerlingen hebben hun voortgang en gemaakte keuzes kort opgeschreven.	De leerlingen hebben kort hun voortgang opgeschreven en maar slechte argumenten en onderbouwing.	De leerlingen hebben hun voortgang niet of nauwelijks bijgehouden en niet of nauwelijks een onderbouwing.
<b>Product</b>	Het product sluit perfect aan op de leerlingen hun geformuleerde probleemstelling en de game is uitgebreid en vormt een geheel.	Het product sluit goed aan op de leerlingen hun geformuleerde probleemstelling en is speelbaar waarbij de game veel verschillende elementen.	Het product sluit aan op de leerlingen hun geformuleerde probleemstelling en de game is speelbaar met meerder game-elementen.	Het product sluit aan op de leerlingen hun geformuleerde probleemstelling en is speelbaar al wel erg minimalistisch.	Het product sluit deels aan op de leerlingen hun geformuleerde probleemstelling en is slecht speelbaar.	Het product sluit slecht aan op de de leerlingen hun geformuleerde probleemstelling en is niet of slecht speelbaar.
<b>Game-elementen</b>	De leerlingen tonen begrip, interesse, en uitgebreide kennis over de elementen zowel gegeven als andere elementen. Kunnen beargumenteren waarom de een belangrijker is dan de ander en wat	De leerlingen tonen begrip te hebben op de game-elementen die ze hebben gebruikt en de essentiële types, kunnen deze uitgebreid uitleggen, en kunnen	De leerlingen tonen begrip te hebben op de game-elementen die ze hebben gebruikt en de essentiële	De leerlingen tonen een begrip te hebben op de game-elementen die ze hebben gebruikt en	De leerlingen tonen een begrip te hebben van de elementen maar kunnen de elementen onvoldoende uitleggen.	De leerlingen tonen weinig tot geen begrip op de elementen en kunnen het ook niet uitleggen.

<sup>6</sup> Stemgebruik: luid genoeg, toon variatie, articuleert goed, vloeiend en enthousiast te presenteren

Non-verbaal: Oogcontact houden, natuurlijke wijze van gebaren, ontspannen houding, en een goede uitstraling

Inhoud: duidelijke en heldere structuur, interactie, duidelijke beheersing van onderwerp, goed gebruik van visuele hulpmiddelen, is volledig in wat hij verteld.

	de invloed van de elementen op de gebruiker is.	beargumenteren waarom de ene belangrijker is dan de ander.	types en kunnen deze uitgebreid uitleggen.	essentiële types en kunnen deze in het kort uitleggen.		
<b>UX</b>	De leerlingen zijn meer dan drie keer door de ontwerpcyclus gegaan waarbij ze kritisch gereflecteerd hebben en gebruikt hebben gemaakt van meer dan drie verschillende methodes.	De leerlingen zijn drie keer uitgebreid door de ontwerpcyclus gegaan waarbij ze kritisch gereflecteerd hebben en gebruik gemaakt van meer dan twee verschillende methodes.	De leerlingen zijn drie keer door de ontwerpcyclus gegaan waarbij ze bij elke stap hebben stilgestaan en een meer dan twee methodes per stap hebben gebruikt.	De leerlingen zijn kort drie keer door de ontwerpcyclus heen gegaan en hebben bij elke stap steeds dezelfde twee methodes gebruikt.	De leerlingen hebben bij het doorgaan van de cyclus niet elke keer bij elke stap in de ontwerpcyclus stilgestaan en hebben maar één methode per stap gebruikt.	De leerlingen zijn niet drie keer door de cyclus gegaan en hebben de methodes niet of verkeerd gebruikt.
<b>Reflectie</b>	De leerlingen hebben kritisch gereflecteerd tijdens het proces en hebben op basis daarvan aanpassingen gemaakt.	De leerlingen hebben gereflecteerd tijdens het proces en konden aanpassingen benoemen.	De leerlingen hebben af en toe tijdens het proces gereflecteerd maar hebben er niet duidelijk iets mee gedaan.	De leerlingen hebben in totaal een keer duidelijk gereflecteerd maar er vervolgens niks mee gedaan.	De leerlingen hebben niet duidelijk gereflecteerd.	De leerlingen hebben niet gereflecteerd.
<b>Samenwerking</b>	De leerlingen communiceerde onderling erg goed, konden elkaar goed aanvullen en toonde initiatief en eigenaarschap in hun taken.	De leerlingen communiceerde onderling erg goed, konden elkaar goed aanvullen en helpen waar nodig, verdeelde taken eerlijk en namen initiatief in het starten met taken.	De leerlingen communiceerde onderling erg goed, konden elkaar goed aanvullen en helpen waar nodig was en verdeelde taken eerlijk en voltooide hun werk op tijd en goed.	De leerlingen hadden een goede communicatie onderling, verdeelde de taken eerlijk en zorgde beide dat ze hun werk op tijd en goed voltooide.	De leerlingen luisterde naar elkaar maar er was sprake van een miscommunicatie of de taken waren oneerlijk verdeeld.	De leerlingen luisterde slecht naar elkaar of hadden een miscommunicatie of de taken waren oneerlijk verdeeld.

Voor het berekenen van het eindcijfer worden alle deeltijfers vermenigvuldigd met de wegingsfactoren van elk onderwerp, aangezien sommige onderwerpen zwaarder wegen dan anderen. Om het eindcijfer te bepalen, moet tabel 6 ingevuld worden.

Tabel 6: Cijferbepaling

Onderwerp	Weefactor	Deeltijfer
Presentatie	1x	
Documentatie	1x	
Product	2x	
Game-elementen	2x	
UX	4x	
Reflectie	1x	
Samenwerking	1x	
Eindcijfer (Totaal/120 x 10)		

## 6. Leerling Materiaal

Het beschikbare materiaal voor deze lessenserie bestaat uit verschillende materialen te verdelen over de twee onderwerpen van de lessen serie: UX en Game design. Voor beide zijn zowel kaarten beschikbaar als andere materialen. Daarnaast is er ook een template document beschikbaar voor leerlingen zodat ze hun voortgang makkelijk kunnen bijhouden in de vorm van een document.

### 6.1 De opdracht

Hieronder wordt de opdracht beschrijving gegeven zoals deze ook aan de leerlinge gegeven kan worden.

#### *Het maken en ontwerpen van een game met een UX-perspectief*

Je gaat in tweetallen een game bedenken en ontwerpen vanuit een UX-perspectief (gebruikersperspectief), waarbij je de ontwerpcyclus (Design Thinking Proces) minimaal drie keer gaat doorlopen, je zal dus ook drie versies van je game maken. Het doel van deze opdracht is dat je leert wat User Experience is, hoe de ontwerpcyclus werkt en waarom het betrekken van de gebruiker belangrijk is bij het maken van een game.

De ontwerpcyclus bestaat uit vijf stappen en in het bijbehorende materiaal kun je de uitleg vinden van de verschillende stappen en wat je zal moeten doen bij de stappen. Begin bij het begin, namelijk de Empathize-stap en werk zo door van stap naar stap. Bij elke stap ga je 'één of meerdere methodes moeten gebruiken, deze zijn ook te vinden bij het bijbehorende materiaal.

Tijdens het doorlopen van de cyclus zal je bij elke stap moeten bijhouden welke methode en keuzes jullie gemaakt hebben. In een bijgeleverd formulier, genaamd document\_naam.docx kunnen jullie per stap de gebruikte methode benoemen, de door jullie gemaakte keuzes uitleggen en het werk laten zien door middel van tekst en/of een foto.

#### *Beoordeling*

Aan het einde van deze opdracht gaan jullie in de tweetallen een presentatie geven aan de klas. In deze presentatie gaan jullie het hele proces door van de probleemstelling, tot de verschillende versies van de game, waarvan je de laatste versie zal laten zien. De laatste versie van het product hoeft geen volledige game in Unity zijn, maar het moet wel een speelbare game zijn en duidelijk laten zien wat het idee achter de game is.

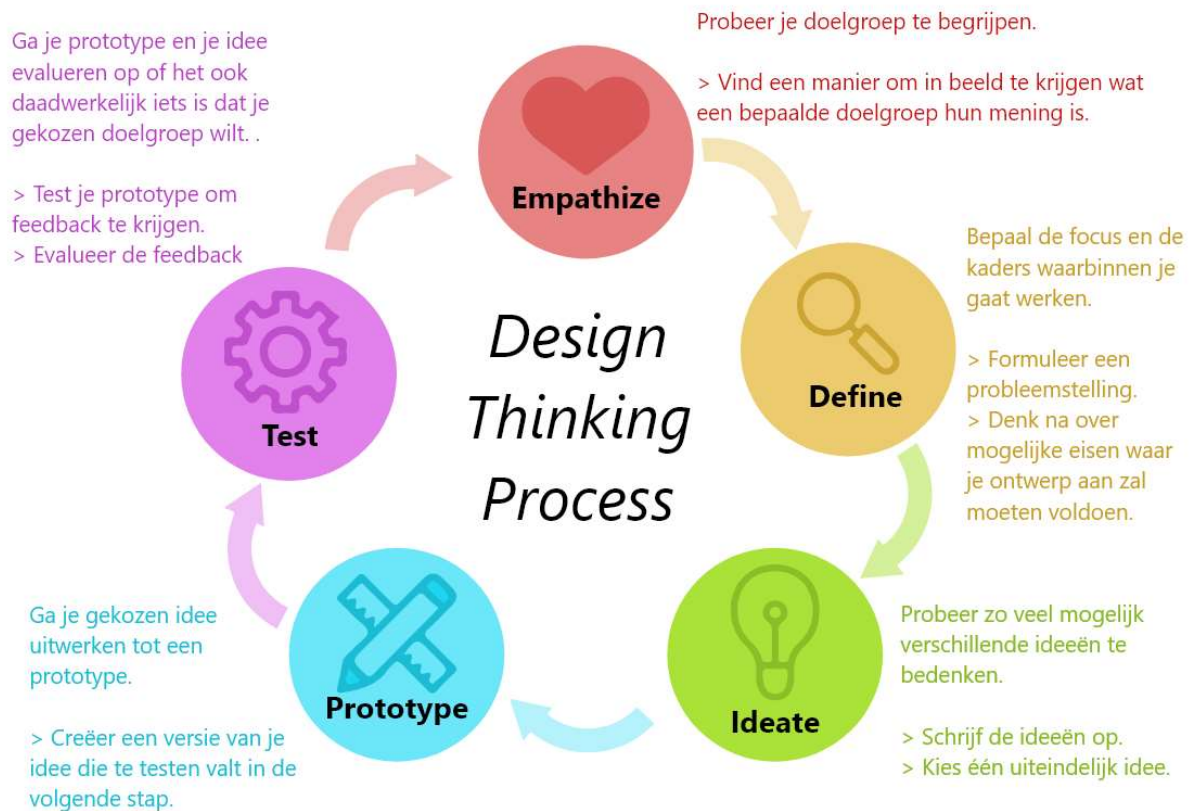
Naast de presentatie zullen jullie ook het document waarin jullie je proces hebben bijgehouden moeten inleveren, en op basis van deze twee onderdelen zullen jullie een cijfer krijgen.

#### *Tips en Hulp:*

- Probeer een duidelijk geformuleerde probleemstelling te hebben zodat je op basis daarvan het een ontwerpdoel kan formuleren.
- Zowel de probleemstelling als het ontwerpdoel kan mogelijk veranderen tijdens het ontwerpproces.
- Jullie gaan tijdens elke cyclus van het ontwerpproces ook een vorm van jullie game maken en testen, deze vorm van jullie game mag uit verschillende vormen bestaan (papier, Unity, etc.)
- Voor het testen zullen je medeklasgenoten gevraagd worden. Het is daarbij dan belangrijk om kritisch te zijn op elkaars werk maar wel op een nette manier feedback te geven (tips & tops).

## 6.2 UX Materialen

De materialen bestaan onder andere uit één A4 met een overzicht van de designcyclus zodat de leerlingen in één opslag alle de stappen van UX-cyclus kunnen zien en wat elke stap inhoud (figuur 1). Deze valt in het groot te vinden in appendix A. Per stap staat er een korte beschrijving van wat het doel van de stap is en daaronder een opdracht hoe leerlingen dit moeten doen.



Figuur 1: Overview UX cyclus (ook wel Design Thinking Process genoemd).

Voor elke stap van de cyclus zijn er ook verschillende methode kaartjes beschikbaar. Leerlingen kunnen per stap (minimaal) één of meerdere methode kaartjes uit kiezen om te gebruiken voor het beantwoorden van de bijbehorende opdracht.

Hieronder staat een kort overzicht van de verschillende kaartjes (figuur 2), waarvan per stap gemiddeld vier methodes beschikbaar zijn. Deze kaartjes kunnen ook in appendix A gevonden worden.

Per groepje leerlingen kunnen deze kaarten uitgedeeld worden zodat leerlingen zelf de vrijheid krijgen om te kiezen welke methode ze het meest aanspreekt. Het is belangrijk hierbij dat leerlingen hun gekozen methode + uitwerkingen van deze methode toevoegen in hun documentatie. Ook zodat ze deze tijdens de eindpresentatie kunnen benoemen, uitleggen en hun resultaten kunnen laten zien.



Figuur 2: Overzicht van verschillende UX-methode kaartjes verdeelt over de vijf stappen

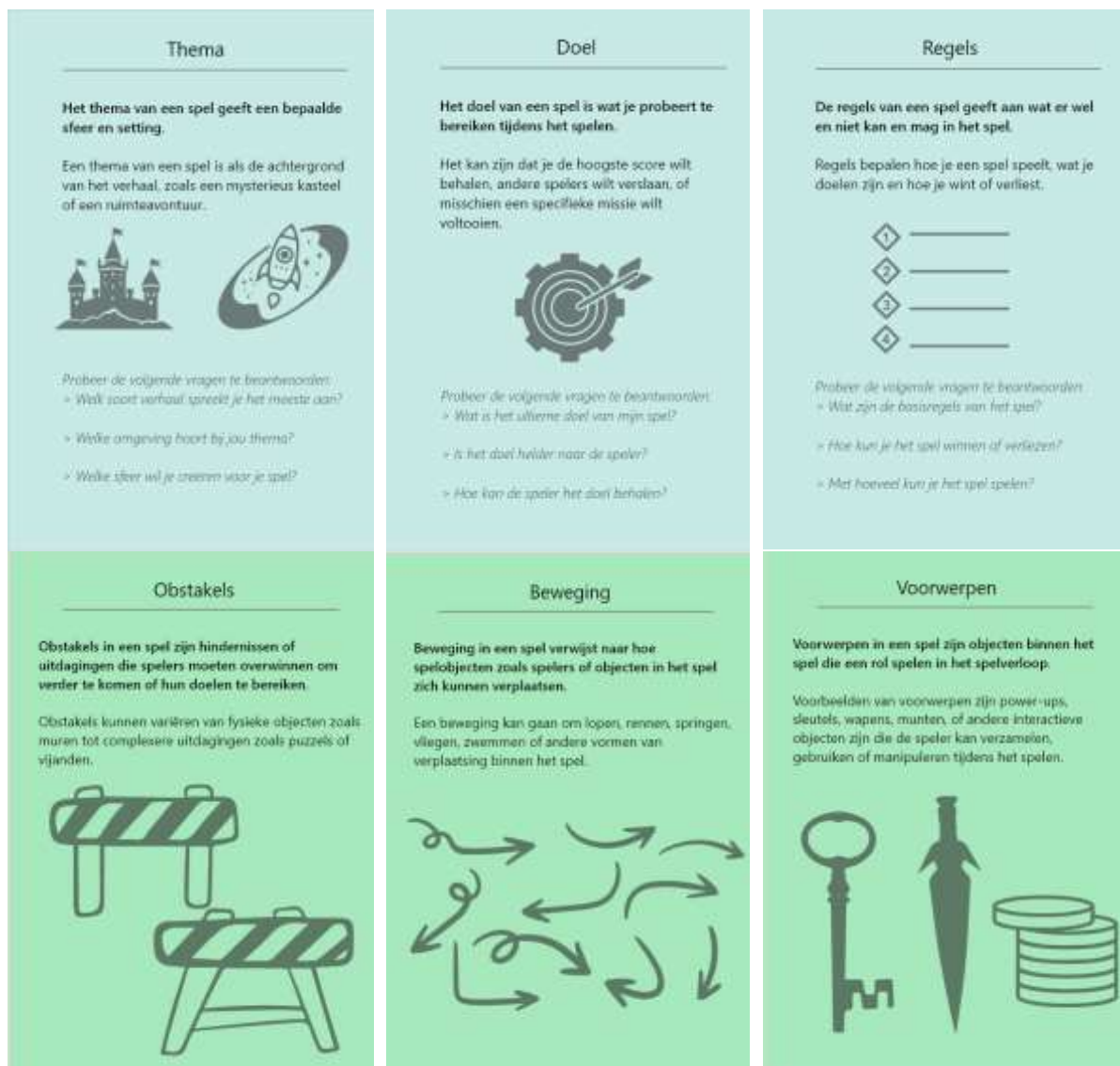
### 6.3 Game Designmaterialen

Naast de bovenstaande UX-materialen zijn er ook een aantal materialen gemaakt om leerlingen te helpen met het bedenken en maken van hun games.

#### Game Design Uitleg kaarten

Als eerste onderdeel, zijn er twee type kaarten gemaakt die helpen leerlingen na te denken over verschillende spel elementen (blauw) en spel mechanismes (groen). De spel element kaarten (8) zijn voorzien van een titel, beschrijving, icoon en een aantal hulp vragen om leerlingen te helpen in het bedenken en formuleren van hun game. De spel mechanisme kaarten (6) zijn voorzien van een titel, beschrijving en icoon. Bij de mechanisme kaarten zijn geen vragen benoemd, omdat deze gaan over mechanismes die vaak in een spel zitten, zoals een speler, een voorwerp en een obstakel. Hieronder

in figuur 3 staan een aantal voorbeelden van de kaarten en in appendix B zijn alle kaarten terug te vinden.



Figuur 3: Enkele voorbeelden van de spel element kaarten (blauw) en spel mechanismes kaarten (groen)

### Invulkaart

Als tweede onderdeel, is er een invulkaart beschikbaar om leerlingen te helpen bij het aanbrengen van structuur in hun game voordat ze bezig gaan met Unity. Deze invulkaart hoeft dan ook pas gedeeld te worden met de leerlingen als ze bezig zijn met het uitwerken van hun gekozen idee. Daarbij kan de keuze zijn om eerst leerlingen een schets of een andere vorm van prototype te maken, voordat ze bezig gaan met na denken over de verschillende game objecten en hun functies. En het kan dus zijn dat deze kaarten pas bij de tweede iteratie ronde van de cyclus wordt toegepast.

De invulkaart (figuur 4) bestaat uit enkele onderdelen, die leerlingen zal helpen om structuur te krijgen in hun spel en hun alvast te laten nadenken over aspecten van Unity. Het idee erachter is dat elke invulkaart zo een ander object van het bedachte spel is. Per object geven leerlingen het een naam, benoemen ze wat het doel van het object is, de kleur van het object, en het aantal van het object. Daarnaast zijn er acht functies die leerlingen kunnen aanvinken of hun object dat heeft: actief,



interactief, etc. Naast het figuur staat een korte omschrijving over wat elk begrip inhoud. Leg deze ook uit aan de leerlingen om misverstanden te voorkomen. Als laatste wordt er per object een omschrijving en een schets gemaakt van het object. Leerlingen kunnen zoveel van deze kaartjes invullen, maar het is voornamelijk belangrijk dat ze de essentie van de objecten maken.

Naam: _____	<u>Actief</u> als het object iets doet
Doel: <input type="text"/>	<u>Interactief</u> als er een interactie tussen dit object en een ander object is
Kleur: <input type="text"/> Aantal: <input type="text"/>	<u>Beweegbaar</u> als het object beweegt of bewogen kan worden door een ander object
Actief <input type="checkbox"/> Interactief <input type="checkbox"/>	<u>Stilstaand</u> als het object een vaste plek heeft en niet verplaatst kan worden
Beweegbaar <input type="checkbox"/> Stilstaand <input type="checkbox"/>	<u>Botsbaar</u> als je tegen het object aan kan botsen
Botsbaar <input type="checkbox"/> Verwoestbaar <input type="checkbox"/>	<u>Verwoestbaar</u> als het object te verwoesten valt
Verzamelbaar <input type="checkbox"/> Schadelijk <input type="checkbox"/>	<u>Verzamelbaar</u> als het object te verzamelen valt
Omschrijving	Schets
<input type="text"/>	<input type="text"/>
	<u>Schadelijk</u> als het object schade kan krijgen of kan aanbrengen

Figuur 4: Invulkaartje voor een object in het spel

### Unity Template

Als derde onderdeel, is er een template in Unity voor leerlingen beschikbaar om in te werken om hun prototype van hun game te maken. Het is belangrijk om duidelijk te maken bij de leerlingen dat de functionaliteit en de essentie van de game belangrijker zijn dan de aankleding van de game. En hun eerste focus dan ook moet zijn op het proberen te maken van hun game dat het zodanig duidelijk is wat het moet kunnen doen.

De template is beschikbaar als een meegeleverd Unity-pakket. Leerlingen moeten dit pakket importeren nadat ze zelf Unity hebben gedownload, voor de Unity-versie 2021.3.3f1. Deze stap wordt uitgelegd in een instructievideo, waarin ook wordt behandeld hoe Unity werkt en welke functies de template heeft. Deze video is te vinden via de volgende link: <https://youtu.be/eXSYZwPvxWQ>. Hieronder volgt ook een korte beschrijving van de Unity-template.

In de Unity template staan onder andere een aantal prefabs<sup>7</sup>, die leerlingen zo in de scene van hun game kunnen slepen. Op deze prefabs staan ook al een aantal functionaliteiten, doormiddel van rigidbody's, colliders en diverse scripts. De prefabs bestaan uit essentiële onderdelen zoals een speler met beweging, een camera die de speler kan volgen, een verzamelbaar object, etc. In de tabel 7, hieronder, is een overzicht gegeven van alle prefabs in de template samen met de verschillende functies.

<sup>7</sup> Een "prefab" in Unity is een vooraf gemaakt object of een verzameling van objecten die je kunt hergebruiken in je game.

Tabel 7: Overzicht van prefabs met bijbehorende functies

Prefab naam	Functies
Player	Lopen, Rennen, springen, schieten, eerste of derde persoon spel.
Enemy	Het heen en weer lopen van A naar B, volgen van een speler, schieten, schade aanbrengen
Collectable	Kan geluid krijgen als hij gepakt wordt of tekst dat het aantal verzamelbare objecten bijhoudt.
Teleport	Als speler op dit element komt wordt hij getransporteerd naar het desbetreffende andere object. (Bestaat uit twee objecten punt van teleport en target position)
Push_object	Een object dat verplaatst kan worden als de speler ertegenaan duwt.
Tekst	Sleep dit object in de scene, als tekst bij de collectables is gewenst
Simpele objecten	Onder mapje simpele objecten staan een aantal standaard objecten die gebruikt kunnen worden voor het maken van je spel omgeving.
Bullet, Enemy_bullet, Gun	Zijn drie objecten die onder andere objecten al geroepen worden verwijder deze dan ook niet.

Voor veel van deze functies van de prefabs kunnen leerlingen ze in de Inspector aan of uit zetten doormiddel van een aantal checkboxes. Een voorbeeld hiervan is de player, te zien in figuur 5, waar zoals gezegd leerlingen kunnen aanzetten of hun speler kan lopen, rennen, schieten of springen.



Figuur 5: Inspector van Prefab Player

Naast de verschillende player opties genaamd: Walk, Run, Jump en Shoot.

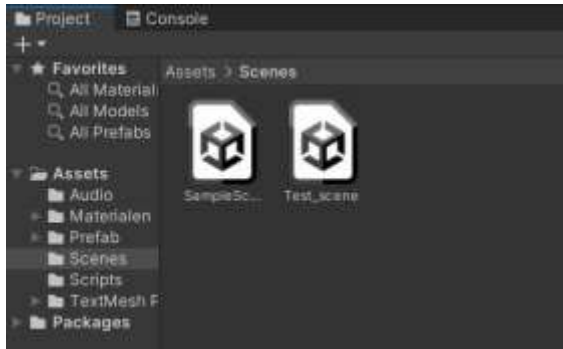
Is er ook een checkbox genaamd tekst, als leerlingen de tekst van de collectable willen gebruiken dan moeten ze deze hier ook invullen.

Daarnaast zijn er twee invulboxen lives en speed. Waarbij de leerlingen kunnen aangeven hoeveel levens hun speler heeft en wat de snelheid van de speler is.

Ook kunnen ze aangeven wat de camera-point is: first person of third person.

Als laatst staan er drie objecten Camera\_1, Camera\_3 en Gun, waar achter objecten staan, deze zijn momenteel gevuld. Mocht het zo zijn dat deze leeg is, dan kun je door dubbel te klikken op het vak een object toe voegen, hierbij is het belangrijk dat het object overeenkomt met de naam die ervoor staat.

Naast een de prefabs is er ook een Test\_scene gemaakt, te vinden onder de map Scenes (figuur 6).



Figuur 6: Screenshot van de inhoud van het mapje Scenes

In de Test\_scene zijn alle prefabs verwerkt en kan als voorbeeld dienen, zodat leerlingen kunnen zien wat de mogelijkheden zijn. Ook kunnen ze onderdelen en prefabs daar eventueel in testen.

Het is niet de bedoeling dat leerlingen bezig gaan met de scripten aanpassen, voornamelijk als de lessenserie maar 5 weken duurt, dit heeft te maken met het feit dat programmeren veel tijd kan innemen, en ook niet het doel is van deze lessen serie. Laat leerlingen dan ook voornamelijk creatief hun game proberen te maken met de prefabs die er zijn, en waar nodig laat ze met papieren kaartjes en andere dingen het spel verder tot realisatie maken.

#### 6.4 Documentatie van leerlingen

Voor het bijhouden van leerlingen hun proces is er een invul document gemaakt voor ze (figuur 6). Het document is zelf in Appendix C te vinden. In dit document zullen de leerlingen al hun informatie moeten invullen, over het design process van hun game. Per stap staat er een invul blok waarbij leerlingen hun resultaten kort in moeten zetten, voor stap 1 is dat onder andere de doelgroep. Dit wordt herhaald voor alle vijf de stappen en als laatste worden leerlingen gevraagd om een evaluatie vraag in te vullen voordat ze doorgaan naar de volgende iteratie ronde van de designcyclus. Ook is er een test formulier beschikbaar voor leerlingen om te gebruiken bij stap 5, die ze hun deelnemers kunnen laten invullen. Voor elke iteratie ronde van de designcyclus vullen leerlingen het document steeds opnieuw in, afhankelijk van de hoeveelheid keren dat ze door de cyclus heen gaan wordt het document ingevuld.

**Stap 1: Empathize**

Doelgroep:

Samenstelling van de belevingen:

**Stap 2: Define**

Probleemstelling:

Ontwerpsamen:

**Stap 3: Ideate**

Foto van alle ideeën:

Geboortides + argumentatie waarom:

**Stap 4: Prototype**

Foto van prototype + korte omschrijving:

**Stap 5: Test**

Samenstelling van belevingen:

Wat ga je aanpassen en waarom:

Evaluatie:

Wat waren de drie meest leerzame fouten die je gemaakt hebt tijdens de afgelopen ronde:

**Test Formulier**

Te gebruiken als feedback over je ontworpen prototype te vragen.

Vul de volgende tabel in om snel en kort en feedback te verkrijgen:

	1	2	3	4	5
How gamelike was het om het spel te begrijpen? (1= Daar moet je, 5 = Daar moet je niet)					
How duidelijk waren de spelregelingen van het spel? (1=Daar moet je niet, 5 = zeer duidelijk)					
How intuïtief waren de bedieningsmechanismen en acties in het spel? (1= zeer eenvoudig, 5= zeer moeilijk)					
How bereid was je met de algemene gebruiksaanwijzing van het spel? (1= zeer onbereid, 5 = zeer bereid)					
How waarschijnlijk is het dat je dit spel opnieuw zou spelen of aan anderen zou laten spelen? (1= zeer onwaarschijnlijk, 5= zeer waarschijnlijk)					

Voor specifieke vragen, stel volgende vragen:

- 1) Als je iets zou kunnen veranderen aan het spel om het beter te maken, wat zou dat dan zijn en waarom?
- 2) Wat waren volgens jou de sterkste punten van de gebruikerservaring van het spel? En waarom?
- 3) Wat is er veranderd aspecten? Waarom waren deze veranderd?
- 4) Zou je dit spel aanraden aan anderen of zelf nog een keer willen spelen? Waarom wel of niet?

Figuur 7: Invuldocument voor leerlingen om hun proces bij te houden.

Een belangrijke aantekening is, om ook aan te geven bij de leerlingen dat ze aangeven welke methodes ze hebben gebruikt bij elke stap en ook die resultaten in het document zetten, dit kan simpel als doormiddel van een foto of screenshot.

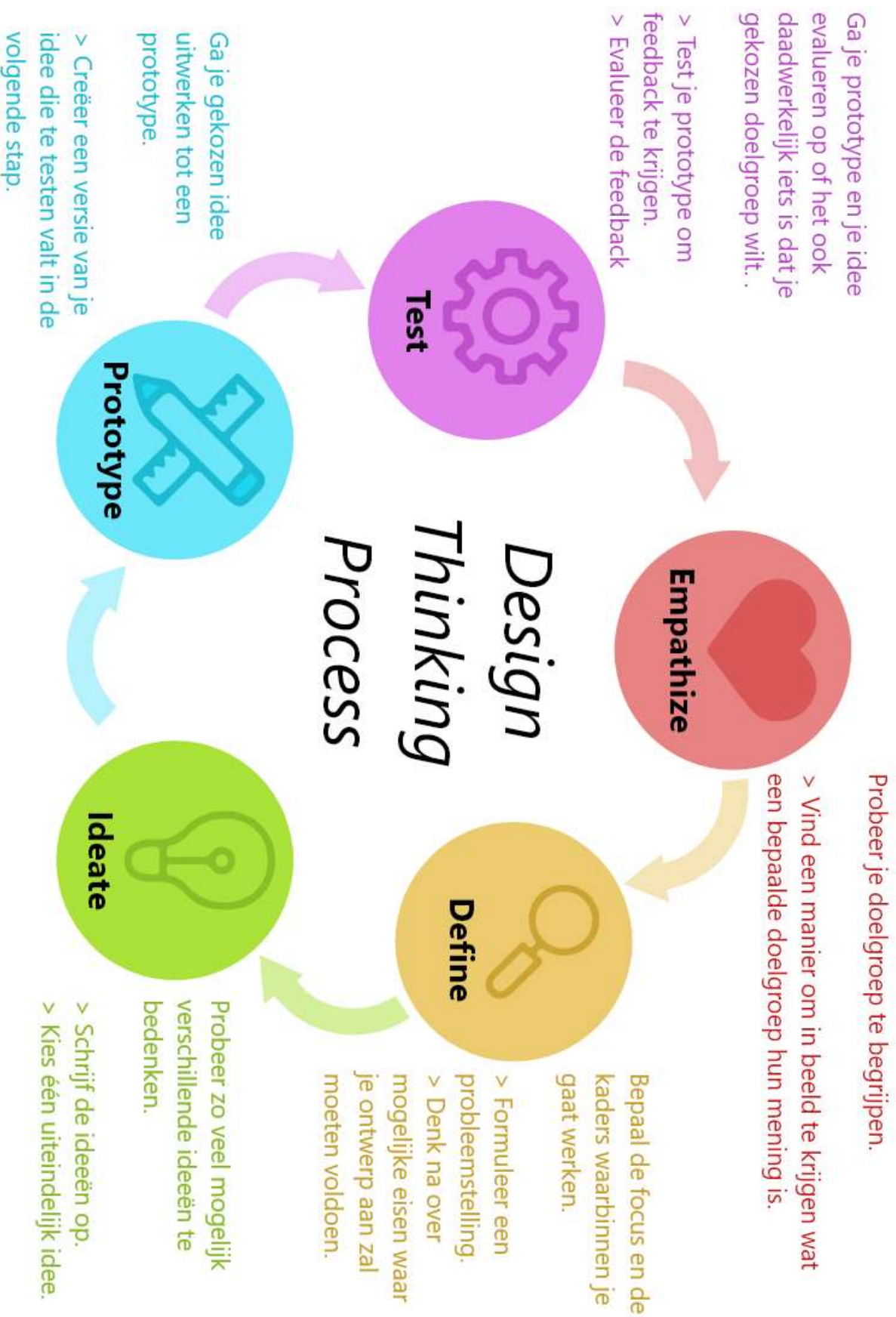
## **Bronnen**

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<https://www.valamis.com/hub/blooms-taxonomy> (Visited on 09/10/2023).


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## Ga in gesprek



Soms ook wel 'Interviewen' genoemd.

- > Bereid een aantal vragen voor die je zou willen stellen, maar het gesprek mag daarvan afwijken.
- > Vraag altijd 'waarom?' om diepere betekenis te ontdekken.


## Observeer



> Bekijk de gebruikers en hun gedrag in de context van het probleemgebied.

Probeer te kijken of je een verschil ziet tussen wat iemand zegt en wat iemand doet.


## Demonstreer



> Vraag iemand om je te laten zien hoe ze een taak aanpakken.


> Laat ze de stappen doorlopen en daarbij vertellen waarom ze doen wat ze doen.

## Ervaar zelf



> Ga in de schoenen staan van je gebruiker en ervaar zelf wat hij of zij meemaakt.


## Share Inspiring Stories



Om je eigen gegevens te begrijpen, kun je de meest inspirerende verhalen delen met anderen.

> Denk aan een gebruikerservaring die je is bijgebleven of verhalen die je aannames tegenspreken.


## Persona's



Persona's zijn fictieve personages die je op basis van je onderzoek creëert om de verschillende gebruikerstypen te vertegenwoordigen.

> Beschrijf de behoeften, het gedrag en de doelen van je gebruikers.

## User Stories



> Probeer de essentie uit je verhaal te halen door het systematisch te beschrijven.

> Als .... [wie] wil hij/zij .... [wat], zodat .... [waarom].


## Empathy-map



Dit is een methode waarmee je je observaties uit je onderzoeksfase kunt vastleggen en inzichten kunt krijgen over de behoeften van je gebruikers.

> Het bestaat uit vier onderdelen, die verwijzen naar wat de gebruiker: Zegt, Doet, Denkt, Voelt.

## Brainwriting



> Deelnemer twee schrijft alle ideeën en opmerkingen op.

> Het vel met opmerkingen wordt doorgegeven aan een tweede deelnemer, die het mag aanvullen of van opbouwend commentaar voorzien.

> Dit proces kan een aantal keer herhaalt worden.

## Negatief Brainstormen



Hierbij wordt het brainstormen omgedraaid. In plaats van het bedenken van ideeën die het probleem oplossen.

> Bedenk zoveel mogelijk ideeën die het probleem juist niet oplossen.

> Evalueer deze ideeën en pas ze aan zodat ze wel het probleem oplossen.


## Willekeurige Associatie



> Kies een willekeurig voorwerp of een woord.

> Bedenk dan wat kan ik met dit voorwerp/woord om nieuwe ideeën te bedenken?

## Mindmappen



Een diagram opgebouwd uit begrippen, teksten, relaties en of plaatjes, die zijn geordend in de vorm van een boomstructuur rond een centraal thema.

## Paper-prototype



> Teken op een vel papier de verschillende "schermen" van je product.

Dit is een handige manier om te laten zien hoe je idee eruitziet en hoe het werkt.

## Storyboard



> Teken op een leeg papier een aantal lege vlakken.

> Teken in de vlakken het verhaal over hoe je gebruiker met jouw product in aanraking komt. Werk de hele gebruikerservaring uit of selecteer de meest belangrijke momenten.

## Eenvoudige Mockup



Een Mockup is een eenvoudige goedkope fysieke weergave van je idee. Om te onderzoeken hoe het idee eruitziet en hoe het zou werken.

> Alles kun je gebruiken als bouw materiaal. Denk aan tape, lijm, papier, hout, koffiebekers.

## Klikbaar Prototype



> Maak een lijst met de functies die je in je product wilt stoppen.

> Kies de 3 tot 5 meest essentiële onderdelen.

Denk na hoe je dit wilt meten en in welke vorm je je jouw prototype wilt bouwen.

## Realistisch Model



Het maakt niet uit als je prototype nog niet perfect is.

> Het gaat erom dat je een indruk van het idee kan geven, en deze kan testen en feedback op kunt halen.

## Usability-test



Usability tests richten zich op het testen van de gebruiksvriendelijkheid van een (digitaal) product.

> Geef gerichte taken en observeer het gemak.

> Stel gerichte vragen over de omgang met het product.

## User-test



User-tests richten zich op het testen van de toegevoegde waarde van een concept of idee.

> Geef gerichte taken en observeer de interactie.

> Stel gerichte vragen over het product ten opzichte van de waarde ervan.



## Appendix B: Game Design Materialen

### Thema

---

Het thema van een spel geeft een bepaalde sfeer en setting.

Een thema van een spel is als de achtergrond van het verhaal, zoals een mysterieus kasteel of een ruimteavontuur.



- Probeer de volgende vragen te beantwoorden:
- > Welk soort verhaal spreekt je het meeste aan?
  - > Welke omgeving hoort bij jou thema?
  - > Welke sfeer wil je creëren voor je spel?

### Doel

---

Het doel van een spel is wat je probeert te bereiken tijdens het spelen.

Het kan zijn dat je de hoogste score wilt behalen, andere spelers wilt verslaan, of misschien een specifieke missie wilt voltooien.



- Probeer de volgende vragen te beantwoorden:
- > Wat is het ultieme doel van mijn spel?
  - > Is het doel helder naar de speler?
  - > Hoe kan de speler het doel behalen?

### Regels

---

De regels van een spel geeft aan wat er wel en niet kan en mag in het spel.

Regels bepalen hoe je een spel speelt, wat je doelen zijn en hoe je wint of verliest.



- Probeer de volgende vragen te beantwoorden:
- > Wat zijn de basisregels van het spel?
  - > Hoe kun je het spel winnen of verliezen?
  - > Met hoeveel kun je het spel spelen?

### Input

---

De input van een spel zijn interacties die een speler heeft met het spel.

Er zijn verschillende soorten manieren waarop een speler interactie kan hebben met een spel; waaronder toetsen indrukken of muis beweging.



- Probeer de volgende vragen te beantwoorden:
- > Welke soorten input zijn er in het spel?
  - > Hoe beïnvloed de input de acties in het spel?

## Uitdaging

De uitdaging van een spel verwijst naar de moeilijkheden die spelers moeten overwinnen om hun doelen te bereiken.

Deze uitdagingen kunnen variëren van het verslaan van vijanden tot het oplossen van puzzels en het behalen van hogere scores.



Probeer de volgende vragen te beantwoorden:

> Wat zijn de obstakels die je moet overwinnen in het spel?

> Op welke manier nemen de uitdagingen toe naarmate je verder komt in het spel?

## Beloning

De beloning in een spel is wat je krijgt als je een uitdaging hebt overwonnen of een doel hebt bereikt.

Een beloning kan bijvoorbeeld punten, voorwerpen of toegang to een nieuw niveau zijn.



Probeer de volgende vragen te beantwoorden:

> Wat zijn beloningen die je kunt verdienen in het spel?

> Hoe motiveert de beloning om verder te spelen?

## Levens

Levens in een spel zijn de kansen die je hebt om fouten te maken voordat je verliest.

Bij elk verlies van een leven kom je dichterbij het einde van het spel.



Probeer de volgende vragen te beantwoorden:

> Heeft het hebben van levens een toegevoegde waarde?

> Wat gebeurt er als alle levens verliest?

## Tijd

Tijd in een spel is de hoeveelheid tijd die je hebt om taken uit te voeren voordat het spel eindigt.

Tijd kan als een beperking werken die je dwingt om snel te handelen en beslissingen te maken. Tijd kan ook werken als een bijhoudende factor zijn.



Probeer de volgende vragen te beantwoorden:

> Hoe voelt het om te spelen tegen de klok?

> Wat is de toegevoegde waarde van tijd bijhouden?

> Waarvoor dient de tijd?

## Obstakels

---

Obstakels in een spel zijn hindernissen of uitdagingen die spelers moeten overwinnen om verder te komen of hun doelen te bereiken.

Obstakels kunnen variëren van fysieke objecten zoals muren tot complexere uitdagingen zoals puzzels of vijanden.



## Beweging

---

Beweging in een spel verwijst naar hoe spelobjecten zoals spelers of objecten in het spel zich kunnen verplaatsen.

Een beweging kan gaan om lopen, rennen, springen, vliegen, zwemmen of andere vormen van verplaatsing binnen het spel.



## Voorwerpen

---

Voorwerpen in een spel zijn objecten binnen het spel die een rol spelen in het spelverloop.

Voorbeelden van voorwerpen zijn power-ups, sleutels, wapens, munten, of andere interactieve objecten zijn die de speler kan verzamelen, gebruiken of manipuleren tijdens het spelen.



## Menu

---

Een menu in een spel is een interface die de speler toegang geeft tot verschillende opties en functies.

Het menu biedt de speler de mogelijkheid om bepaalde acties uit te voeren; zoals het starten van het spel, aanpassen van instellingen, bekijken van scores, etc.



## Speler

De speler in een spel is degene die het spel speelt en controle heeft over het personage of object dat zich in de spelwereld bevindt.

De speler neemt beslissingen en voert acties uit om doelen te bereiken en uitdagingen te overwinnen binnen het spel.



## Aankleding

De aankleding in een spel verwijst naar alle visuele elementen die de sfeer en uitstraling van het spel bepalen, zoals achtergronden, materialen en objecten.

De aankleding draagt bij aan de algehele beleving en atmosfeer van het spel, waardoor het spel levendiger en interessanter wordt.



Naam: \_\_\_\_\_

Doel:

Kleur:  Aantal:

Actief	<input type="checkbox"/>	Interactief	<input type="checkbox"/>
Beweegbaar	<input type="checkbox"/>	Stilstaand	<input type="checkbox"/>
Botsbaar	<input type="checkbox"/>	Verwoestbaar	<input type="checkbox"/>
Verzamelbaar	<input type="checkbox"/>	Schadelijk	<input type="checkbox"/>

Omschrijving

Schets

Naam: \_\_\_\_\_

Doel:

Kleur:  Aantal:

Actief	<input type="checkbox"/>	Interactief	<input type="checkbox"/>
Beweegbaar	<input type="checkbox"/>	Stilstaand	<input type="checkbox"/>
Botsbaar	<input type="checkbox"/>	Verwoestbaar	<input type="checkbox"/>
Verzamelbaar	<input type="checkbox"/>	Schadelijk	<input type="checkbox"/>

Omschrijving

Schets

## Appendix G: Field Study Information Brochure and Consent

### Informatie Brochure ~ Field Study Vwo 5

Graag nodig ik jou uit om deel te nemen aan een onderdeel van mijn onderzoek voor mijn afstudeeropdracht voor mijn master Interaction Technology aan de universiteit van Twente. Voordat je een beslissing neemt, is het belangrijk dat je begrijpt waarom het onderzoek wordt gedaan en wat het inhoudt. Neem de tijd om de volgende informatie aandachtig door te lezen. Als er onduidelijkheden zijn of je meer informatie wenst kun je vragen stellen.

#### **WIE BEN IK EN WAAR GAAT DIT ONDERZOEK OVER**

Mijn naam is Rochelle Spaargaren en ik ben bezig met het afronden van mijn master Interaction Technology. Dit onderzoek zal onderdeel uitmaken van mijn afstudeeropdracht waarvoor ik een lessenserie aan het ontwerpen ben over het onderwerp User Experience (UX) voor Vwo en Havo 5 leerlingen. De resultaten van dit onderzoek zullen gebruikt worden om het ontwerp van de lessenserie te verbeteren en zullen ook gebruikt worden in het verslag.

#### **WAT HOUDT DEELNEMEN IN?**

Het onderzoek bestaat uit totaal zes lessen, waarin ik jullie als klas vraag om verschillende opdrachten uit te voeren. Terwijl jullie deze taken uitvoeren, loop ik rond en zal ik af en toe vragen stellen. Daarnaast zullen we enkele opdrachten gezamenlijk uitvoeren, en aan het einde zullen we een groepsdiscussie houden om te evalueren wat jullie van de materialen vonden.

#### **MOET U DEELNEMEN?**

Je bent niet verplicht om deel te nemen aan het onderzoek zelf. Dat betekent dat je kunt besluiten om het toestemmingsformulier niet te ondertekenen, waardoor jouw informatie niet wordt gebruikt voor mijn onderzoek. Echter, je zult nog steeds deelnemen aan de lessen en opdrachten, omdat de onderwerpen die behandeld worden ook voor jou van belang zijn.

#### **WAT ZIJN MOGELIJKE GEVAREN EN VOORDELEN AAN DEELNEMEN?**

Er zijn geen lichamelijke of psychische risico's verbonden aan uw deelname. Een voordeel aan het deelnemen van het onderzoek, is dat u een erg dankbare student zal hebben. Bovendien zullen de behandelde onderwerpen nuttig zijn voor de eindopdracht van Vwo 6 en bij het kiezen van een keuzedomein.

#### **IS DEELNAME VERTROUWELIJK?**

De verzamelde gegevens blijven vertrouwelijk en worden niet gedeeld buiten de onderzoeker en begeleiders betrokken bij de afstudeeropdracht. Aan het einde van het onderzoek zullen alle verzamelde en gepersonaliseerde gegevens vernietigd worden om de vertrouwelijkheid te waarborgen. In het verslag zullen de gegevens samengevat en anoniem benoemd worden.

#### **HOE WORDT DE INFORMATIE DIE U VERSTREKT GEREGRISTEERD, OPGESLAGEN EN BESCHERMD?**

De informatie die verzameld wordt bestaat uit onder andere ingevulde materialen, een feedbackformulier en geschreven aantekeningen tijdens de groesevaluatie. Deze informatie zal alleen toegankelijk zijn voor de onderzoeker zelf. De verzamelde gegevens zullen anoniem en samengevat worden gebruikt voor het eindverslag van de afstudeeropdracht.

Als deelnemer heb je het recht om te verzoeken om inzage, rectificatie of verwijdering van persoonsgegevens. De gegevens worden veilig opgeslagen op een eigen schijf en zullen zodra deze niet meer nodig zijn voor de afronding van het onderzoek verwijderd worden.

#### **WAT GEBEURT ER MET DE RESULTATEN VAN HET ONDERZOEK?**

De verzamelde resultaten en data worden gebruikt voor de verbetering van het ontwerp van de lessenserie en zal dan ook opgenomen worden in het verslag van de afstudeeropdracht.

#### **MET WIE MOET U CONTACT OPNEMEN VOOR MEER INFORMATIE?**

Voor meer informatie kun je contact opnemen met de onderzoeker: Rochelle Spaargaren ([r.spaargaren@student.utwente.nl](mailto:r.spaargaren@student.utwente.nl)).

Als je vragen hebt over jouw rechten als onderzoeksdeelnemer, informatie wilt inwinnen of zorgen over dit onderzoek wilt bespreken met iemand anders dan de onderzoeker, kunt u contact opnemen met Angelika Mader ([a.h.mader@utwente.nl](mailto:a.h.mader@utwente.nl)), de hoofd-begeleider van de afstudeeropdracht.

Daarnaast kunt u contact opnemen met de secretaris van de ethische commissie van de Faculteit Electrical Engineering, Mathematics and Computer Science van de Universiteit Twente via [ethicscommittee-cis@utwente.nl](mailto:ethicscommittee-cis@utwente.nl).

### **Consent Form ~ Field Study Vwo 5**

**Gelieve de juiste vakjes aan te vinken:**

**Ja Nee**

#### **Meedoen aan het onderzoek**

Ik heb de onderzoek informatie gedateerd [\_\_/\_\_/\_\_\_\_] gelezen en begrepen of het is mij voorgelezen. Ik heb de mogelijkheid gehad vragen te stellen over het onderzoek en deze vragen zijn beantwoord naar mijn voldoening.

Ik stem er vrijwillig in mee om deel te nemen aan dit onderzoek en ik begrijp dat ik kan weigeren vragen te beantwoorden en dat ik me op elk moment kan terugtrekken uit het onderzoek, zonder dat ik hiervoor een reden voor hoeft op te geven.

#### **Gebruik van de informatie van het onderzoek**

Ik begrijp dat de informatie die ik deel zal worden gebruikt als onderdeel van de afstudeeropdracht. De informatie die ik deel zal in het verslag samengevat en vertrouwelijk gehouden worden.

Ik begrijp dat persoonlijke verzamelde informatie dat mij kan identificeren zoals mijn naam, niet gedeeld zal worden buiten de betrokken onderzoekers en begeleiders van de afstudeeropdracht.

#### **Handtekeningen**

\_\_\_\_\_  
Naam deelnemer

\_\_\_\_\_  
Handtekening

\_\_\_\_\_  
Datum

Ik heb informatie brochure nauwkeurig voorgelen aan de potentiële deelnemer en, naar mijn beste vermogen, ervoor gezorgd dat de deelnemer begrijpt waar hij vrijwillig mee instemt.

\_Rochelle Spaargaren\_\_\_\_

Naam onderzoeker

\_\_\_\_\_

Handtekening

\_\_\_\_\_

Datum

**Onderzoek contactgegevens voor meer informatie:**

Voor verdere vragen kunt u per e-mail contact ([r.spaargaren@student.utwente.nl](mailto:r.spaargaren@student.utwente.nl)) contact opnemen met Rochelle Spaargaren.

**Contactgegevens voor vragen over uw rechten als onderzoeker' deelnemer**

Als u vragen heeft over uw rechten als onderzoeker, informatie wilt inwinnen, vragen wilt stellen of zorgen over dit onderzoek wilt bespreken met iemand anders dan de onderzoeker, kunt u contact opnemen met Angelika Mader, de begeleider van de afstudeeropdracht, via de e-mail [a.h.mader@utwente.nl](mailto:a.h.mader@utwente.nl).

Daarnaast kunt u contact opnemen met de secretaris van de ethische commissie van de Faculteit Electrical Engineering, Mathematics and Computer Science van de Universiteit Twente via [ethicscommittee-cis@utwente.nl](mailto:ethicscommittee-cis@utwente.nl).

## Appendix H: Evaluation Session Information Brochure and Consent Information Brochure ~ A lesson series with a tinkering approach

During the sixth lecture of the course Mastering Tinkering, I will give a guest lecture. During this lecture, I will ask you as students to evaluate my “Tinkering toolbox” designed for high school students to help them tinker with making games while learning about UX-design. There are both paper materials and Unity-related materials available. Before deciding to take part in this study, please read the following information carefully. If there are any questions, please feel free to ask them.

### **WHO AM I AND WHAT IS THIS STUDY ABOUT?**

My name is Rochelle Spaargaren, and I am currently working on my graduation project for my master Interaction Technology. This study is a part of my graduation project, in which I am designing a lesson series for the Computer Science course in high schools about User Experience (UX) that uses a tinkering approach. The results of this study will be used to further improve the design of the materials and will be used in the final report.

### **WHAT DOES PARTICIPATING ENTAIL?**

The study will consist of an evaluation session that will happen during the fifth Mastering Tinkering lecture, on the 2<sup>nd</sup> of April. During this lecture, after a brief introduction to all the materials, as group you will be asked to tinker with the materials and evaluate on this based on what you have learned in the past lectures.

### **WHY ARE YOU ASKED TO PARTICIPATE?**

You are asked to participate in this study due to your enrolment in the course Mastering Tinkering.

### **DO YOU HAVE TO PARTICIPATE?**

Participating in the study is completely voluntary. You may refuse to answer any questions, and you have the right to withdrawn from the study at any time without providing a reason. However, active participation during class is required as it is a component of the Mastering Tinkering course.

### **WHAT ARE POSSIBLE DANGERS AND BENEFITS OF PARTICIPATING?**

By participating in this study, you as a student in the course Mastering Tinkering, gain a better understanding of the possibilities of tinkering. By evaluating this material, you gain deeper insight into the different aspects of designing for tinkering. So, you learn more about tinkering, help a fellow Interaction Technology student, and it costs you no extra time outside of the classroom. There are no physical or psychological risks associated with participating in this study.

### **IS PARTICIPATING CONFIDENTIAL?**

The gathered data will remain confidential and will not be shared outside the researcher and supervisors involved in this graduation project. At the end of the study, all gathered information and personalised data will be destroyed to ensure confidentiality. In the report of the graduation project, the data will be summarised and kept anonymous.

### **HOW IS THE INFORMATION YOU PROVIDE REGISTERED, STORED AND PROTECTED?**

The information will be gathered through the following ways: written feedback made by myself during the groups discussion on the materials, observations made during the session, and a feedback



form that is filled out as groups on the materials. The gathered information will only be accessible to the researcher and will be used for the improvement of the materials. Moreover, the information will be used in the report of the graduation project. As a participant, you have the right to request access, rectification, or deletion of personal data. The data is securely stored on a dedicated drive and will be deleted once no longer needed for the completion of the graduation project.

**WHAT HAPPENS WITH THE RESULTS OF THE STUDY?**

The collected results and data will be used to improve the design of the lesson series and will therefore be included in the report of the graduation project.

**WHO TO CONTACT FOR MORE INFORMATION:**

For any further questions you can contact Rochelle Spaargaren through the email: [r.spaargaren@student.utwente.nl](mailto:r.spaargaren@student.utwente.nl)

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 Angelika Mader, the supervisor of the graduation project, through the email [a.h.mader@utwente.nl](mailto:a.h.mader@utwente.nl).

Additionally, you can contact the Secretary of the Ethics Committee of the Faculty of Electrical Engineering, Mathematics and Computer Science at the University of Twente through [ethicscommittee-cis@utwente.nl](mailto:ethicscommittee-cis@utwente.nl)

**Consent Form ~ Tinkering with Unity and games**

*Please tick the appropriate boxes*

**Yes No**

**Taking part in the study**

I have read and understood the study information dated [\_\_/\_\_/\_\_\_\_], 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 the gathering of the feedback that I give during the session. This feedback is both in the form of a quick group discussion as well as an evaluation form with suggestion per group.

**Use of the information in the study**

I understand that information I provide will be used for the improvements of the tinkering materials for the master graduation project. The information in the report will be summarised and kept confidential.

I understand that personal information collected about me that can identify me, such as [e.g. my name or where I live], will not be shared beyond the researchers and employees involved in the master thesis.

**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.

\_Rochelle Spaargaren\_\_\_\_

Researcher name

\_\_\_\_\_

Signature

\_\_\_\_\_

Date

**Study contact details for further information:**

For any further questions you can contact Rochelle Spaargaren through the email:

[r.spaargaren@student.utwente.nl](mailto:r.spaargaren@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 Angelika Mader, the supervisor of the graduation project, through the email [a.h.mader@utwente.nl](mailto:a.h.mader@utwente.nl).

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## Appendix I: Survey Information Brochure and Consent

### **Informatie Brochure Informatica Docent**

Graag nodig ik u uit om deel te nemen aan een onderdeel van mijn onderzoek voor mijn afstudeeropdracht voor mijn master Interaction Technology aan de universiteit van Twente. Voordat u een beslissing neemt, is het belangrijk dat u begrijpt waarom het onderzoek wordt gedaan en wat het inhoudt. Neem u tijd om de volgende informatie aandachtig door te lezen. Als er onduidelijkheden zijn of u meer informatie wenst kunt u vragen stellen.

#### **WIE BEN IK EN WAAR GAAT DIT ONDERZOEK OVER**

Mijn naam is Rochelle Spaargaren en ik ben bezig met het afronden van mijn master Interaction Technology. Dit onderzoek zal onderdeel uitmaken van mijn afstudeeropdracht waarvoor ik een lessenserie aan het ontwerpen ben over het onderwerp User Experience (UX) voor Vwo en Havo 5 leerlingen. De resultaten van dit onderzoek zullen gebruikt worden om het ontwerp van de lessenserie te verbeteren en zullen ook gebruikt worden in het verslag.

#### **WAT HOUDT DEELNEMEN IN?**

Het onderzoek bestaat uit een online survey waarbij er gerichte vragen gesteld zullen worden over uw mening op de docentenhandleiding. Het invullen van de survey zal ongeveer tussen een half uur en driekwartier duren.

#### **WAAROM BENT U GEVRAAGD OM DEEL TE NEMEN?**

U bent uitgekozen om deel te nemen aan het onderzoek vanwege uw expertise op het gebied van Informatica en lesgeven.

#### **MOET U DEELNEMEN?**

Deelnemen aan het onderzoek is compleet vrijwillig en u heeft het recht om deelname te weigeren, een/elke vraag te weigeren en u kunt zich op elk moment terugtrekken zonder enige consequentie.

#### **WAT ZIJN MOGELIJKE GEVAREN EN VOORDELEN AAN DEELNEMEN?**

Een voordeel aan het deelnemen van het onderzoek, is dat u een erg dankbare student zal hebben. Er zijn geen lichamelijke of psychische risico's verbonden aan uw deelname.

#### **IS DEELNAME VERTROUWELIJK?**

De verzamelde gegevens blijven vertrouwelijk en worden niet gedeeld buiten de onderzoeker en begeleiders betrokken bij de afstudeeropdracht. Aan het einde van het onderzoek zullen alle verzamelde en gepersonaliseerde gegevens vernietigd worden om de vertrouwelijkheid te waarborgen. In het verslag zullen de gegevens samengevat en anoniem benoemd worden.

#### **HOE WORDT DE INFORMATIE DIE U VERSTREKT GEREGRISTEERD, OPGESLAGEN EN BESCHERMD?**

De informatie zal verzameld worden door middel van geschreven feedback. Deze zullen alleen toegankelijk zijn voor de onderzoeker zelf. De verzamelde gegevens zullen worden gebruikt voor het eindverslag van de afstudeeropdracht.

Als deelnemer heeft u het recht om te verzoeken om inzage, rectificatie of verwijdering van persoonsgegevens. De gegevens worden veilig opgeslagen op een eigen schijf en zullen zodra deze niet meer nodig zijn voor de afronding van het onderzoek verwijderd worden.

## WAT GEBEURT ER MET DE RESULTATEN VAN HET ONDERZOEK?

De verzamelde resultaten en data worden gebruikt voor de verbetering van het ontwerp van de lessenserie en zal dan ook opgenomen worden in het verslag van de afstudeeropdracht.

## MET WIE MOET U CONTACT OPNEMEN VOOR MEER INFORMATIE?

Voor meer informatie kunt u contact opnemen met de onderzoeker: Rochelle Spaargaren ([r.spaargaren@student.utwente.nl](mailto:r.spaargaren@student.utwente.nl)).

Als u vragen heeft over uw rechten als onderzoeksdeelnemer, informatie wilt inwinnen of zorgen over dit onderzoek wilt bespreken met iemand anders dan de onderzoeker, kunt u contact opnemen met Angelika Mader ([a.h.mader@utwente.nl](mailto:a.h.mader@utwente.nl)), de hoofd-begeleider van de afstudeeropdracht.

Daarnaast kunt u contact opnemen met de secretaris van de ethische commissie van de Faculteit Electrical Engineering, Mathematics and Computer Science van de Universiteit Twente via [ethicscommittee-cis@utwente.nl](mailto:ethicscommittee-cis@utwente.nl).

## Consent Form Enquête Informatica Docenten

**Gelieve de juiste vakjes aan te vinken:**

**Ja Nee**

### Meedoen aan het onderzoek

Ik heb de onderzoek informatie gedateerd [\_\_/\_\_/\_\_\_\_] gelezen en begrepen of het is mij voorgelezen. Ik heb de mogelijkheid gehad vragen te stellen over het onderzoek en deze vragen zijn beantwoord naar mijn voldoening.

Ik stem er vrijwillig in mee om deel te nemen aan dit onderzoek en ik begrijp dat ik kan weigeren vragen te beantwoorden en dat ik me op elk moment kan terugtrekken uit het onderzoek, zonder dat ik hiervoor een reden voor hoeft op te geven.

### Gebruik van de informatie van het onderzoek

Ik begrijp dat de informatie die ik deel zal worden gebruikt als onderdeel van de afstudeeropdracht. De informatie die ik deel zal in het verslag samengevat en vertrouwelijk gehouden worden.

Ik begrijp dat persoonlijke verzamelde informatie dat mij kan identificeren zoals mijn naam, niet gedeeld zal worden buiten de betrokken onderzoekers en begeleiders van de afstudeeropdracht.

### Handtekeningen

\_\_\_\_\_  
Naam deelnemer

\_\_\_\_\_  
Handtekening

\_\_\_\_\_  
Datum

Ik heb informatie brochure nauwkeurig voorgelezen aan de potentiële deelnemer en, naar mijn beste vermogen, ervoor gezorgd dat de deelnemer begrijpt waar hij vrijwillig mee instemt.

\_\_Rochelle Spaargaren\_\_

Naam onderzoeker

\_\_\_\_\_  
Handtekening

\_\_\_\_\_  
Datum

**Onderzoek contactgegevens voor meer informatie:**

Voor verdere vragen kunt u per e-mail contact ([r.spaargaren@student.utwente.nl](mailto:r.spaargaren@student.utwente.nl)) contact opnemen met Rochelle Spaargaren.

**Contactgegevens voor vragen over uw rechten als onderzoek' deelnemer**

Als u vragen heeft over uw rechten als onderzoek deelnemer, informatie wilt inwinnen, vragen wilt stellen of zorgen over dit onderzoek wilt bespreken met iemand anders dan de onderzoeker, kunt u contact opnemen met Angelika Mader, de begeleider van de afstudeeropdracht, via de e-mail [a.h.mader@utwente.nl](mailto:a.h.mader@utwente.nl).

Daarnaast kunt u contact opnemen met de secretaris van de ethische commissie van de Faculteit Electrical Engineering, Mathematics and Computer Science van de Universiteit Twente via [ethicscommittee-cis@utwente.nl](mailto:ethicscommittee-cis@utwente.nl).

## Appendix C: Invuldocument Leerlingen Documenteren Proces

### Stap 1: Empathize

Doelgroep:

*Samenvatting van de bevindingen.*

### Stap 2: Define

Probleemstelling:

Ontwerpeisen:

### Stap 3: Ideate

*Foto van alle ideeën:*

Gekozen idee + argumentatie waarom:

### Stap 4: Prototype

*Foto van prototype + korte omschrijving.*

### Stap 5: Test

*Samenvatting van bevindingen:*

Wat ga je aanpassen en waarom:

### Evaluatie

Wat waren de drie meest leerzame fouten die je gemaakt hebt tijdens de afgelopen ronde:

## Test Formulier

*Te gebruiken om feedback over je ontworpen prototype te krijgen.*

*Vul de volgende tabel in om snel en kort en feedback te verkrijgen:*

	1	2	3	4	5
Hoe gemakkelijk was het om het spel te begrijpen? (1= Zeer moeilijk, 5 = Zeer makkelijk)					
Hoe duidelijk waren de doelstellingen van het spel? (1=Zeer onduidelijk, 5 = zeer duidelijk)					
Hoe intuïtief waren de bedieningselementen en acties in het spel? (1=zeer verwarrend, 5=zeer intuïtief)					
Hoe tevreden was je met de algehele gebruikerservaring van het spel? (1=zeer ontevreden, 5 = zeer tevreden)					
Hoe waarschijnlijk is het dat je dit spel opnieuw zou spelen of aan anderen zou aanbevelen? (1= zeer onwaarschijnlijk, 5= zeer waarschijnlijk)					

*Voor specifiekere uitleg, stel volgende open vragen:*

- 5) Als je iets zou kunnen veranderen aan het spel om het beter te maken, wat zou dat dan zijn en waarom?

- 6) Wat waren volgens jou de sterkste punten van de gebruikerservaring van het spel? En waarom?

- 7) Waren er verwarrende aspecten? Waarom waren deze verwarrend?

- 8) Zou je dit spel aanraden aan anderen of zelf nog een keer willen spelen? Waarom wel of niet?

## Appendix J: Unity Scripts

### Bullet Script:

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
// Source used to help create this code: https://www.youtube.com/watch?v=EwiUomzehKU
public class Bullet : MonoBehaviour
    // This script gives bullets a length of life, what to do on certain collisions and
    // by having a boolean it is used for both the enemy as well as player bullets.
{
    public float life = 3;
    public bool player_bullet = true;
    // Create two variables, one float and one boolean
    void Awake() //After object is called, it will be destroyed when life runs out (in
    this case 3).
    {
        Destroy(gameObject, life);
    }

    private void OnCollisionEnter(Collision other) // Checks if there is a collision
    between bullet and another object.
    {
        if (!player_bullet && other.gameObject.tag == "Player") // If boolean is not
        player bullet, and the other object is the player destroy that gameObject and bullet.
        {
            Destroy(other.gameObject);
            Destroy(gameObject);
        }
        if (player_bullet && other.gameObject.tag == "destroyable_object") // If boolean
        is player bullet and the other object has a tag as destroyable object it destroys that
        object and itself.
        {
            Destroy(other.gameObject);
            Destroy(gameObject);
        }
    }

    private void OnCollisionStay(Collision collision) //Checks that if object stays on a
    object such as a wall the bullet gets destroyed.
    {
        Destroy(gameObject);
    }
}
```



## Camera\_movement Script:

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
//Source used to help create this script: https://discussions.unity.com/t/how-to-make-camera-follow-player-position-and-rotation/150127/3
public class Camera_movement : MonoBehaviour
{
    // Script that gives the camera a way to follow the player from a third person view.

    public Transform player;
    public Vector3 offset = new Vector3(0,7, -7);
    private Space offsetPositionSpace = Space.Self;
    [SerializeField] private bool lookAt = true;
    // Creates four variables, a position of the player the camera has to follow, a vector giving the offset, a space and a boolea that checks if the camera is looking at player.

    private void Update() // In the update the function Refresh is called.
    {
        Refresh();
    }

    public void Refresh() // Checks where the player is and changes according to this
    {
        if (offsetPositionSpace == Space.Self)
        {
            transform.position = player.TransformPoint(offset);
        }
        else
        {
            transform.position = player.position + offset;
        }
        if (lookAt)
        {
            transform.LookAt(player);
        }
        else
        {
            transform.rotation = player.rotation;
        }
    }
}
```

## Collectable script:

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
#if UNITY_EDITOR
using UnityEditor;
#endif
public class Collectible : MonoBehaviour
{
    //This script checks if current gameObject has a collision with the player object and
    //if so certain aspects happen.

    [SerializeField]public bool text;
    [SerializeField] public bool sound;
    [HideInInspector][SerializeField] private AudioClip SoundClip;
    public GameObject player;
    // Four variables two booleans for text and sound, an audioclip and the gameobject of
    //the player.

    private void OnTriggerEnter(Collider other) // If there is a collision with the
    //player it can play the audioclip or it can add to the player function AddCoins.
    {
        if(other.gameObject == player)
        {
            if (sound)
            {
                AudioSource.PlayClipAtPoint(SoundClip, transform.position, 1f);
            }
            if (text)
            {
                Player.Instance.AddCoins();
            }
            Destroy(this.gameObject);
        }
    }
}

#if UNITY_EDITOR
[CustomEditor(typeof(Collectible))]
public class Collectible_Editor : Editor
{
    public override void OnInspectorGUI()
    {
        DrawDefaultInspector();

        Collectible script = (Collectible)target;

        if (script.sound)
        {
            var Soundclip = serializedObject.FindProperty("SoundClip");
            EditorGUILayout.PropertyField(Soundclip);
            serializedObject.ApplyModifiedProperties();
        }
    }
}
#endif
```

## Enemy Script:

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using UnityEngine.AI;
#if UNITY_EDITOR
using UnityEditor;
#endif

//Source used to create the following script: https://discussions.unity.com/t/how-do-i-
make-a-enemy-follow-me/235026/4

public class Enemy : MonoBehaviour
{
    /* Dit script krijgen objecten een beweging mee, als ware bewakers die heen en weer
    lopen.
    Ook wordt er n dit script meegegeven dat als de Player het Object met dit script
    raakt wordt Destroyed.
    */
    public enum ActionEnemy
    {
        Static_Movement,
        Follow_Player
    }
    public ActionEnemy actionEnemy;
    private Vector3 startPosition;
    [SerializeField] public bool Shoot = false;

    [SerializeField] GameObject player;
    [HideInInspector][SerializeField] Transform Player_position;

    [HideInInspector]
    [SerializeField] public bool Random_radius = false;
    [HideInInspector]
    [SerializeField] public bool Random_speed = false;

    [HideInInspector][SerializeField] private float Speed = 2f;
    [HideInInspector][SerializeField] private float Radius = 5f;

    //[HideInInspector] [SerializeField] private float Speed = 5f;
    [HideInInspector] [SerializeField] private bool is_an_enemy = true;
    Rigidbody rb;

    [SerializeField] private float timer = 5;
    private float bulletTime;
    public GameObject bulletPrefab;
    public Transform bulletSpawnpoint;
    public float bulletSpeed = 10;

    /* Beginnen met het aannaken van 4 variables waarvan de laatste drie ook aan te
    passen zijn in de Inspector, door het gebruik van
    [SerializeField], de eerste variable gaat over het doorgeven de positie (x, y en z)
    vandaar Vector3. De andere drie gaat over de beweging
    van het object.
    */
    void Start() //De start functie wordt maar 1x opgeroepen aan het begin.
    {
        rb = GetComponent<Rigidbody>();
    }
}
```

```

startPosition = transform.position;
if (Random_radius) {
    Radius = Random.Range(1f, 10f);
}
if (Random_radius)
{
    Speed = Random.Range(1f, 5f);
}

/* In de functie start wordt de variable startPosition gelijk gesteld aan de
 huidige positie van het object.
 De magnitude en de Offset krijgen allebei een random waarde tussen 1 en 10, en -
 10 en 10, waardoor elk object dat dit script krijgt
 een andere snelheid en grootte van beweging krijgt.
 */
}

void Update() // De update wordt elk frame opgeroepen.
{
    if (actionEnemy == 0)
    {
        transform.position = startPosition + transform.forward * Mathf.Sin(Time.time
* Speed) * Radius;
        /* In de update krijgt het object een snelheid mee, door de
 transform.position te updaten. Eerst door de huidige startPosition variable
 * en een formule. transform.forward betekent dat op de Z-as (blauwe lijn)
 een beweging ontstaat.
 * Daarna staat de formule waarbij de sinus, tijd en de gemaakte variables
 worden gebruikt.
 */
    }
    else
    {
        FollowPlayer();
        if (Shoot)
        {
            ShootAtPlayer();
        }
    }
}

void FollowPlayer()
{
    Vector3 pos = Vector3.MoveTowards(transform.position, Player_position.position,
Speed * Time.deltaTime);
    rb.MovePosition(pos);
    transform.LookAt(Player_position);
}

void ShootAtPlayer()
{
    bulletTime -= Time.deltaTime;
    if (bulletTime > 0) return;
    bulletTime = timer;
    var bullet = Instantiate(bulletPrefab, bulletSpawnpoint.position,
bulletSpawnpoint.rotation);
}

```

```

        bullet.GetComponent<Rigidbody>().velocity = bulletSpawnpoint.forward *
bulletSpeed;
        Destroy(bullet, 1f);
    }

    private void OnCollisionEnter(Collision collision)
    {
        /*Met de functie OnTriggerEnter wordt er gezegd als de trigger wordt
geactiveert, door een ander object met
een Collider, wordt deze functie geactiveerd.
*/
        if (collision.gameObject == player)
        {
            /* Als er een collision plaats vind met een gameObject die de tag Player
heeft, dit kun je terug zien bovenaan in de inspector
* Dan wordt dat object destroyed uit de game.
*/
            if (is_an_enemy)
            {
                Player.Instance.Levens();
                transform.position = startPosition;
            }
        }
    }
}

#if UNITY_EDITOR
[CustomEditor(typeof(Enemy))]
public class Enemy_Editor : Editor
{
    public override void OnInspectorGUI()
    {
        DrawDefaultInspector();

        Enemy script = (Enemy)target;

        if (script.actionEnemy == 0)
        {

            var RandomSnelheid = serializedObject.FindProperty("Random_speed");
            EditorGUILayout.PropertyField(RandomSnelheid);
            serializedObject.ApplyModifiedProperties();
            var RandomStraal = serializedObject.FindProperty("Random_radius");
            EditorGUILayout.PropertyField(RandomStraal);
            serializedObject.ApplyModifiedProperties();
            if (script.Random_speed == false)
            {
                var Snelheid = serializedObject.FindProperty("Speed");
                EditorGUILayout.PropertyField(Snelheid);
                serializedObject.ApplyModifiedProperties();
            }

            if (script.Random_radius == false)
            {
                var Straal = serializedObject.FindProperty("Radius");
                EditorGUILayout.PropertyField(Straal);
                serializedObject.ApplyModifiedProperties();
            }

        }
        else
        {
            //(script.volgen_speler)
            {
                var player = serializedObject.FindProperty("Player_position");
                EditorGUILayout.PropertyField(player);
                serializedObject.ApplyModifiedProperties();
                var Snelheid = serializedObject.FindProperty("Speed");
                EditorGUILayout.PropertyField(Snelheid);
                serializedObject.ApplyModifiedProperties();
            }
            var Is_anEnemy = serializedObject.FindProperty("is_an_enemy");
            EditorGUILayout.PropertyField(Is_anEnemy);
            serializedObject.ApplyModifiedProperties();
        }
    }
}
#endif

```

## Gun Script:

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
//Source used to create this script: https://www.youtube.com/watch?v=EwiUomzehKU
public class Gun : MonoBehaviour
{
    //Spawns bullets when key is pressed.

    public Transform bulletSpawnpoint;
    public GameObject bulletPrefab;
    public float bulletSpeed = 10;
    public Player play;
    // Four variables, the spawnpoint of the bullet, the bullet object, the speed of the
    bullet and a reference to the script player

    // Update is called once per frame
    void Update()
    {
        if (play.Shoot == true &&
            (Input.GetKeyDown(KeyCode.E)||Input.GetMouseButtonDown(0))) // If the player boolean
            shoot is true and either E is pressed or the right mouse key than spawn bullet.
        {
            var bullet = Instantiate(bulletPrefab, bulletSpawnpoint.position,
            bulletSpawnpoint.rotation); // Spawns the bullet.
            bullet.GetComponent<Rigidbody>().velocity = bulletSpawnpoint.forward *
            bulletSpeed; // Gives the object bullet a velocity forward that it moves.
        }
    }
}
```

## Player script:

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using UnityEngine.UI;
#if UNITY_EDITOR
using UnityEditor;
#endif
// Source used to create part of this script: https://www.youtube.com/watch?v=bqLRWtkgNGg
public class Player : MonoBehaviour
{
    [Header("Player Opties: ")]
    [SerializeField] public bool Walk;

    [Tooltip("Press SHIFT to run")] [SerializeField] public bool Run;
    [HideInInspector] [SerializeField] public float RunSpeed;
    [HideInInspector] [SerializeField] public float speed;
    float rotationSpeed = 1f;
    [Tooltip("Press SPACEBAR to jump")] [SerializeField] public bool Jump;
    [Tooltip("Press E or right mouse to shoot")] [SerializeField] public bool Shoot;
    [Tooltip("Activate for update of text")] [SerializeField] public bool Text;
    [HideInInspector] [Tooltip("The speed given to the jump")] [SerializeField] public
float jumpSpeed;
    [HideInInspector] [Tooltip("The gravity ")] [SerializeField] public float
gravityScale;
    float jumpCooldown = 0.8f;
    float maxDuration = 0.5f;
    float jumpTimer = 0.0f;
    private bool walking = true;
    private bool running = false;

    private float jumpTime;
    private bool jumping;

    public int lives;

    Rigidbody rb;
    private int _count;
    private static Player _instance;
    private Vector3 startPosition;

    public enum Camera_point
    {
        First_person,
        Third_person
    }
    public Camera_point camera_point;

    public Camera camera_1;
    public Camera camera_3;
    public GameObject gun;

    public static Player Instance
    {
        get
        {
            if (_instance == null)
```

```

        {
            Debug.LogError("Player is null");
        }
        return _instance;
    }
}

void Start()
{
    rb = GetComponent<Rigidbody>(); // get rigidbody
    _count = 0; // reset count of collected items back to 0
    lives = 3; // set amount of liv
    startPosition = transform.position;
    camera_1.enabled = false;
    camera_3.enabled = true;
    if (camera_point == 0) // checks if camera is first or third person and enables
and disables the appropriate camera
    {
        camera_1.enabled = true;
        camera_3.enabled = false;
    }
    else
    {
        camera_1.enabled = false;
        camera_3.enabled = true;
    }
    if (!Shoot) // if shoot boolean not true, set gun object to false (so it is not
visible)
    {
        gun.SetActive(false);
    }
}

void Awake()
{
    _instance = this;
}

public void AddCoins() // Function that updates the amount of coins
{
    _count++;
}

public void Levens() // Function that updates the lives after getting hurt.
{
    if (lives >= 1)
    {
        lives--;
        transform.position = startPosition; //respawns player back to start position
if it still has a life.
    }
    else
    {
        Destroy(this.gameObject); // destroy player object.
    }
}

// Update is called once per frame
void Update()

```



```

    {
        float horizontalInput = Input.GetAxis("Horizontal"); // Get the horizontal and
vertical input.
        float verticalInput = Input.GetAxis("Vertical");
        if (Walk && walking && !running) // gives player the walk function.
        {
            rb.velocity = (transform.forward * verticalInput) * speed;
            transform.Rotate(eulers: (transform.up * horizontalInput) *
rotationSpeed);
        }
        if (Text) // If there is text, update the count function.
        {
            UIManager.Instance.UpdateCoinText(_count);
        }
        if (Jump) // if player can jump
        {
            if (Input.GetKeyDown(KeyCode.Space) && jumpTimer <= 0.0f) // If space is
pressed and timer is counted down then jumping is set to true.
            {
                jumping = true;
                jumpTime = 0;
                jumpTimer = jumpCooldown; // Jumptimer is set to the jumpCooldown time.
            }
            if (jumping)
            {
                jumpTime += Time.deltaTime; // updates the jumpTime
                rb.velocity = new Vector2(rb.velocity.x, jumpSpeed); // Gives upwards
velocity.
            }
        }
        if (jumpTimer > 0.0f) // Counts down the jumptimer as long its not 0.0f
        {
            jumpTimer -= Time.deltaTime;
        }

        if (Input.GetKeyUp(KeyCode.Space) | jumpTime > maxDuration) // if key is released
or time allowed to press key, jumping is set to false.
        {
            jumping = false;
        }
        if (Input.GetKeyDown(KeyCode.LeftShift) | Input.GetKeyDown(KeyCode.RightShift))
// Shift pressed player runs instead of walks.
        {
            walking = false;
            running = true;
        }
        if (Input.GetKeyUp(KeyCode.LeftShift) | Input.GetKeyUp(KeyCode.RightShift)) // if
shift not pressed walk true and running false
        {
            walking = true;
            running = false;
        }
        if (!walking && running) // gives the player the run speed.
        {
            rb.velocity = (transform.forward * verticalInput) * RunSpeed;
            transform.Rotate(eulers: (transform.up * horizontalInput) *
rotationSpeed);
        }
    }

```

```

    }

    private void FixedUpdate()
    {
        rb.AddForce(Physics.gravity * (gravityScale - 1)*rb.mass);
    }

}

#if UNITY_EDITOR
[CustomEditor(typeof(Player))]
public class Player_Editor: Editor
{
    public override void OnInspectorGUI()
    {
        DrawDefaultInspector();

        Player script = (Player)target;

        if (script.Walk)
        {
            var Speed = serializedObject.FindProperty("speed");
            EditorGUILayout.PropertyField(Speed);
            serializedObject.ApplyModifiedProperties();
        }
        if (script.Jump)
        {
            var JumpAmount = serializedObject.FindProperty("jumpSpeed");
            EditorGUILayout.PropertyField(JumpAmount);
            serializedObject.ApplyModifiedProperties();
            var GravityScale = serializedObject.FindProperty("gravityScale");
            EditorGUILayout.PropertyField(GravityScale);
            serializedObject.ApplyModifiedProperties();
        }
        if (script.Run)
        {
            var runSpeed = serializedObject.FindProperty("RunSpeed");
            EditorGUILayout.PropertyField(runSpeed);
            serializedObject.ApplyModifiedProperties();
        }
    }
}
#endif

```

### Teleport script:

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;

public class Teleport : MonoBehaviour
{
    // Script that transports object (thePlayer) to a new position (teleportTarget).

    public Transform teleportTarget;
    public GameObject Player;

    private void OnTriggerEnter(Collider other) // Checks if player gets on platform, if
    so position of player gets the position of the teleportTarget.
    {
        if (other.gameObject.tag == "Player")
        {
            Player.transform.position = teleportTarget.transform.position;
        }
    }
}
```

### UIManager script:

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine.UI;
using UnityEngine;
using TMPro;
using System;

public class UIManager : MonoBehaviour
{
    //Script where the text is updated when collectables are found.

    private static UIManager _instance;
    [SerializeField] private String Fill_in_Text;
    public TMP_Text Text;
    public static UIManager Instance
    {
        get
        {
            if (_instance == null)
            {
                Debug.Log("UIManager is null!");
            }
            return _instance;
        }
    }

    void Awake()
    {
        _instance = this;
    }
    public void UpdateCoinText(int count)
    {
        Text.text = Fill_in_Text + count; //Updates de tekst and the variable count in
    the canvas.
    }
}
```

# Appendix K: Presentation Slides Teacher Guide

## Het Maken van een Game met UX

### Lessen aanpak: Hele Taak Eerst

- Jullie krijgen de eindopdracht aan het begin
- Terwijl jullie daar aan werken zul er tussendoor sub-opdrachten gegeven worden.

### De opdracht:

*Het bedenken en ontwerpen van een game vanuit een UX-perspectief.*

### De Opdracht

**WOLF**

- In taaklijst
- De game bedenken en ontwerpen vanuit een UX-perspectief (gebruikersperspectief)

**WOLF**

- Doet het toezien van de ontwerpcyclus (UX Design Cycle)
- Doel van de cyclus minimaal 3 keer.

**Beoordeling**

- Documentatie (houden van journaal)
- Presentatie waarin jullie je hele proces presenteren inclusief jullie prototype.
- Product: eindgame die jullie hebben gemaakt.

### De Materialen

1. UX Design Cycle & methode kaartjes
2. Game Design Kaarten
3. Invul kaarten
4. Unity Template
5. Documentatie

### UX-Design Cycle

De UX-Cycle bestaat uit vijf stappen:

1. Empathize
2. Define
3. Ideate
4. Prototype
5. Test

Waar elke stap is in een algemeen opdracht.

Doel: Vanuit een gebruikers perspectief een product ontwerpen.

### Step 1: Empathize

#### Empathize

Probeer je de doelgroep te begrijpen.

- Vind een manier om in beeld te krijgen wat een bepaalde doelgroep hun mening is.

### Methode Kaartjes

<b>Na te lezen</b>	<b>Doelgroep</b>	<b>Demografie</b>	<b>Omgevingsfactoren</b>
Wat is de achtergrond van de doelgroep? Wat zijn hun behoeften? Wat zijn hun interesses? Wat zijn hun waarden?	Wat is de achtergrond van de doelgroep? Wat zijn hun behoeften? Wat zijn hun interesses? Wat zijn hun waarden?	Wat is de achtergrond van de doelgroep? Wat zijn hun behoeften? Wat zijn hun interesses? Wat zijn hun waarden?	Wat is de achtergrond van de doelgroep? Wat zijn hun behoeften? Wat zijn hun interesses? Wat zijn hun waarden?

### Step 2: Define

#### Define

Bepaal de focus en de kaders waarbinnen je gaat werken.

- Formuleer een probleemstelling.
- Denk na over mogelijke eisen waar je ontwerp aan zal moeten voldoen.

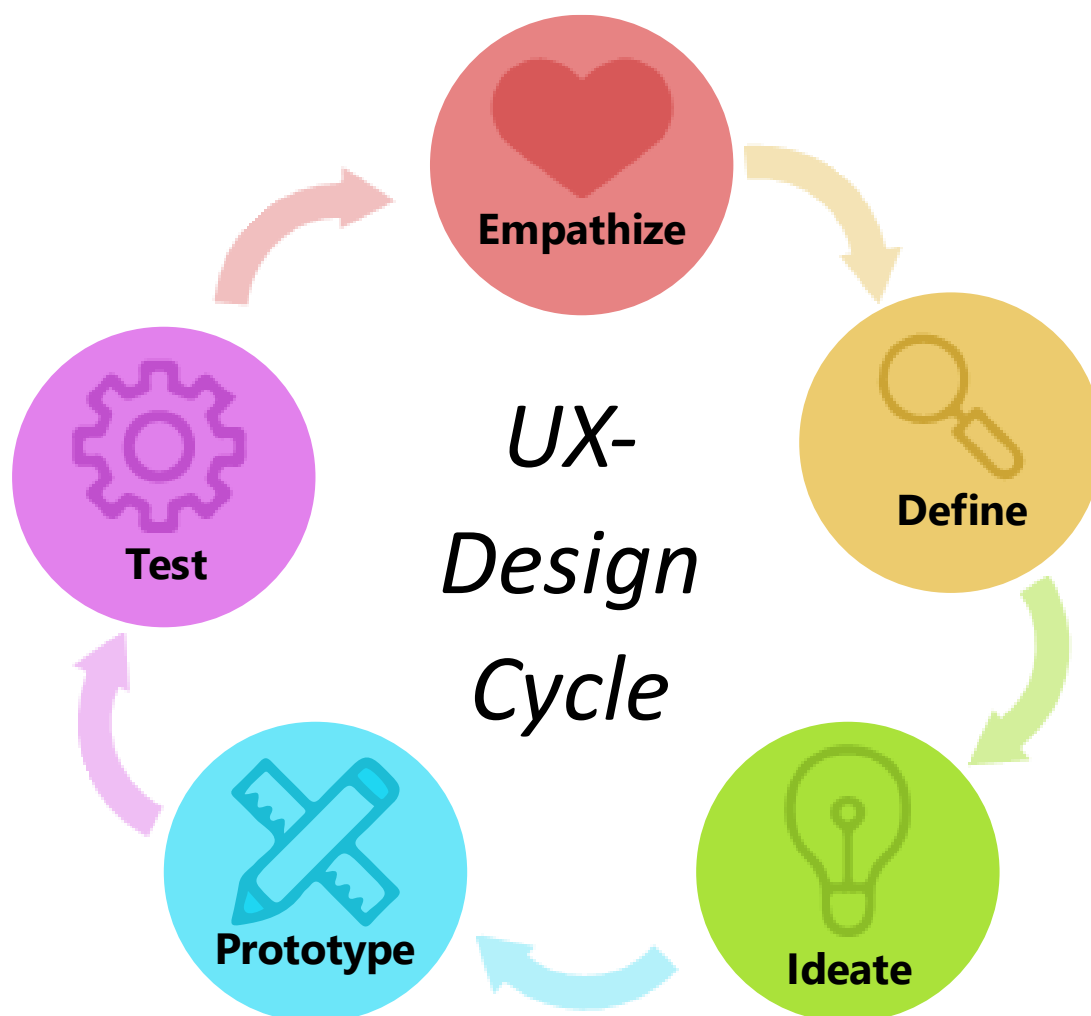
### Methode Kaartjes

<b>Doelstelling</b>	<b>Probleem</b>	<b>Doelgroep</b>	<b>Omgevingsfactoren</b>
Wat is de achtergrond van de doelgroep? Wat zijn hun behoeften? Wat zijn hun interesses? Wat zijn hun waarden?	Wat is de achtergrond van de doelgroep? Wat zijn hun behoeften? Wat zijn hun interesses? Wat zijn hun waarden?	Wat is de achtergrond van de doelgroep? Wat zijn hun behoeften? Wat zijn hun interesses? Wat zijn hun waarden?	Wat is de achtergrond van de doelgroep? Wat zijn hun behoeften? Wat zijn hun interesses? Wat zijn hun waarden?



## Het bedenken en ontwerpen van een game met de UX-cyclus (Domein P)

### Docentenhandleiding



### Samenvatting

*In deze docenthandleiding is de benodigde uitleg en materialen te vinden om de lessenserie 'Het bedenken en ontwerpen van een game met de UX-cyclus' als docent uit te kunnen voeren. De lessenserie gebruikt twee methodes: 'hele taak eerst' en 'tinkering'. Bij de hele taak eerst en tinkering staan leerlingen centraal in hun eigen leerproces en heeft de docent een faciliterende rol. De materialen zijn op zo'n manier ontwikkeld dat leerlingen met behulp van de UX-cyclus en game design gerelateerde materialen leren over UX, doormiddel van het maken van een game, bestaande onder andere uit een Unity-template waarin leerlingen een 3D spel kunnen maken zonder zich eerst te moeten verdiepen in het programmeren in Unity.*

## **Inhoud**

1. Beschrijving en doel van lessenserie
  - 1.1. Introductie op lessenserie
  - 1.2. Insteek van de lessenserie
  - 1.3. Onderwerpen van de lessenserie
  - 1.4. Overzicht lessenserie
2. Toelichtingen
  - 2.1. Hele Taak Eerst
  - 2.2. Tinkering
  - 2.3. Rol van de docent
3. Leerdoelen
4. Lessen indeling
  - 4.1. Introductie lessen User Experience
  - 4.2. Introductie Invulkaartje en UX-template
5. Beoordelingsmethode
6. Leerlingmateriaal
  - 6.1. De opdracht
  - 6.2. UX materialen
  - 6.3. Game design materialen
  - 6.4. Documentatie van leerlingen

### Bronnen

Appendix A: UX Materialen

Appendix B: Game design materialen

Appendix C: Invuldocument Leerlingen Documenteren Proces

## 1. Beschrijving en doel van de lessenserie

### 1.1 Introductie op lessenserie

In deze lessenserie worden leerlingen stap voor stap geïntroduceerd met User Experience (UX) en worden ze vertrouwd met het ontwerpproces waarbij ze leren ontwerpen vanuit de gebruikerservaring. In deze lessenserie, wordt dieper ingegaan op de essentiële concepten van UX, zoals gebruikersgericht ontwerp, bruikbaarheid, en de algehele gebruikerservaring. Deze kennis krijgen leerlingen doormiddel van zelfstandige deelname aan het ontwerpproces bij het ontwerpen van een game.

De lessenserie richt zich niet alleen op het overbrengen van de theoretische en praktische kennis, maar ook op het stimuleren van creativiteit en kritisch denken van de leerlingen. Door middel van het gebruiken van de 'hele taak eerst' concept leren ze niet alleen de basisprincipes van UX, maar ontwikkelen ze ook vaardigheden die belangrijk zijn bij het ontwerpen en analyseren van producten. Daarnaast worden leerlingen aangemoedigd om samen te werken, hun ideeën te delen en feedback te geven op elkaars werk, wat bijdraagt aan een interactieve en collaboratieve leeromgeving.

### 1.2 Insteek van de lessenserie

Deze lessenserie behandelt het keuzedomein P: User Experience. Het hoofddoel van deze lessenserie is om leerlingen de principes van ontwerpen vanuit het perspectief van de gebruiker bij te brengen. Dit wordt bereikt door ze een game te laten ontwerpen, specifiek gericht op een bepaalde doelgroep, bijvoorbeeld hun eigen klasgenoten. De benadering is gebaseerd op de 'hele taak eerst' concept, waarbij leerlingen aan het begin gelijk de hele opdracht krijgen waar ze de volledige lessenserie de tijd voor krijgen om uit te voeren. Daarnaast wordt in de lessenserie ook een tinkering aanpak gebruikt, waarbij ze de vrijheid krijgen om zelf te ontdekken hoe ze een game moeten maken met zogenoemde bouwblokken. De gedachte hierachter is dat leerlingen meer tijd kunnen besteden aan het ontwerpproces en ondertussen ook informatie leren over game designelementen zonder dat het te ingewikkeld gebracht wordt of dat ze veel tijd verliezen in het programmeren van de game. Deze lessenserie is ontworpen voor Havo 5 en Vwo 5 en zal 18 lessen in beslag nemen.

### 1.3 Onderwerpen van de lessenserie

Deze lessenserie behandelt diverse onderwerpen, waaronder wat User Experience (UX) is en waarom het van belang is bij het ontwerpen van digitale producten. Daarnaast worden de volgende specifieke onderwerpen behandeld:

4. **De ontwerpcyclus:** Elke stap van de ontwerpcyclus wordt behandeld, waarbij voor elke stap verschillende methoden en technieken beschikbaar zijn voor leerlingen om toe te passen.
5. **Game designelementen:** Leerlingen zullen inzicht krijgen in de essentiële elementen van game design, waardoor ze in staat zijn gebruiksvriendelijke games te ontwerpen.
6. **Unity:** Leerlingen zullen bij het maken van een prototype van hun game ook in aanraking komen met Unity en leren over de basisprincipes van het werken met dit platform, waardoor ze essentiële vaardigheden verwerven voor het ontwikkelen van digitale games.

### 1.4 Overzicht lessenserie

Zoals eerder vermeld, zal de lessenserie 18 lessen duren, voor een klas die drie uur per week les heeft betekend dat het 6 weken zal duren. In Tabel 1 is een weekoverzicht gemaakt voor de lessenserie. Verder op in hoofdstuk 4 zal er dieper per les ingegaan worden op wat er behandeld moet worden en welke materialen daarbij worden gebruikt.



Tabel 8: Weekoverzicht van de lessenserie

<b>Week</b>	<b>Onderwerp</b>	<b>Beschrijving</b>
1	Introductie opdracht & Unity	Introductie opdracht en UX-cyclus, introductie en demonstratie Unity, opdracht met Unity, starten stap 1 Ontwerpcyclus.
2	Cyclus 1	Stap 2 (Define), Stap 3 (Ideate), Stap 4 (Prototype)
3	Cyclus 1 & start Cyclus 2	Stap 4 (Prototype), Stap 5 (Test), Evalueren en verbeteren/veranderen van probleemstelling waar nodig.
4	Cyclus 2	Uitwerken/Verbeteren prototype 2 (Unity variant)
5	Cyclus 2 en 3	Testen prototype 2, verbeteren voor laatste prototype, voorbereiden presentatie.
6	Eindpresentatie	Presenteren van het proces en eindproduct.

Dit schema geeft een overzicht van de wekelijkse activiteiten, waarbij elke week een specifiek onderdeel wordt behandeld. Het hoofdleerdoel van de lessenserie is om leerlingen bekend te maken met UX-concepten zodat ze deze kunnen beschrijven, toepassen en verantwoorden bij het ontwerpen van games in duo's.

## 2. Toelichtingen

In deze lessenserie wordt gebruik gemaakt van twee andere manieren van lesgeven dan regulier: de 'hele taak eerst' en 'tinkering'. In dit hoofdstuk wordt eerst ingegaan op de twee verschillende methodes om context te geven wat ze precies inhouden. Daarna wordt er uitleg gegeven hoe deze twee methodes de rol van de docent beïnvloed.

### 2.1 Hele Taak Eerst

Een traditionele les begint met uitleg, gevolgd door het toewijzen van deeltaken aan leerlingen, en eindigt met een gehele taak in de vorm van een toets of praktische opdracht. Bij de benadering van de 'hele taak eerst' wordt dit omgedraaid, waarbij aan het begin van de les de volledige taak wordt gegeven. Leerlingen gaan dan zelfstandig aan de slag met de stof en de gehele taak, terwijl de docent op maat begeleiding biedt. Enkele voordelen van de 'hele taak eerst' benadering zijn dat leerlingen inhoudelijk gemotiveerd raken voor de komende leerstof, dat ze concreet weten wat ze aan het einde moeten kennen en kunnen, dat het meer uitdaging biedt aan gevorderde leerlingen vanaf het begin, en dat het goed aansluit bij het concept van tinkering.

Bij de 'hele taak eerst' benadering wordt de introductie van nieuwe lesstof gestart door direct de gehele taak te presenteren. Dit houdt in dat een bestaande opdracht of taak naar voren wordt gehaald en als uitgangspunt wordt genomen voor de les. Hierbij kunnen alle instructies en hulp die normaal tijdens de les worden gegeven, als ondersteuning bij het volbrengen van de gehele taak worden beschouwd. Geef elke leerling vervolgens alleen de hulp die ze nodig hebben, door selectief bepaalde onderdelen weg te laten.

### 2.2 Tinkering

Tinkering is een speelse, experimentele, en iteratieve benadering waarbij deelnemers voortdurend hun doelen heroverwegen, nieuwe paden verkennen en nieuwe mogelijkheden bedenken (Resnick & Rosenbaum, 2013). Om leerlingen te laten tinkeren, is het essentieel dat ze bouwblokken hebben om mee te experimenteren. Een voorbeeld van de bouwblokken is het programma Scratch, waar er blokjes zijn gemaakt voor verschillende programma functies en leerlingen met slepen een werkend programma kunnen maken. Door te werken met deze bouwblokken leren leerlingen over het onderwerp. Tinkering is populair binnen STEM-gerelateerde vakgebieden (Science, Technology, Engineering, and Mathematics), omdat de aanwezigheid van bouwblokken onderwerpen zoals programmeren en elektronica tastbaarder maakt voor leerlingen.

Tinkering sluit goed aan op de 'hele taak eerst' benadering omdat het de leerlingen in staat stelt te experimenteren met de materialen, in dit geval materialen die beschikbaar zijn gesteld voor het maken van een game met behulp van de UX-cyclus. Aangezien de leerlingen direct al weten wat de gehele taak is, kunnen ze hiermee experimenteren en deze verkennen. Bovendien vertoont tinkering vergelijkbare concepten met UX en de UX-cyclus, waarvan het iteratieve concept er een van is. Zowel bij UX als tinkering draait het om het ontwerpen en snel testen van ideeën om te zien of ze werken. Door te experimenteren met verschillende benaderingen en het omgaan met mislukkingen kunnen leerlingen waardevolle inzichten opdoen.

### 2.3 Rol van de docent

Voor deze lessenserie staat de student centraal in het leerproces en heeft de docent een faciliterende rol die studenten begeleidt om zelfstandig te verkennen en te ontdekken. Als docent vervul je deze rol en streef je naar een balans tussen het helpen van leerlingen bij het overwinnen van obstakels, het geven van feedback en het handhaven van een zekere afstand, zodat leerlingen

zelf tot de nodige oplossingen kunnen komen (Ryoo et al., 2015). Het is belangrijk voor de docent om samen te werken met de leerlingen en niet te proberen het werk voor hen te doen, zodat de leerlingen zelf tot de nodige oplossingen kunnen komen (Ryoo et al., 2015).

Als docent heb je drie primaire doelstellingen voor deze lessenserie, zoals uiteengezet door Gutwill en collega's (2015):

1. **Ontsteek de initiële interesse:** Het eerste doel van de docent is om de initiële interesse van leerlingen te wekken, hen te motiveren om aan het leerproces te beginnen en te starten met de taak.
2. **Handhaaf de betrokkenheid van de leerlingen:** Het is cruciaal voor de docent om de actieve deelname van leerlingen gedurende het leerproces te handhaven. Dit betekent dat leerlingen betrokken en geïnteresseerd blijven in het onderwerp of de activiteit.
3. **Verdiep begrip en betrokkenheid:** Een andere belangrijke rol van de docent is om het begrip en de betrokkenheid van leerlingen te verdiepen. Dit houdt in dat de docent leerlingen begeleidt om een dieper begrip van het onderwerp te ontwikkelen en hun toewijding aan het leerproces te bevorderen.

Door deze drie doelstellingen op vaardige wijze in evenwicht te brengen, speel je als docent een sleutelrol in het creëren van een effectieve en boeiende leeromgeving.

### 3. Leerdoelen

De doelstelling van deze lessenserie zijn gebaseerd op de twee eindtermen van domein P: User Experience, zoals hieronder gegeven:

*Analyse: De kandidaat kan de relatie tussen ontwerpkeuzes van een interactief digitaal artefact en de verwachte cognitieve, gedragsmatige en affectieve veranderingen of ervaringen verklaren.*

*Ontwerp: De kandidaat kan voor een digitaal artefact de gebruikersinteractie vormgeven, de ontwerpbeslissingen verantwoorden en voor een eenvoudige toepassing implementeren.*

Het hoofdlerdoel van deze lessenserie is:

*De leerling kan UX-concepten omschrijven, toepassen en verantwoorden bij het ontwerpen van een game in duo's waarbij gebruik wordt gemaakt van een tinkering aanpak.*

Op basis van dit hoofdlerdoel zijn de volgende 10 leerdoelen geformuleerd voor de lessenserie, te vinden in Tabel 2. De leerdoelen zijn op te delen in vier onderwerpen: Algemene kennis UX, UX toepasbare leerdoelen, game design gerelateerd en algemene vaardigheden.

De leerdoelen zijn gecategoriseerd gebaseerd op de 6 niveaus van Blooms Taxonomie (Andreev, 2023):

- Onthouden = kunnen ophalen van informatie
- Begrijpen = vaardigheid om adequaat betekenis te geven aan informatie
- Toepassen = kennis in nieuwe situaties toe te passen
- Analyseren = informatie op te delen in onderdelen zodat de structuur kan worden begrepen en bestudeerd
- Evalueren = om de waarde van iets te kunnen beoordelen in relatie tot een bepaald doel
- Creëren = om met behulp van het geleerde nieuwe ideeën, oplossingen, producten te ontwikkelen.

Tabel 9: Overzicht van de leerdoelen van de lessenserie

	<i>Leerdoel</i>	<i>Niveau</i>
1	De leerling kan benoemen wat het doel van UX (User Experience) is.	Onthouden en Begrijpen
2	De leerling heeft de hele UX-cycle minimaal twee keer doorlopen.	Toepassen
3	De leerling heeft met het ontwerpen van een game gewisseld tussen het perspectief van de ontwerper en de gebruiker.	Toepassen
4	De leerling kan uitleggen waarom het betrekken van de gebruikers tijdens het ontwerp van een product noodzakelijk is voor het bereiken van een goede UX.	Begrijpen
5	De leerling kan de verschillende stappen van de UX-cycle benoemen en aangeven wat elke stap inhoud.	Begrijpen
6	De leerling kan voor elke stap van de cyclus twee methoden benoemen en er minimaal één van toepassen.	Begrijpen en toepassen
7	De leerling kan gebaseerd op de evaluatiestap reflecteren op welke onderdelen er veranderd moeten worden.	Analyseren en Evalueren
8	De leerling kan diverse essentiële onderdelen van game design benoemen en toepassen.	Begrijpen en toepassen
9	De leerling kan diverse elementen van game design benoemen en toepassen	Begrijpen en toepassen

10	De leerling kan goed samenwerken met een klasgenoot door het eerlijk verdelen van de taken en het zorgen dat ze hun werk goed doen.	Toepassen
----	---	-----------

## 4. Lessenoverzicht

In dit hoofdstuk wordt een lessenoverzicht per les beschreven. Hierbij is uitgegaan van dat de leerlingen een les hebben van 50 minuten. Dit lessenoverzicht is vrij specifiek maar is ook vrijheid voor eigen invulling als docent, door bijvoorbeeld meer tijd te nemen voor bepaalde onderdelen, etc.

### 4.1 Lessenoverzicht

In Tabel 3 is een lessenoverzicht te vinden, hierin wordt per les een beschrijving en het doel van de les gegeven. Deze beschrijvingen zijn nog wat aan de globale kant zodat docenten zelf invulling kunnen geven. Het idee achter de lessen serie is om leerlingen zoveel mogelijk zelf te laten ontdekken en minimale hoeveelheid aan klassikale uitleg te geven.

Tabel 10: Lessenoverzicht met beschrijving per les en het doel achter de les.

Les	Beschrijving	Doel
1 & 2	Introductie Unity Template (6.3.3), installeren van Unity, en uitleg Opdracht (6.1)	Door introduceren van de Unity template en leerlingen daar alvast mee laten spelen en ontdekken weten ze wat de mogelijkheden zijn van hun spel (en dus ook de beperkingen). Maakt ze enthousiast over waar ze mee bezig gaan.
3	Introduceer UX-materiaal (6.2) en uitvoeren van Empathize (stap 1)	Leerlingen gaan bezig met het observeren van hun doelgroep (hun mede-klasgenoten).
4	Uitvoeren van Define (stap 2)	Leerlingen gaan hun gevonden observaties formuleren in een probleemstelling.
5	Uitvoeren van Ideate (stap 3), introduceer hierbij de game design kaarten (6.3.1)	Leerlingen gaan zo veel mogelijk ideeën bedenken die een oplossing vormen voor hun probleemstelling, specifiek verschillende game ideeën, probeer ze minimaal 10 ideeën te laten bedenken.
6	Maken van eerste prototype (Stap 4), voor structuur en verhaallijn introduceer de invulkaarten (6.3.2.)	Leerlingen gaan hun idee uitwerken met 1 van de methode kaartjes, hierbij zijn ze vrij om te kiezen waarin, maar is het wel belangrijk dat ze voor het aanbrengen van structuur de invulkaarten invullen.
7	Verder met het bouwen van het eerste prototype & het voorbereiden van de test (stap 5). Voor het voorbereiden kunnen ze kijken bij het gegeven invuldocument (6.4) wat voor vragen ze kunnen stellen.	Leerlingen krijgen extra les om het prototype uit te werken en zich voorbereiden op het testen, specifiek ook gericht op wat willen ze weten.
8	Uitvoeren van de test (Stap 5) en het evalueren van de feedback.	Leerlingen gaan bij elkaar de games testen en zien elkaar van feedback om hun ideeën te verbeteren, belangrijk om wel dat de test personen geïnformeerd te worden over de specifieke doelgroep.
9	Evalueren feedback en starten cyclus 2, hierbij eerst door de eerste drie stappen heen gaan voor mogelijke aanpassingen in probleemstelling en bedenken van nieuwe ideeën.	Leerlingen verwerken feedback door het herlopen van de eerste drie stappen van de cyclus om een plan van aanpak te hebben met veranderingen die ze willen doorvoeren.

10 – 12	Uitwerken verbeterde prototype (in Unity)	Leerlingen maken een nieuwe en verbeterde prototype van hun idee, deze moet met Unity gemaakt zijn.
13	Testen en evalueren van feedback van prototype 2.	Leerlingen gaan het 2 <sup>e</sup> prototype testen en evalueren de verzamelde feedback.
14	Implementeren aanpassingen waar mogelijk (cyclus 3) en voorbereiden op presentatie.	Leerlingen verwerken de feedback in de laatste cyclus en gaan zicht voorbereiden op de eindpresentatie.
15	Afrondende les om alles af te ronden en voorbereiden.	Leerlingen kunnen laatste vragen stellen en verder werken aan het laatste prototype, de presentatie of de documentatie.
16 & 17	Presentaties	Leerlingen presenteren het werk dat ze hebben gedaan.
18	(Speling – een les die ingezet kan worden waar nodig).	(Vrij ter invulling waar nodig).

Zoals in Tabel 3 te lezen valt, wordt er meer tijd besteed aan de eerste cyclus dan de andere twee cyclussen, dit heeft te maken met het feit dat tijdens de eerste cyclus leerlingen meer tijd zullen besteden aan het ontdekken van de gebruikers en gebruikerservaringen ten opzichte van de 2<sup>e</sup> en 3<sup>e</sup> cyclus waarbij er een grotere focus ligt op het verbeteren van het idee op basis van de feedback van de gebruiker.

#### 4.2 Introductie lessen User Experience

Het is belangrijk om tijdens de introductie lessen zowel leerlingen duidelijk de opdracht uit te leggen als een demonstratie en opdracht te geven over Unity. Door leerlingen in het begin gelijk een introductie te geven met Unity kunnen ze alvast experimenteren met de mogelijkheden van de template van Unity en weten ze met welke beperkingen ze moeten werken. Maar dit is dan ook gelijk een kans om leerlingen enthousiast te maken voor de opdracht en het ontwerpen en maken van hun game.

Voor het uitleggen van de Unity template is een filmpje beschikbaar waar alle stappen behandeld worden, waaronder het installeren van Unity, het downloaden en openen van de template, en de werking van de template.

Daarnaast zal er een duidelijke uitleg gegeven moeten worden over de opdracht, de lesmethode, de verschillende materialen en de manier van documenteren van de leerlingen. Om hierbij te helpen is er een PowerPoint gemaakt die deze materialen allemaal uitlegt. Deze PowerPoint kan als hulp en basis gebruikt worden, en ingezet worden wanneer u dat zelf het handig vindt.

In Tabel 4 is een overzicht gegeven van een voorbeeld van een mogelijke indeling van de eerste lessen.

*Tabel 11: Overzicht indeling eerste lessen*

Onderwijsfuncties	Docenten acties	Leerlingen acties
<i>Peilen beginsituatie/ activeren voorkennis</i>	Opent met de vraag gerelateerd aan “wat is een leuke game om te spelen?” na een aantal antwoorden, door met “waar moet een aantrekkelijke game aan voldoen?”	Leerlingen geven antwoord op de vraag en ondertussen schrijft docent dit op, op een whiteboard.

	<i>Doormiddel van het vragen wat leerlingen leuke games vinden en waar een aantrekkelijke game uit moet bestaan beginnen leerlingen al na te denken over hun eigen gebruikerservaring met games en te denken vanuit het perspectief van een ontwerper.</i>	
<i>Presenteren kennis en werkwijze</i>	Vervolgens uitleg geven over wat de bedoeling van de aankomende lessen is. Hierbij beginnen met uitleg van de opdracht – deze ook met de leerlingen doornemen, laat hierbij ook gelijk de materialen zien (alleen de UX-materialen) + invul document die ze moeten invullen.	
<i>Demonstratie + aan de slag</i>	Als docent laat u zien hoe leerlingen Unity moeten downloaden en leerlingen volgen dit proces. Wanneer leerlingen klaar zijn met het downloaden heeft u als docent twee opties: Leerlingen het filmpje laten kijken of zelf een demonstratie te geven van de Unity omgeving en template.	Individueel downloaden leerlingen Unity.

#### 4.3 Introductie Invulkaartje en UX-template

Aangezien leerlingen diverse prototypes van hun game gaan maken, kan het zijn dat je er als docent voor kiest om te zeggen dat leerlingen pas bij de tweede iteratie een Unity prototype mogen maken, dit hoeft natuurlijk niet, en is ook deels afhankelijk van de prototype methode die leerlingen kiezen.

Het voordeel van leerlingen pas tijdens de tweede iteratie een prototype te laten maken in Unity is dat ze tijdens het ontwerpen van hun prototype van cyclus 1, alleen bezig zijn met de UX-cyclus en dus ook meer kunnen focussen op de verhaallijn en andere onderdelen van hun spel dan alleen de functionaliteit in Unity. Zo kunnen ze hun spel vormgeven en eventueel al verbeteren op basis van een test voordat ze bezig gaan met het spel maken in Unity.

Voordat leerlingen hun prototype in Unity gaan maken is het verstandig om leerlingen eerst de invulkaartjes te geven, zodat ze de verschillende objecten van hun game vast kunnen uitschrijven en structuur geven aan hoe ze het spel zullen maken in Unity. Geef leerlingen hier de tijd voor.



## 5. Beoordelingsmethode

Voor de beoordeling van de opdracht is het essentieel om te controleren of de leerlingen voldoen aan de bovengenoemde tien leerdoelen. Om dit te beoordelen is een rubriek opgesteld met in totaal zeven onderwerpen, zoals weergegeven in Tabel 5. De rubriek bestaat uit zes niveaus, variërend van uitstekend tot onvoldoende. Naast elk van deze niveaus wordt ook een cijferindicatie vermeld.

Tabel 12: Beoordelingsrubriek van de opdracht

	Uitstekend (>9)	Goed (8)	Ruim Voldoende (7)	Voldoende (6)	Matig (5.5)	Onvoldoende (<5)
<b>Presentatie<sup>8</sup></b>	De leerlingen geven een presentatie waarbij stemgebruik en non-verbale vaardigheden uitstekend gebruikt worden om duidelijk, enthousiast en uitgebreid de inhoud van de presentatie over te brengen.	De leerlingen geven een presentatie waarbij stemgebruik en een groot deel van non-verbale vaardigheden wordt gebruikt om duidelijk, enthousiast en uitgebreid de inhoud van de presentatie over te brengen.	De leerlingen geven een presentatie waarbij de inhoud duidelijk verteld wordt, leerlingen enthousiast over hun proces vertellen, waarbij een aantal stemgebruik en non-verbale vaardigheden worden toegepast.	De leerlingen geven een presentatie waarbij de inhoud redelijk duidelijk en enthousiast verteld wordt waarbij een aantal stemgebruik en non-verbale vaardigheden worden toegepast.	De leerlingen geven een presentatie waarbij de inhoud niet helemaal duidelijk verteld wordt waarbij stemgebruik en non-verbale vaardigheden bijna niet wordt toegepast.	De leerlingen geven een presentatie waarbij de inhoud onduidelijk of onvoldoende verteld wordt en leerlingen stemgebruik en non-verbale vaardigheden slecht tot niet toepassen.
<b>Documentatie</b>	De leerlingen hebben uitgebreid hun voortgang en keuzes opgeschreven waarbij ze elke keuze duidelijk toelichten met meerdere argumenten op basis van onderzoek/testen/etc. waar bij er een kritisch geanalyseerd is.	De leerlingen hebben uitgebreid hun voortgang en keuzes opgeschreven waarbij ze elke keuze duidelijk toelichten met argumenten op basis van onderzoek/testen/etc.	De leerlingen hebben hun voortgang en keuzes opgeschreven waarbij ze bij sommige keuze duidelijke argumenten op hebben geschreven.	De leerlingen hebben hun voortgang en gemaakte keuzes kort opgeschreven.	De leerlingen hebben kort hun voortgang opgeschreven en maar slechte argumenten en onderbouwing.	De leerlingen hebben hun voortgang niet of nauwelijks bijgehouden en niet of nauwelijks een onderbouwing.
<b>Product</b>	Het product sluit perfect aan op de leerlingen hun geformuleerde probleemstelling en de game is uitgebreid en vormt een geheel.	Het product sluit goed aan op de leerlingen hun geformuleerde probleemstelling en is speelbaar waarbij de game veel verschillende elementen.	Het product sluit aan op de leerlingen hun geformuleerde probleemstelling en de game is speelbaar met meerder game-elementen.	Het product sluit aan op de leerlingen hun geformuleerde probleemstelling en is speelbaar al wel erg minimalistisch.	Het product sluit deels aan op de leerlingen hun geformuleerde probleemstelling en is slecht speelbaar.	Het product sluit slecht aan op de de leerlingen hun geformuleerde probleemstelling en is niet of slecht speelbaar.

<sup>8</sup> Stemgebruik: luid genoeg, toon variatie, articuleert goed, vloeiend en enthousiast te presenteren

Non-verbaal: Oogcontact houden, natuurlijke wijze van gebaren, ontspannen houding, en een goede uitstraling

Inhoud: duidelijke en heldere structuur, interactie, duidelijke beheersing van onderwerp, goed gebruik van visuele hulpmiddelen, is volledig in wat hij verteld.

<b>Game-elementen</b>	De leerlingen tonen begrip, interesse, en uitgebreide kennis over de elementen zowel gegeven als andere elementen. Kunnen beargumenteren waarom de een belangrijker is dan de ander en wat de invloed van de elementen op de gebruiker is.	De leerlingen tonen begrip te hebben op de game-elementen die ze hebben gebruikt en de essentiële types, kunnen deze uitgebreid uitleggen, en kunnen beargumenteren waarom de ene belangrijker is dan de ander.	De leerlingen tonen begrip te hebben op de game-elementen die ze hebben gebruikt en de essentiële types en kunnen deze uitgebreid uitleggen.	De leerlingen tonen een begrip te hebben op de game-elementen die ze hebben gebruikt en essentiële types en kunnen deze in het kort uitleggen.	De leerlingen tonen een begrip te hebben van de elementen maar kunnen de elementen onvoldoende uitleggen.	De leerlingen tonen weinig tot geen begrip op de elementen en kunnen het ook niet uitleggen.
<b>UX</b>	De leerlingen zijn twee keer of vaker door de ontwerpcyclus gegaan waarbij ze kritisch gereflecteerd hebben en gebruik hebben gemaakt van verschillende methodes. Ze kunnen kritisch en onderbouwd uitleg geven over de verschillende stappen van de cyclus.	De leerlingen zijn twee keer uitgebreid door de ontwerpcyclus gegaan waarbij ze kritisch gereflecteerd hebben en gebruik hebben gemaakt van verschillende methodes. Ze kunnen onderbouwd uitleg geven over de verschillende stappen van de cyclus.	De leerlingen zijn twee keer door de ontwerpcyclus gegaan waarbij ze bij elke stap hebben stilgestaan en methodes per stap hebben gebruikt. Hierdoor kunnen ze ook goed uitleggen wat de verschillende stappen van de cyclus inhoudt.	De leerlingen zijn kort twee keer door de ontwerpcyclus heen gegaan en hebben de methodes gebruikt. Ook kunnen ze kort uitleg geven over de verschillende stappen van de cyclus.	De leerlingen zijn kort twee keer door de ontwerpcyclus heen gegaan waarbij ze de methodes erg matig hebben gebruikt. Ook kunnen ze erg matig uitleg geven over de verschillende stappen van de cyclus.	De leerlingen zijn niet twee keer door de cyclus gegaan, hebben de methodes niet of verkeerd gebruikt of kunnen niet uitleggen wat de verschillende stappen van de cyclus zijn.
<b>Reflectie</b>	De leerlingen hebben kritisch gereflecteerd tijdens het proces en hebben op basis daarvan aanpassingen gemaakt.	De leerlingen hebben gereflecteerd tijdens het proces en konden aanpassingen benoemen.	De leerlingen hebben af en toe tijdens het proces gereflecteerd maar hebben er niet duidelijk iets mee gedaan.	De leerlingen hebben in totaal een keer duidelijk gereflecteerd maar er vervolgens niks mee gedaan.	De leerlingen hebben niet duidelijk gereflecteerd.	De leerlingen hebben niet gereflecteerd.
<b>Samenwerking</b>	De leerlingen communiceerde onderling erg goed, konden elkaar goed aanvullen en toonde initiatief en eigenaarschap in hun taken.	De leerlingen communiceerde onderling erg goed, konden elkaar goed aanvullen en helpen waar nodig, verdeelde taken eerlijk en namen initiatief in het starten met taken.	De leerlingen communiceerde onderling erg goed, konden elkaar goed aanvullen en helpen waar nodig was en verdeelde taken eerlijk en voltooid hun werk op tijd en goed.	De leerlingen hadden een goede communicatie onderling, verdeelde de taken eerlijk en zorgde beide dat ze hun werk op tijd en goed voltooiden.	De leerlingen luisterde naar elkaar maar er was sprake van een miscommunicatie of de taken waren oneerlijk verdeeld.	De leerlingen luisterde slecht naar elkaar of hadden een miscommunicatie of de taken waren oneerlijk verdeeld.

Voor het berekenen van het eindcijfer worden alle deelcijfers vermenigvuldigd met de wegingsfactoren van elk onderwerp, aangezien sommige onderwerpen zwaarder wegen dan anderen. Om het eindcijfer te bepalen, moet Tabel 6, ingevuld worden.

Tabel 13: Cijferbepaling

Onderwerp	Weefactor	Deelcijfer
Presentatie	1x	
Documentatie	1x	
Product	2x	
Game-elementen	2x	
UX	4x	
Reflectie	1x	
Samenwerking	1x	
Eindcijfer (Totaal/120 x 10)		

## 6. Leerling Materiaal

Het beschikbare materiaal voor deze lessenserie bestaat uit verschillende materialen te verdelen over de twee onderwerpen van de lessen serie: UX en Game design. Voor beide zijn zowel kaarten beschikbaar als andere materialen. Daarnaast is er ook een templatedocument beschikbaar voor leerlingen zodat ze hun voortgang makkelijk kunnen bijhouden in de vorm van een document.

### 6.1 De opdracht

Hieronder wordt de opdracht beschrijving gegeven zoals deze ook aan de leerlinge gegeven kan worden.

#### *Het maken en ontwerpen van een game met een UX-perspectief*

##### *Wat?*

Je gaat in tweetallen een game bedenken en ontwerpen vanuit een UX-perspectief (gebruikersperspectief).

##### *Hoe?*

Door het toepassen van de ontwerpcyclus (Design Thinking Proces), die je minimaal 2 keer doorloopt.

##### *Waarom?*

Je leert wat User Experience is, hoe de ontwerpcyclus werkt en waarom het betrekken van de gebruiker belangrijk is bij het maken van een game.

##### *Wat is de ontwerpcyclus?*

De ontwerpcyclus bestaat uit vijf stappen: Empathize, Define, Ideate, Prototype en Test. In het bijbehorende materiaal kun je de uitleg vinden van de verschillende stappen en wat je zal moeten doen bij de stappen. Begin bij het begin, namelijk de Empathize-stap en werk zo door van stap naar stap. Bij elke stap ga je één methode gebruiken, kies een kaartje met een methode die jou aanspreekt.

##### *Bijhouden van proces*

Bij elke stap moet je bijhouden welke methode en keuzes jullie gemaakt hebben. Dit doe je door het Invuldocument.docx in te vullen, waarin jullie je werk met tekst of foto's laten zien.

##### *Beoordeling*

Jullie worden beoordeeld op drie onderdelen:

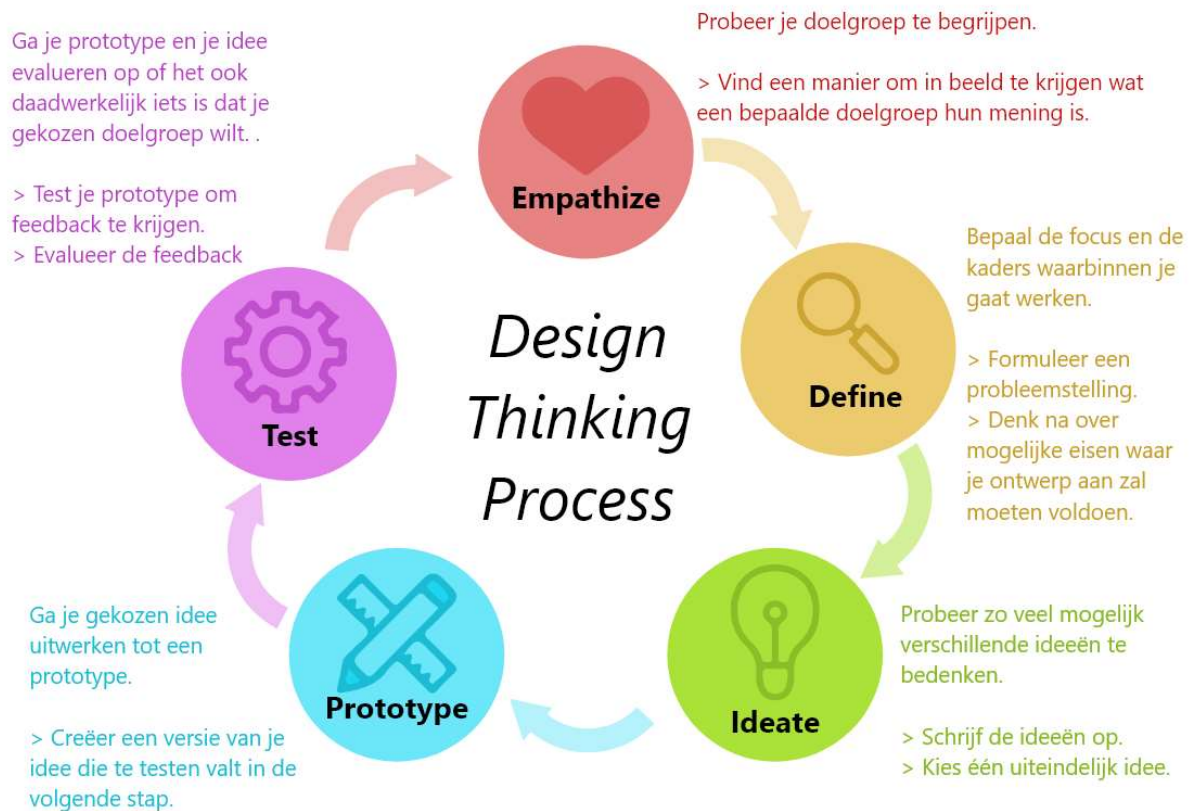
- Documentatie
- Presentatie: waarin jullie je hele proces presenteren inclusief jullie prototype.
- Product

##### *Tips:*

- Formuleer een duidelijke probleemstelling zodat je op basis daarvan het een ontwerpdoel kan formuleren.
- De probleemstelling en het ontwerpdoel kan mogelijk veranderen.
- Tijdens elke cyclus gaan jullie je prototype maken en testen. Dit prototype mag uit verschillend materiaal gemaakt worden (papier, Unity, etc.).
- Testen zal gedaan worden door je medeklasgenoten. Wees kritisch, maar geef feedback op een nette manier.

## 6.2 UX Materialen

De materialen bestaan onder andere uit één A4 met een overzicht van de designcyclus zodat de leerlingen in één opslag alle de stappen van UX-cyclus kunnen zien en wat elke stap inhoud (Figuur 1). Deze valt in het groot te vinden in Appendix A. Per stap staat er een korte beschrijving van wat het doel van de stap is en daaronder een opdracht hoe leerlingen dit moeten doen.



Figuur 8: Overview UX cyclus (ook wel Design Thinking Process genoemd).

Voor elke stap van de cyclus zijn er ook verschillende methode kaartjes beschikbaar. Leerlingen kunnen per stap (minimaal) één of meerdere methode kaartjes uit kiezen om te gebruiken voor het beantwoorden van de bijbehorende opdracht.

Hieronder staat een kort overzicht van de verschillende kaartjes (Figuur 2), waarvan per stap gemiddeld vier methodes beschikbaar zijn. Deze kaartjes kunnen ook in appendix A gevonden worden.

Per groepje leerlingen kunnen deze kaarten uitgedeeld worden zodat leerlingen zelf de vrijheid krijgen om te kiezen welke methode ze het meest aanspreekt. Het is belangrijk hierbij dat leerlingen hun gekozen methode + uitwerkingen van deze methode toevoegen in hun documentatie. Ook zodat ze deze tijdens de eindpresentatie kunnen benoemen, uitleggen en hun resultaten kunnen laten zien.



Figuur 9: Overzicht van verschillende UX-methode kaartjes verdeelt over de vijf stappen

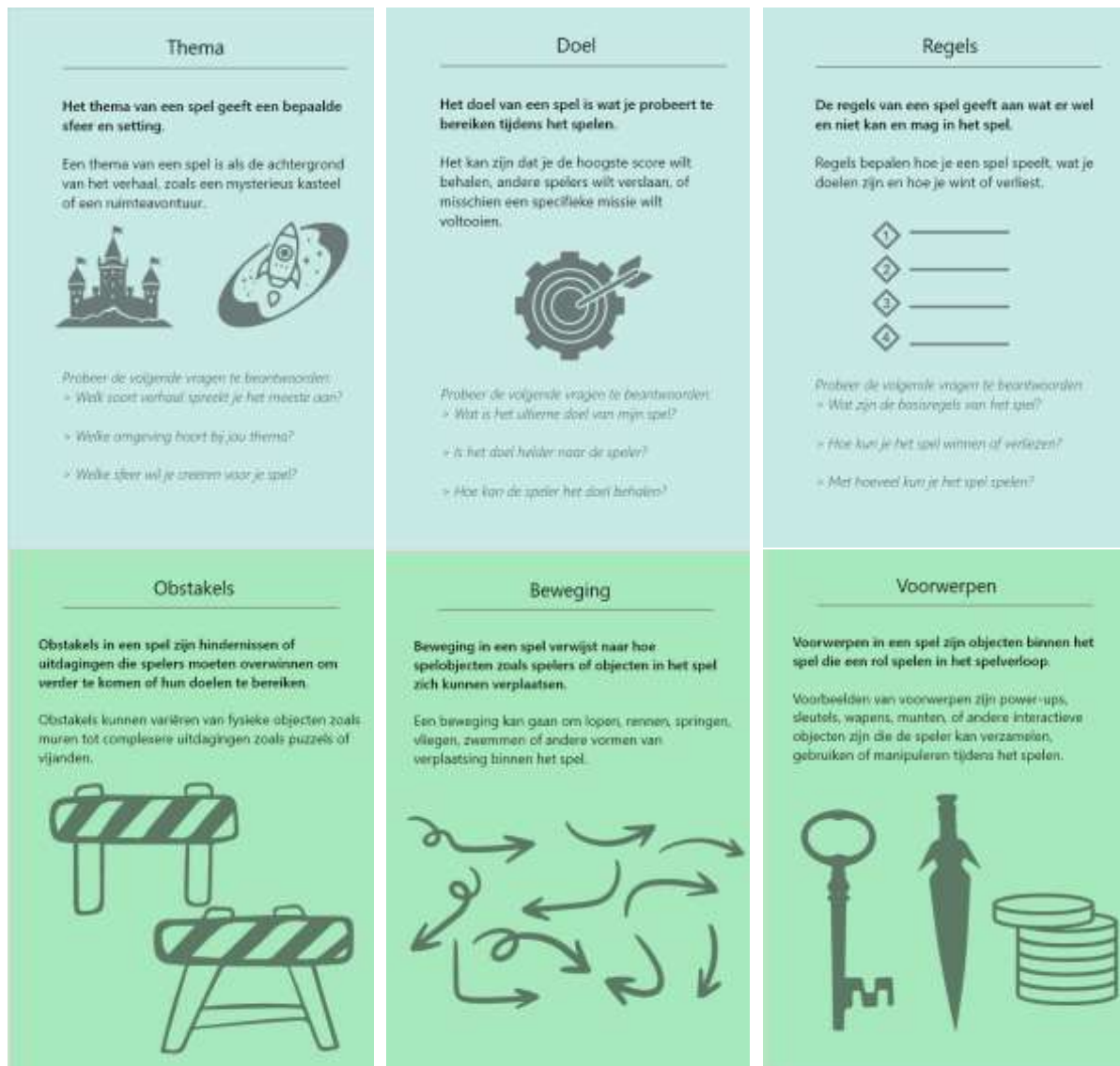
### 6.3 Game Designmaterialen

Naast de bovenstaande UX-materialen zijn er ook een aantal materialen gemaakt om leerlingen te helpen met het bedenken en maken van hun games.

#### 6.3.1 Game Design Uitleg kaarten

Als eerste onderdeel, zijn er twee type kaarten gemaakt die helpen leerlingen na te denken over verschillende spel elementen (blauw) en spel mechanismes (groen). De spel element kaarten (8) zijn voorzien van een titel, beschrijving, icoon en een aantal hulp vragen om leerlingen te helpen in het bedenken en formuleren van hun game. De spel mechanisme kaarten (6) zijn voorzien van een titel, beschrijving en icoon. Bij de mechanisme kaarten zijn geen vragen benoemd, omdat deze gaan over mechanismes die vaak in een spel zitten, zoals een speler, een voorwerp en een obstakel. Hieronder

in Figuur 3 staan een aantal voorbeelden van de kaarten en in appendix B zijn alle kaarten terug te vinden.



Figuur 10: Enkele voorbeelden van de spel element kaarten (blauw) en spel mechanismes kaarten (groen)

### 6.3.2 Invulkaart

Als tweede onderdeel, is er een invulkaart beschikbaar om leerlingen te helpen bij het aanbrengen van structuur in hun game voordat ze bezig gaan met Unity. Deze invulkaart hoeft dan ook pas gedeeld te worden met de leerlingen als ze bezig zijn met het uitwerken van hun gekozen idee. Daarbij kan de keuze zijn om eerst leerlingen een schets of een andere vorm van prototype te maken, voordat ze bezig gaan met na denken over de verschillende game objecten en hun functies. En het kan dus zijn dat deze kaarten pas bij de tweede iteratie ronde van de cyclus wordt toegepast.

De invulkaart (Figuur 4) bestaat uit enkele onderdelen, die leerlingen zal helpen om structuur te krijgen in hun spel en hun alvast te laten nadenken over aspecten van Unity. Het idee erachter is dat elke invulkaart een ander object van het bedachte spel is. Per object geven leerlingen het een naam, benoemen ze wat het doel van het object is, de kleur van het object, en het aantal van het object. Daarnaast zijn er acht functies die leerlingen kunnen aanvinken of hun object dat heeft: actief,

interactief, etc. Naast Figuur 4 staat een korte omschrijving over wat elk begrip inhoud. Leg deze ook uit aan de leerlingen om misverstanden te voorkomen. Als laatste wordt er per object een omschrijving en een schets gemaakt van het object. Leerlingen kunnen zoveel van deze kaartjes invullen, maar het is voornamelijk belangrijk dat ze de essentie van de objecten maken.

<p>Naam: _____</p> <p>Doel: <input type="text"/></p> <p>Kleur: <input type="text"/> Aantal: <input type="text"/></p> <p>Actief <input type="checkbox"/> Interactief <input type="checkbox"/></p> <p>Beweegbaar <input type="checkbox"/> Stilstaand <input type="checkbox"/></p> <p>Botsbaar <input type="checkbox"/> Verwoestbaar <input type="checkbox"/></p> <p>Verzamelbaar <input type="checkbox"/> Schadelijk <input type="checkbox"/></p>	<p><u>Actief</u> als het object iets doet</p> <p><u>Interactief</u> als er een interactie tussen dit object en een ander object is</p> <p><u>Beweegbaar</u> als het object beweegt of bewogen kan worden door een ander object</p> <p><u>Stilstaand</u> als het object een vaste plek heeft en niet verplaatst kan worden</p> <p><u>Botsbaar</u> als je tegen het object aan kan botsen</p> <p><u>Verwoestbaar</u> als het object te verwoesten valt</p> <p><u>Verzamelbaar</u> als het object te verzamelen valt</p> <p><u>Schadelijk</u> als het object schade kan krijgen of kan aanbrengen</p>				
<table border="0" style="width: 100%;"> <tr> <td style="text-align: center; width: 50%;">Omschrijving</td> <td style="text-align: center; width: 50%;">Schets</td> </tr> <tr> <td style="border: 1px solid black; height: 100px;"></td> <td style="border: 1px solid black; height: 100px;"></td> </tr> </table>	Omschrijving	Schets			
Omschrijving	Schets				

Figuur 11: Invulkaartje voor een object in het spel

### 6.3.3 Unity Template

Als derde onderdeel, is er een template in Unity voor leerlingen beschikbaar om in te werken om hun prototype van hun game te maken. Het is belangrijk om duidelijk te maken bij de leerlingen dat de functionaliteit en de essentie van de game belangrijker zijn dan de aankleding van de game. En hun eerste focus dan ook moet zijn op het proberen te maken van hun game dat het zodanig duidelijk is wat het moet kunnen doen. Voor het maken van de prototypes in Unity kunnen de leerlingen het beste op één van de laptops het hele prototype maken, er zijn wel mogelijkheden in Unity om één project te delen dat ze er tegelijkertijd in werken, maar met de lengte van de lessenserie zal dit meer problemen opleveren dan gemak.

De template is beschikbaar als een meegeleverd Unity-pakket. Leerlingen moeten dit pakket importeren nadat ze zelf Unity hebben gedownload, voor de Unity-versie 2021.3.3f1. Deze stap wordt uitgelegd in een instructievideo, waarin ook wordt behandeld hoe Unity werkt en welke functies de template heeft. Deze video is te vinden via de volgende link:

<https://youtu.be/eXSYZwPvxWQ>. Hieronder volgt ook een korte beschrijving van de Unity-template.

In de Unity template staan onder andere een aantal prefabs<sup>9</sup>, die leerlingen zo in de scene van hun game kunnen slepen. Op deze prefabs staan ook al een aantal functionaliteiten, doormiddel van rigidbody's, colliders en diverse scripts. De prefabs bestaan uit essentiële onderdelen zoals een speler met beweging, een camera die de speler kan volgen, een verzamelbaar object, etc. In de Tabel

<sup>9</sup> Een "prefab" in Unity is een vooraf gemaakt object of een verzameling van objecten die je kunt hergebruiken in je game.

7, hieronder, is een overzicht gegeven van alle prefabs in de template samen met de verschillende functies.

Tabel 14: Overzicht van prefabs met bijbehorende functies

Prefab naam	Functies
Player	Lopen, Rennen, springen, schieten, eerste of derde persoon spel.
Enemy	Het heen en weer lopen van A naar B, volgen van een speler, schieten, schade aanbrengen
Collectable	Kan geluid krijgen als hij gepakt wordt of tekst dat het aantal verzamelbare objecten bijhoudt.
Teleport	Als speler op dit element komt wordt hij getransporteerd naar het desbetreffende andere object. (Bestaat uit twee objecten punt van teleport en target position)
Push_object	Een object dat verplaatst kan worden als de speler ertegenaan duwt.
Tekst	Sleep dit object in de scene, als tekst bij de collectables is gewenst
Simpele objecten	Onder mapje simpele objecten staan een aantal standaard objecten die gebruikt kunnen worden voor het maken van je spel omgeving.
Bullet, Enemy_bullet, Gun	Zijn drie objecten die onder andere objecten al geroepen worden verwijder deze dan ook niet.

Voor veel van deze functies van de prefabs kunnen leerlingen ze in de Inspector aan of uit zetten doormiddel van een aantal checkboxes. Een voorbeeld hiervan is de Player, te zien in Figuur 5, waar zoals gezegd leerlingen kunnen aanzetten of hun speler kan lopen, rennen, schieten of springen.



Figuur 12: Inspector van Prefab Player

Naast de verschillende Player opties genaamd: Walk, Run, Jump en Shoot.

Is er ook een checkbox genaamd tekst, als leerlingen de tekst van de collectable willen gebruiken dun moeten ze deze hier ook invullen.

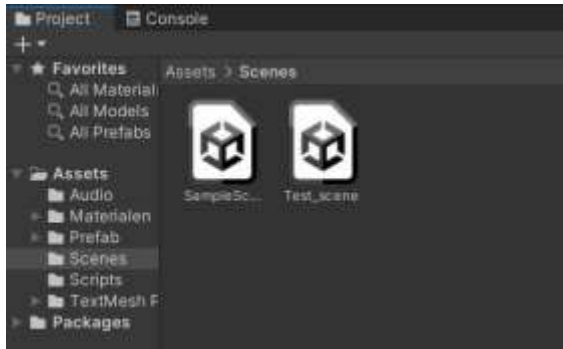
Daarnaast zijn er twee invulboxen lives en speed. Waarbij de leerlingen kunnen aangeven hoeveel levens hun speler heeft en wat de snelheid van de speler is.

Ook kunnen ze aangeven wat de camera-point is: first person of third person.

Als laatst staan er drie objecten Camera\_1, Camera\_3 en Gun, waar achter objecten staan, deze zijn momenteel gevuld. Mocht het zo zijn dat deze leeg is, dan kun je door dubbel te klikken op het vak een object toe voegen, hierbij is het belangrijk dat het object overeenkomt met de naam die ervoor staat.

Naast een de prefabs is er ook een Test\_scene gemaakt, te vinden onder de map Scenes (Figuur 6).





Figuur 13: Screenshot van de inhoud van het mapje Scenes

In de Test\_scene zijn alle prefabs verwerkt en kan als voorbeeld dienen, zodat leerlingen kunnen zien wat de mogelijkheden zijn. Ook kunnen ze onderdelen en prefabs daar eventueel in testen.

Het is niet de bedoeling dat leerlingen bezig gaan met de scripts aanpassen, voornamelijk als de lessenserie maar 5 weken duurt, dit heeft te maken met het feit dat programmeren veel tijd kan innemen, en ook niet het doel is van deze lessen serie. Laat leerlingen dan ook voornamelijk creatief hun game proberen te maken met de prefabs die er zijn, en waar nodig laat ze met andere materialen zoals papier, klei, etc., het spel verder tot realisatie maken.

#### 6.4 Documentatie van leerlingen

Voor het bijhouden van leerlingen hun proces is er een invul document gemaakt voor ze (Figuur 7). Het document is zelf in Appendix C te vinden. In dit document zullen de leerlingen al hun informatie moeten invullen, over het designproces van hun game. Per stap staat er een invul blok waarbij leerlingen hun resultaten kort in moeten zetten, voor stap 1 is dat onder andere de doelgroep. Dit wordt herhaald voor alle vijf de stappen en als laatste worden leerlingen gevraagd om een evaluatie vraag in te vullen voordat ze doorgaan naar de volgende iteratie ronde van de designcyclus. Ook is er een test formulier beschikbaar voor leerlingen om te gebruiken bij stap 5, die ze hun deelnemers kunnen laten invullen. Voor elke iteratie ronde van de designcyclus vullen leerlingen het document steeds opnieuw in, afhankelijk van de hoeveelheid keren dat ze door de cyclus heen gaan wordt het document ingevuld.

**Stap 1: Empathize**

Doelgroep:

Samenstelling van de bevolkingen:

**Stap 2: Define**

Probleemstelling:

Ontwerpeisen:

**Stap 3: Ideate**

Foto van alle ideeën:

Geboortides + argumenten waarom:

**Stap 4: Prototype**

Foto van prototype + korte omschrijving:

**Stap 5: Test**

Samenstelling van bevolkingen:

Wat ga je aanpassen en waarom:

Evaluatie:

Wat waren de drie meest leerzame fouten die je gemaakt hebt tijdens de afgelopen ronde:

**Test Formulier**

Te gebruiken om feedback over je ontwerpen prototype te krijgen.

Vul de volgende tabel in om snel en kort en feedback te verkrijgen:

	1	2	3	4	5
How gamelike was het om het spel te begrijpen? (1= Daar moet je, 5= Daar moet je niet)					
How duidelijk waren de spelregelingen van het spel? (1=Daar moet je niet, 5 = zeer duidelijk)					
How intuïtief waren de bedieningsmechanismen en acties in het spel? (1=zeer verwart, 5=zeer intuïtief)					
How bereid was je met de algemene gebruikersterming van het spel? (Score: 1=sterrend, 5 = niet sterrend)					
How waarschijnlijk is het dat je dit spel opnieuw zou spelen of aan anderen zou laten spelen? (1= zeer onwaarschijnlijk, 5= zeer waarschijnlijk)					

Voor specifieke uitlog, stel volgende open vragen:

1) Als je het zou kunnen veranderen aan het spel om het beter te maken, wat zou dat dan zijn en waarom?

2) Wat waren volgens jou de sterkste punten van de gebruikerservaring van het spel? En waarom?

3) Wat is er veranderd aspecten? Waarom waren deze veranderd?

4) Zou je dit spel aanraden aan anderen of zelf nog een keer willen spelen? Waarom wel of niet?

Figuur 14: Invuldocument voor leerlingen om hun proces bij te houden.

Een belangrijke aantekening is, om ook aan te geven bij de leerlingen dat ze aangeven welke methodes ze hebben gebruikt bij elke stap en ook die resultaten in het document zetten, dit kan simpel als doormiddel van een foto of screenshot.

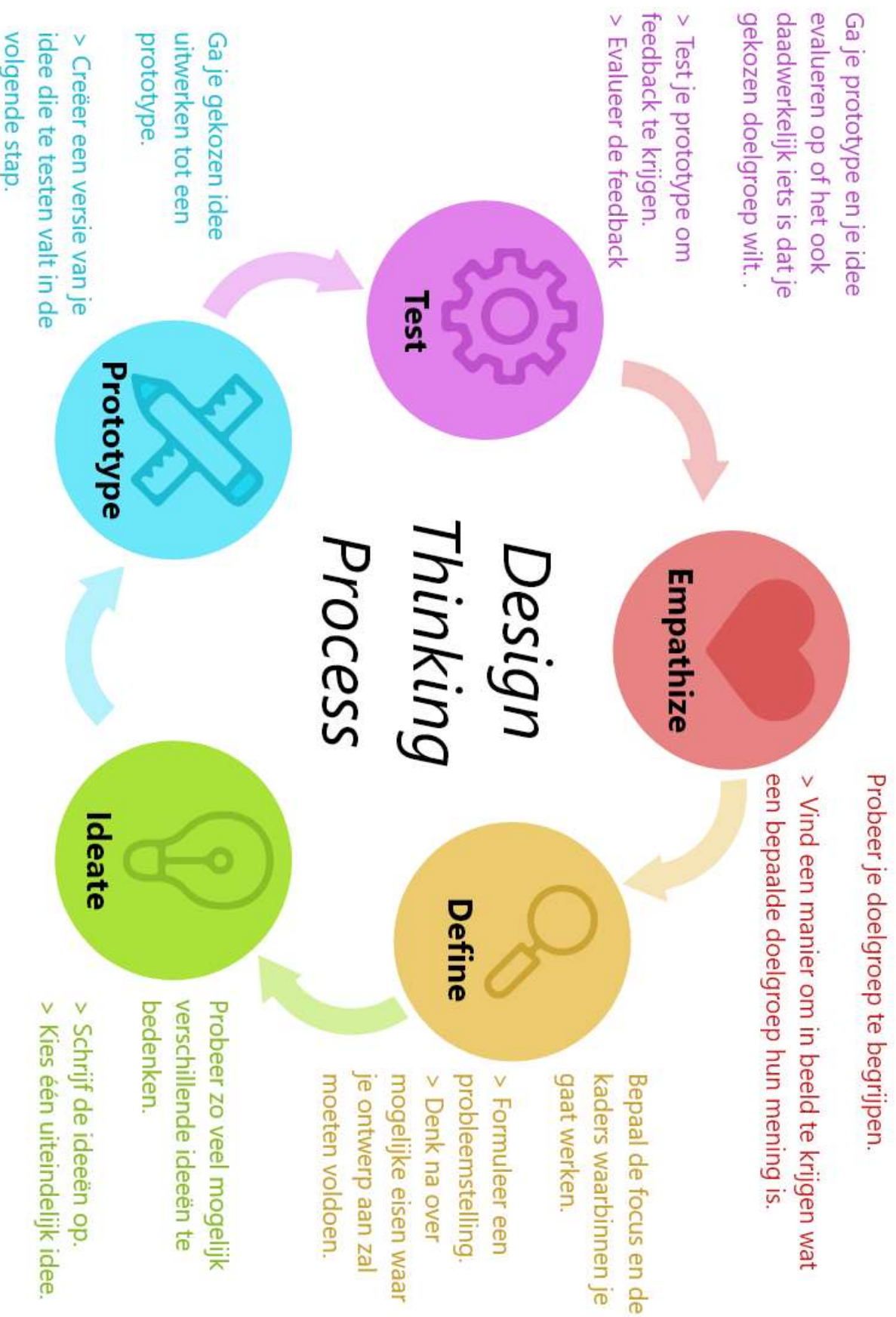
## **Bronnen**

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## Ga in gesprek



Soms ook wel 'Interviewen' genoemd.

- > Bereid een aantal vragen voor die je zou willen stellen, maar het gesprek mag daarvan afwijken.
- > Vraag altijd 'waarom?' om diepere betekenis te ontdekken.


## Observeer



- > Bekijk de gebruikers en hun gedrag in de context van het probleemgebied.


Probeer te kijken of je een verschil ziet tussen wat iemand zegt en wat iemand doet.

## Demonstreer




- > Vraag iemand om je te laten zien hoe ze een taak aanpakken.
- > Laat ze de stappen doorlopen en daarbij vertellen waarom ze doen wat ze doen.

## Ervaar zelf



- > Ga in de schoenen staan van je gebruiker en ervaar zelf wat hij of zij meemaakt.


## Share Inspiring Stories



Om je eigen gegevens te begrijpen, kun je de meest inspirerende verhalen delen met anderen.

- > Denk aan een gebruikerservaring die je is bijgebleven of verhalen die je aannames tegenspreken.


## Persona's



Persona's zijn fictieve personages die je op basis van je onderzoek creëert om de verschillende gebruikerstypen te vertegenwoordigen.

- > Beschrijf de behoeften, het gedrag en de doelen van je gebruikers.


## User Stories



> Probeer de essentie uit je verhaal te halen door het systematisch te beschrijven.

- > Als .... [wie] wil hij/zij .... [wat], zodat .... [waarom].


## Empathy-map



Dit is een methode waarmee je je observaties uit je onderzoeksfase kunt vastleggen en inzichten kunt krijgen over de behoeften van je gebruikers.

- > Het bestaat uit vier onderdelen, die verwijzen naar wat de gebruiker: Zegt, Doet, Denkt, Voelt.

## Brainwriting



> Deelnemer twee schrijft alle ideeën en opmerkingen op.

- > Het vel met opmerkingen wordt doorgegeven aan een tweede deelnemer, die het mag aanvullen of van opbouwend commentaar voorzien.
- > Dit proces kan een aantal keer herhaalt worden.

## Negatief Brainstormen



Hierbij wordt het brainstormen omgedraaid. In plaats van het bedenken van ideeën die het probleem oplossen,

- > Bedenk zoveel mogelijk ideeën die het probleem juist niet oplossen.
- > Evalúeer deze ideeën en pas ze aan zodat ze wel het probleem oplossen.


## Willekeurige Associatie



> Kies een willekeurig voorwerp of een woord.

- > Bedenk dan wat kan ik met dit voorwerp/woord om nieuwe ideeën te bedenken?

## Mindmappen



Een diagram opgebouwd uit begrippen, teksten, relaties en of plaatjes, die zijn geordend in de vorm van een boomstructuur rond een centraal thema.

## Paper-prototype



> Teken op een vel papier de verschillende "schermen" van je product.

Dit is een handige manier om te laten zien hoe je idee eruitziet en hoe het werkt.

## Storyboard



> Teken op een leeg papier een aantal lege vlakken.

> Teken in de vlakken het verhaal over hoe je gebruiker met jouw product in aanraking komt. Werk de hele gebruikerservaring uit of selecteer de meest belangrijke momenten.

## Eenvoudige Mockup



Een Mockup is een eenvoudige goedkope fysieke weergave van je idee. Om te onderzoeken hoe het idee eruitziet en hoe het zou werken.

> Alles kun je gebruiken als bouw materiaal. Denk aan tape, lijm, papier, hout, koffiebekers.

## Klikbaar Prototype



> Maak een lijst met de functies die je in je product wilt stoppen.

> Kies de 3 tot 5 meest essentiële onderdelen.

Denk na hoe je dit wilt meten en in welke vorm je je jouw prototype wilt bouwen.

## Realistisch Model



Het maakt niet uit als je prototype nog niet perfect is.

> Het gaat erom dat je een indruk van het idee kan geven, en deze kan testen en feedback op kunt halen.

## Usability-test



Usability tests richten zich op het testen van de gebruiksvriendelijkheid van een (digitaal) product.

> Geef gerichte taken en observeer het gemak.

> Stel gerichte vragen over de omgang met het product.

## User-test



User-tests richten zich op het testen van de toegevoegde waarde van een concept of idee.

> Geef gerichte taken en observeer de interactie.

> Stel gerichte vragen over het product ten opzichte van de waarde ervan.

## **Appendix B: Game Design Materialen**

## Thema

---

Het thema van een spel geeft een bepaalde sfeer en setting.

Een thema van een spel is als de achtergrond van het verhaal, zoals een mysterieus kasteel of een ruimteavontuur.



Probeer de volgende vragen te beantwoorden:

- > Welk soort verhaal spreekt je het meeste aan?
- > Welke omgeving hoort bij jou thema?
- > Welke sfeer wil je creëren voor je spel?

## Doel

---

Het doel van een spel is wat je probeert te bereiken tijdens het spelen.

Het kan zijn dat je de hoogste score wilt behalen, andere spelers wilt verslaan, of misschien een specifieke missie wilt voltooien.



Probeer de volgende vragen te beantwoorden:

- > Wat is het ultieme doel van mijn spel?
- > Is het doel helder naar de speler?
- > Hoe kan de speler het doel behalen?

## Regels

---

De regels van een spel geeft aan wat er wel en niet kan en mag in het spel.

Regels bepalen hoe je een spel speelt, wat je doelen zijn en hoe je wint of verliest.



Probeer de volgende vragen te beantwoorden:

- > Wat zijn de basisregels van het spel?
- > Hoe kun je het spel winnen of verliezen?
- > Met hoeveel kun je het spel spelen?

## Input

---

De input van een spel zijn interacties die een speler heeft met het spel.

Er zijn verschillende soorten manieren waarop een speler interactie kan hebben met een spel; waaronder toetsen indrukken of muis beweging.



Probeer de volgende vragen te beantwoorden:

- > Welke soorten input zijn er in het spel?
- > Hoe beïnvloedt de input de acties in het spel?



## Uitdaging

---

De uitdaging van een spel verwijst naar de moeilijkheden die spelers moeten overwinnen om hun doelen te bereiken.

Deze uitdagingen kunnen variëren van het verslaan van vijanden tot het oplossen van puzzels en het behalen van hogere scores.



Probeer de volgende vragen te beantwoorden:  
> Wat zijn de obstakels die je moet overwinnen in het spel?

> Op welke manier nemen de uitdagingen toe naarmate je verder komt in het spel?

## Beloning

---

De beloning in een spel is wat je krijgt als je een uitdaging hebt overwonnen of een doel hebt bereikt.

Een beloning kan bijvoorbeeld punten, voorwerpen of toegang tot een nieuw niveau zijn.



Probeer de volgende vragen te beantwoorden:  
> Wat zijn beloningen die je kunt verdienen in het spel?

> Hoe motiveert de beloning om verder te spelen?

## Levens

---

Levens in een spel zijn de kansen die je hebt om fouten te maken voordat je verliest.

Bij elk verlies van een leven kom je dichterbij het einde van het spel.



Probeer de volgende vragen te beantwoorden:  
> Heeft het hebben van levens een toegevoegde waarde?

> Wat gebeurt er als je alle levens verliest?

## Tijd

---

Tijd in een spel is de hoeveelheid tijd die je hebt om taken uit te voeren voordat het spel eindigt.

Tijd kan als een beperking werken die je dwingt om snel te handelen en beslissingen te maken. Tijd kan ook werken als een bijhoudende factor zijn.



Probeer de volgende vragen te beantwoorden:  
> Hoe voelt het om te spelen tegen de klok?

> Wat is de toegevoegde waarde van tijd bijhouden?

> Waarvoor dient de tijd?

## Obstakels

---

Obstakels in een spel zijn hindernissen of uitdagingen die spelers moeten overwinnen om verder te komen of hun doelen te bereiken.

Obstakels kunnen variëren van fysieke objecten zoals muren tot complexere uitdagingen zoals puzzels of vijanden.



## Beweging

---

Beweging in een spel verwijst naar hoe spelobjecten zoals spelers of objecten in het spel zich kunnen verplaatsen.

Een beweging kan gaan om lopen, rennen, springen, vliegen, zwemmen of andere vormen van verplaatsing binnen het spel.



## Voorwerpen

---

Voorwerpen in een spel zijn objecten binnen het spel die een rol spelen in het spelverloop.

Voorbeelden van voorwerpen zijn power-ups, sleutels, wapens, munten, of andere interactieve objecten zijn die de speler kan verzamelen, gebruiken of manipuleren tijdens het spelen.



## Menu

---

Een menu in een spel is een interface die de speler toegang geeft tot verschillende opties en functies.

Het menu biedt de speler de mogelijkheid om bepaalde acties uit te voeren; zoals het starten van het spel, aanpassen van instellingen, bekijken van scores, etc.



## Speler

---

De speler in een spel is degene die het spel speelt en controle heeft over het personage of object dat zich in de spelwereld bevindt.

De speler neemt beslissingen en voert acties uit om doelen te bereiken en uitdagingen te overwinnen binnen het spel.



## Aankleding

---

De aankleding in een spel verwijst naar alles visuele elementen die de sfeer en uitstraling van het spel bepalen, zoals achtergronden, materialen en objecten.

De aankleding draagt bij aan de algehele beleving en atmosfeer van het spel, waardoor het spel levendiger en interessanter wordt.



Naam:

Doel:

Kleur:

Aantal:

Actief

Interactief

Beweegbaar

Stilstaand

Botsbaar

Verwoestbaar

Verzamelbaar

Schadelijk

Omschrijving

Schets

Naam:

Doel:

Kleur:

Aantal:

Actief

Interactief

Beweegbaar

Stilstaand

Botsbaar

Verwoestbaar

Verzamelbaar

Schadelijk

Omschrijving

Schets

Naam:

Doel:

Kleur:

Aantal:

Actief

Interactief

Beweegbaar

Stilstaand

Botsbaar

Verwoestbaar

Verzamelbaar

Schadelijk

Omschrijving

Schets

Naam:

Doel:

Kleur:

Aantal:

Actief

Interactief

Beweegbaar

Stilstaand

Botsbaar

Verwoestbaar

Verzamelbaar

Schadelijk

Omschrijving

Schets

## Appendix C: Invuldocument Leerlingen

### Stap 1: Empathize

Doelgroep:

*Samenvatting van de bevindingen.*

### Stap 2: Define

Probleemstelling:

Ontwerpeisen:

### Stap 3: Ideate

*Foto van alle ideeën:*

Gekozen idee + argumentatie waarom:

### Stap 4: Prototype

*Foto van prototype + korte omschrijving.*

### Stap 5: Test

*Samenvatting van bevindingen:*

Wat ga je aanpassen en waarom:

### Evaluatie

Wat waren de drie meest leerzame fouten die je gemaakt hebt tijdens de afgelopen ronde:

## Test Formulier

*Te gebruiken om feedback over je ontworpen prototype te krijgen.*

*Vul de volgende tabel in om snel en kort en feedback te verkrijgen:*

	1	2	3	4	5
Hoe gemakkelijk was het om het spel te begrijpen? (1= Zeer moeilijk, 5 = Zeer makkelijk)					
Hoe duidelijk waren de doelstellingen van het spel? (1=Zeer onduidelijk, 5 = zeer duidelijk)					
Hoe intuïtief waren de bedieningselementen en acties in het spel? (1=zeer verwarrend, 5=zeer intuïtief)					
Hoe tevreden was je met de algehele gebruikerservaring van het spel? (1=zeer ontevreden, 5 = zeer tevreden)					
Hoe waarschijnlijk is het dat je dit spel opnieuw zou spelen of aan anderen zou aanbevelen? (1= zeer onwaarschijnlijk, 5= zeer waarschijnlijk)					

*Voor specifiekere uitleg, stel volgende open vragen:*

- 9) Als je iets zou kunnen veranderen aan het spel om het beter te maken, wat zou dat dan zijn en waarom?

- 10) Wat waren volgens jou de sterkste punten van de gebruikerservaring van het spel? En waarom?

- 11) Waren er verwarrende aspecten? Waarom waren deze verwarrend?

- 12) Zou je dit spel aanraden aan anderen of zelf nog een keer willen spelen? Waarom wel of niet?