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Designing an Interactive Technology Installation for an Educational Wine-Tasting Experience, for Novice Wine Consumers

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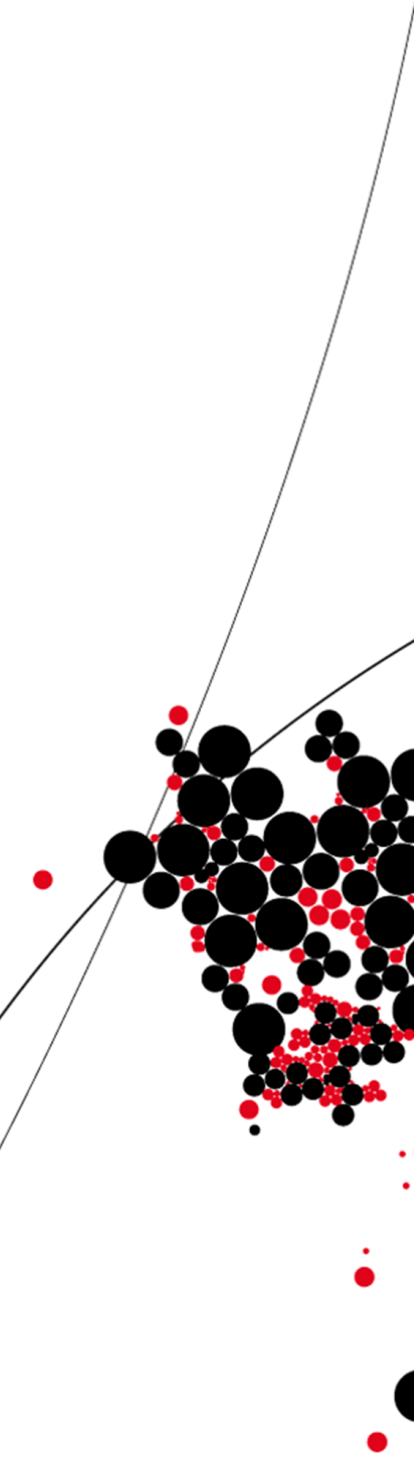
M.Sc. Thesis



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Abstract

It can be hard for novice wine consumers to choose what wines they would enjoy, and why. Wine tastings can help by educating these novice wine drinkers on how to taste, describe and assess a wine. Several technological products and projects have been created to help the user learn more about wine, but none aim to enhance the wine-tasting experience. Therefore, this research investigated how to design an interactive technology installation that supports the educational aspects of wine tasting. Based on prior research, nine design guidelines were established to create a traditional satisfactory and educational wine-tasting experience. These guidelines were translated into the interaction technology domain to form the requirements that resulted in the design of the interactive technology wine-tasting experience: A novel wine-tasting experience that educates novice wine consumers on how to taste, describe and objectively evaluate a wine using an interactive table. This interactive technology experience was evaluated to see if the requirements were met with a functionality test by the researcher, a functional usability test, and a non-functional evaluation study. Lastly, the implications, limitations and possible future work are discussed.

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Chapter 1

Introduction

"You walk into a wine shop, and the clerk asks if he can helpyou select a wine. You pause in thought, then turn in embarrassment and walk out the door. You know what kind of wine you like when you taste it, but you just don't know how to communicate that to the salesperson. Determining why you enjoy one wine over another and expressing yourself articulately are just a matter of practice and a few well-chosen words."

Jackson Meyer, *The Book of Wine* [5]

1.1 Introduction

With a large number of wines available in the wine aisle of a supermarket or wine shop, it can be hard for a consumer to decide what wine they would enjoy, and why. Noting how a wine tastes can help a consumer remember a wine they especially enjoyed or one they would rather not taste again. However, novice wine drinkers might know they like a wine while they are tasting it, but might not be able to describe it [5].

A wine is often described based on its appearance, nose and palate, which are further divided into twelve descriptive characteristics [6], [7]. What makes it even more complex, is that the appearance, nose and palate of a wine can vary depending on a multitude of factors. There are over 65,000 wine producers worldwide and about 10,000 different types of grapes suitable for wine-making [8]–[10], and the climate, harvest year and wine-making process all play a role in how a wine looks, smells and

tastes [6], [7], [9], [11].

With novice wine drinkers unaware of some, or all, of these characteristics, it can be difficult to describe what wines they have enjoyed in the past or would like to try in the future. Furthermore, there is a lot of in-depth information available on the subject of wine, making it difficult for novice wine drinkers to know where to start learning to gain the basic understanding they want to acquire.

One way a novice wine drinker can learn more about the basics of wine is by participating in a wine tasting [6], [7], [12]. During a wine tasting, the wine-tasting process is described, the wine-tasting steps are explained, and different grape varieties are compared. This teaches the consumer how to distinguish and describe the different characteristics of a wine and how these characteristics could have been created by the type of grape or wine-making processes used. By gaining these tools, the consumer gains a better understanding of what wines they might enjoy, why they enjoy them, and how to describe the wines they enjoy [13], [14].

Perhaps, the traditional experience can be further enhanced by incorporating an interactive technology installation that supports the educational aspects of the wine-tasting. That is why this report aims to investigate how to design such an interactive technology wine-tasting experience and whether such a system is effective in aiding the education of novice wine drinkers about how to taste, describe and assess a wine. The goal of this research is not to change the educational content of the wine-tasting, but to create a system that can support how this information is conveyed to novice wine drinkers.

1.2 State of the Art

There are already several technological products and projects developed that aim to help the user learn more about the subject of wine, or enhance the wine-tasting experience [15]–[20]. Overall, previous research on this subject suggests that the need to create a novel experience for wine tasters exists, but not many technological advances have been made.

There are only a few experiences that focus on enhancing the wine-tasting experi-

ence itself [20], [21]. Several studies have investigated the relationship between ambient conditions and the perception of wine [22]–[27]. Results of these studies show that the music and colour of the room can have a significant effect on the perception of wine.

The majority of the products and projects that have been developed, focus on helping the user select what wine to buy during the selection process in a store [15]–[17]. Most noticeably, by providing the user with a quick method of seeing what elements a wine contains. However useful, these elements may not always be properly understood by novice wine drinkers. Seeing a high tannin or acidity level, for instance, might be an aspect of wine that novice drinkers do not understand, or know their preference of.

No technologies that aim to enhance the wine-tasting experience for novice wine drinkers have been found. This offers an opportunity to create an interactive technology that can help novice wine drinkers learn more about the subject of wine through an interactive wine-tasting experience.

1.3 Research Question

This research aims to investigate how and if an interactive technology can be created to enhance the educational aspects of a wine-tasting experience for novice wine drinkers. Therefore, at the start of this project, the following research question is defined:

How to design a satisfactory interactive technology installation that increases the educational knowledge on wine tasting, for novice wine drinkers?

To answer this research question, several sub-questions are formulated:

- *SQ-1: What are the guidelines to create a satisfactory traditional wine-tasting experience?*
- *SQ-2: How can these guidelines be translated into the interactive technology domain, setting the requirements for the ideation of an interactive technology wine-tasting experience?*
- *SQ-3: What components, both hardware and software, are necessary to create an interactive technology wine-tasting experience?*
- *SQ-4: How can the functional and non-functional requirements be evaluated?*

1.4 Defining the Wine-Tasting Setting

Wine tastings are provided with different goals in mind. For novice wine drinkers, this is generally to either sell wine or to create an educational experience where participants can learn more about wine. As the goal of this research is to help beginner wine consumers how to distinguish and describe wine to gain a better understanding of what wine they might enjoy and why, this research will focus on enhancing the educational aspect of the wine-tasting experience. Overall, the goal is to help novice wine drinkers learn more about how to taste wine, and the characteristics of wine, and to gain an understanding of several grape varieties. The wine-tasting experience created is a single session wine-tasting, which lasts about 1,5 to 2 hours in total, with about 6-10 participants.

1.5 Health and Responsible Alcohol Consumption

Moderate wine consumption, especially that of red wine, has been linked to cardiovascular health benefits [28]–[30]. The polyphenols found in wine, can provide both patients with cardiovascular disease and healthy individuals with cardiovascular protective effects [28]. Additionally, an inverse relationship between light-to-moderate consumption of wine and vascular risk has been found [29]. Similarly, based on randomised controlled studies and case–control studies, moderate red wine consumption seems to have an effect on lowering the risk of developing cardiovascular disease and diabetes [30]. However, which ingredient of wine causes these effects are unclear.

Overall, it is important to note that moderation is an extremely important factor, as excessive alcohol consumption can lead to detrimental health outcomes, including morbidity and mortality [28]. Therefore, the health benefits of wine should be considered within the context of a healthy lifestyle.

Chapter 2

Design Process

This research investigates how to design an interactive technology learning experience on the subject of wine-tasting. During this research, an interactive table is designed to support the educational content of an wine-tasting experience.

The design process followed during this research is similar to the Creative Technology Design Process [31]. This process consists of four key stages: Ideation, specification, realisation and evaluation. This process uses a spiral model, which means the sequence of the steps is variable and can flow in either direction to create an iterative process.

Before ideating on possible interactive technology installations, background information needs to be gathered. To better understand wine-tasting experiences and the user, prior research on traditional wine-tasting experiences is investigated. Additionally, preferred learning styles of individuals are explored. With this information the design guidelines for the development of a traditional satisfactory wine-tasting experience are created.

As a first ideation step, each of the guidelines is further investigated on how to translate them into the interactive technology domain, through literature research and mind-mapping by the researcher. This ideation process results in a list of non-functional and functional requirements for the interactive technology wine-tasting installation.

These requirements are then used to make certain design decisions and to ideate on possible interactions the user can have with the installation. Moreover, at this point, the decision to create an interactive table is made and the initial concept of the interactive technology wine-tasting experience is defined.

Next, this concept is further specified, which results in an additional set of functional requirements that are used in the realisation of the interactive technology wine-tasting installation.

After the realisation of the installation, the experience goes through a functional evaluation to see if all of the functional requirements have been met. Several adjustments are made to the system to make sure the requirements are met. After the functional evaluation, the system is evaluated on the non-functional requirements. Lastly, the research is analysed on its context, implications and limitations and future research opportunities are discussed.

Chapter 3

Reasons for Participating in a Wine Tasting

To gain a better understanding of the user, this chapter investigates the reasons for visiting a wine-tasting experience. Overall, potential customers can be attracted to wine tastings for multiple reasons, including gaining educational knowledge, social reasons, and the desire for sensory perception.

3.1 Educational

Participating in a wine tasting can greatly help novice tasters enhance their wine-related knowledge, as wine tasting offers opportunities to learn about their wine preferences, wine-tasting techniques, wine varietals, wine regions, history and culture, vinification techniques and even wine and food pairing.

By learning more about wine, individuals can feel more comfortable about stating their wine-tasting findings or preferences. According to [32], an important reason for participating in wine tastings is to make better purchase decisions. Additionally, according to [33], individuals feel more confident in their ratings of the characteristics of wine by gaining more education and training on the subject.

3.1.1 Developing Preferences

Due to a lack of knowledge and experience, it can be hard for consumers to find a wine they would enjoy. This leads to less consumption and minimal exploration. A tasting can help consumers increase their wine knowledge and help them articulate their preferences clearly. With increased knowledge, consumers are also more likely to discern nuances between various wine types [13], [14].

3.1.2 Wine-Tasting Techniques

During a wine tasting participants are guided on proper wine-tasting techniques, using a systematic approach [6], [7]. To evaluate and describe a wine properly, it is important to assess several aspects of a wine, such as its appearance, aromas and taste. Learning a systematic approach to evaluate these aspects gives novice wine drinkers the tools to articulate their preferences and assess the quality of a wine.

3.1.3 Wine Varietals and Regions

68 countries produce wine, and a variety of over 10,000 different grapevine varieties exist [9], [10]. With that many different types of wine, it can be daunting to know where to start learning about the differences [34]. Wine tastings do not only provide insights into the diversity of the wine world, but they can also help participants understand and distinguish between different grape varieties. By drinking and comparing wines, participants create a better understanding of how wine can be described and what type of wines they enjoy. Furthermore, it helps participants understand what varieties to start their wine knowledge journey with.

3.1.4 History and Culture

Wine-making dates back to ancient times, providing a rich historical background to the wine-making experience [35]. Early on, wine was a sign of opulence, and played an important role in ancient civilisations, showing its cultural and social importance. According to [36] and [37], the historical and cultural aspects of wine play a vital role in the market segmentation strategies to influence the consumers' awareness of wine

ingredients and labelling. To relay these aspects, storytelling has played a key element in connecting wine with the history and culture of countries [38].

3.1.5 Vinification Techniques

Vinification is the process of making wine [7], [39], [40]. Several different vinification techniques can be used to adjust the style and flavour of a wine.[1] Winemakers carefully choose the techniques that will best showcase the unique qualities of the grapes and create a wine that is balanced and delicious. By visiting a wine-tasting, these vinification techniques can be further explored.

3.1.6 Wine and Food Pairing

Another reason wine tastings can be educational is by teaching participants how various wines can complement different dishes. Several aspects of a dish, such as acidity, sweetness, saltiness or spiciness, can change the perception of how a wine tastes. Additionally, the wine can also influence the flavour of the food. Understanding how these aspects impact the flavour experience of wine can lead to better pairings, resulting in a more enjoyable food and wine experience [7], [41].

3.2 Social

People are also drawn to wine tastings for a variety of social reasons. Firstly, people are attracted to wine tastings for an exciting and novel experience [42]. Secondly, a reason for visiting this experience is the opportunity to socialise with like-minded individuals [32], [43]. Third, relieving stress, relaxation and pleasure were also given as reasons for visiting a wine-tasting [32], [44], [45]. Lastly, the opportunity to talk about wine with friends and family was given as a reason to visit wine tastings [32].

[1] A wine maker can choose to extended maceration for increased tannin extraction, selecting fermentation styles like stainless steel tanks or oak barrels, adding sugar to boost alcohol or sweetness levels, and adjusting acidity levels by adding tartaric or citric acid. [7], [39], [40]

3.3 Sensory Perception

Individuals also enjoy the sensory perception of wine. They take pleasure in tasting wine and looking for interesting or special wines [44]. Moreover, wine tasting is a multisensory experience, where almost all senses are used [46]. Only by looking, smelling and tasting a wine can it be fully experienced. Additionally, all of these attributes are necessary to describe the characteristics of a wine [7]. Wine tastings allow individuals to explore these sensory perceptions of wine.

3.4 Conclusion

This chapter found that people are mostly attracted to wine tastings for educational and social purposes. During a wine tasting, participants can learn a lot about their preferences, how to taste wine, the regions where the wine comes from, the history of wine, vinification techniques and how to pair food and wine. However, they can also be there to have a good time with friends, family or strangers, or enjoy the sensory perception of tasting and exploring wines.

Chapter 4

Guidelines for a Satisfactory and Educational Traditional Wine-Tasting Experience

To understand how to create a satisfactory wine-tasting experience, previous research conducted on how to create a satisfactory wine-tasting experience from the perspective of the customer is included [47]. For the full report on this research, please refer to Annex 1. To further aid this research, preferred learning styles of individuals are also investigated.

With this information, this chapter aims to answer the following sub-research question:

SQ-1: What are the guidelines to create a satisfactory traditional wine-tasting experience?

4.1 Guidelines for a Satisfactory Customer Experience of a Traditional Wine-Tasting

Several guidelines to create a satisfactory wine-tasting experience, have already been investigated in prior research [47]. These guidelines state that for a wine tasting to be

educational for novice wine drinkers, the experience should be approachable, memorable, ensure correct tangibility, have a high level of responsiveness, guide the zooming in and out of the glass, leave room for discussion, maintain the correct level of educational information, and is considered a good value for money. In this section, these guidelines are investigated.

4.1.1 Correct Educational Level

Recognising and describing the characteristics of a wine is a vital part of understanding wine and should play a central role in the wine-tasting experience. As this research focuses on novice drinkers, it is crucial to consider what information is shared with the participants. Overall, the information provided during the wine tasting should help the customer better understand and describe the characteristics of the wine they are drinking.

4.1.2 Correct Tangibility

Tangibility concerns the physical space where the tasting is held [48]. Thus, making sure there are enough amenities available and that the space is clean and neat. This physical space also includes the light settings of the room and the equipment that should be available [49], [50].

4.1.3 Approachable

Wine can have a somewhat snobbish image, which makes it a less approachable subject for novice wine drinkers [47]. This snobbish image can also be a reason why novice wine drinkers might be afraid to speak up during a wine tasting. Overall, it is important to create a wine-tasting experience that is approachable for tasters of different wine knowledge levels, but novice wine drinkers should especially feel open to participate during the experience.

4.1.4 Memorable

The memorability of a wine tasting is based on how novel and aesthetically pleasing the experience is [51], [52]. Additionally, storytelling plays an important role in creating a memorable experience [12]. Memorability can be enhanced by helping the customers acquire wine knowledge innovatively [52]. This means the story told should be creative and well thought out, focusing on letting the customers learn more about the characteristics of wine [53].

4.1.5 High Level of Responsiveness

Responsiveness of employees to the questions and concerns of a customer is an important factor that contributes to the satisfaction of the experience. Similarly, the attitude of staff is an important characteristic that relates to customer satisfaction when visiting a winery [50]. Specifically related to wine-tastings, helping the participants promptly during a wine tasting can enhance the satisfaction of the wine-tasting experience [48].

4.1.6 Aid Transitions

During a wine tasting, participants are constantly switching between individual and group activities. When noting the appearance, nose or palate of the wine, participants are fully focusing on the characteristics in the glass, doing so individually [7]. Between these moments, their findings are discussed with the rest of the group. Based on interviews with experts on wine tasting, this zooming in and out of the glass should be guided during the wine-tasting to help the customer notice where their focus should lie during each part of the wine tasting [47].

4.1.7 Create Room for Discussion

Some aspects of wine tasting are considered subjective. Taste and smell are slightly different in each taster, which means that the aromas found in a wine can be looked upon with a level of subjectivity [6], [7]. Therefore, what people taste should not be immediately categorised as right or wrong, but should instead create a topic for discussion. According to the interviews with wine-tasting experts, this means that a

satisfactory wine-tasting experience creates room for discussion between participants, and leads these discussions to be educational for all participants [47]. Especially for beginners, when still developing your nose and palate, it can be helpful to hear what tasting notes others found in the wine and discuss whether you experienced it as well.

4.1.8 Good Value for Money

Customer satisfaction is also dependent on the value the customer gets for their money [48]. Therefore, the price point should be low enough to reflect a good value for the customer, while still allowing a suitable profit to set up the wine tasting.

4.2 Learning Styles

As an educational experience is created it is important to investigate how the educational contents can be best conveyed to the participants of the interactive technology wine-tasting experience. Therefore, this chapter investigates different learning styles to understand how individuals prefer to perceive, process and retain information. After which, the learning styles used in traditional wine-tastings are determined to find learning style opportunities in the development of the interactive technology wine-tasting experience.

There is evidence that individuals differ in which learning style they prefer to acquire new knowledge. However, whether this contributes to better learning outcomes has not been proven [54]. Therefore, these learning styles can be used to create a preferred learning experience, but should not be expected to improve knowledge retention. Most individuals use a combination of learning styles. Furthermore, which learning style or learning styles are preferred can depend on the context and type of knowledge to be gained. By utilising multiple learning styles in an educational experience, an inclusive learning environment, catering to each of the learning styles can be created.

4.2.1 VARK Model

The VARK model identifies four types of learning styles: visual learners, auditory learners, read/write learners, and kinesthetic learners [54], [55]. Firstly, visual learners

prefer visual aids to understand and retain information. This includes charts, graphs, diagrams, videos and demonstrations. Secondly, auditory learners like verbal explanations best. This means oral presentations, lectures and discussions are their preferred way to retain information. Additionally, verbalising their thoughts is also a preferred learning activity for auditory learners. Thirdly, as the name suggests, read/write learners prefer learning methods that involve reading and writing, such as textbooks, note-taking, and essay writing. This includes making and reading summaries to understand the material. Lastly, kinesthetic learners, also called tactile learners, prefer hands-on activities and physical activities. They enjoy learning by doing, with activities that include movement, touch, and experimentation.

4.2.2 Social and Solitary Learning Styles

In addition to the VARK learning styles, a distinction can be made between social and solitary learning styles. Individuals with a social learning style prefer learning by comparing, listening, networking and discussing with others. Contrary to social learners, solitary learners prefer to work independently, observe the activities of others, reflect on their findings and decide their own work pace [56], [57]. Similar to the VARK model, finding a way to combine these learning styles can create an inclusive learning environment for all types of learners.

4.3 Conclusion

This chapter aimed to answer the following sub-research question:

SQ-1: What are the guidelines to create a satisfactory traditional wine-tasting experience?

Previous research suggests that the following elements need to be considered to create a satisfactory wine-tasting experience: defining the correct educational level, ensuring tangibility, assuring approachability, enhancing memorability, providing responsiveness, aiding transitions, creating room for discussions, and creating room for discussions. Furthermore, multiple learning styles should be included to create an inclusive educational environment.

Based on the research conducted in this chapter, several design guidelines are constructed, as can be seen in figure 4.1. These guidelines can be used to develop a satisfactory wine-tasting experience.

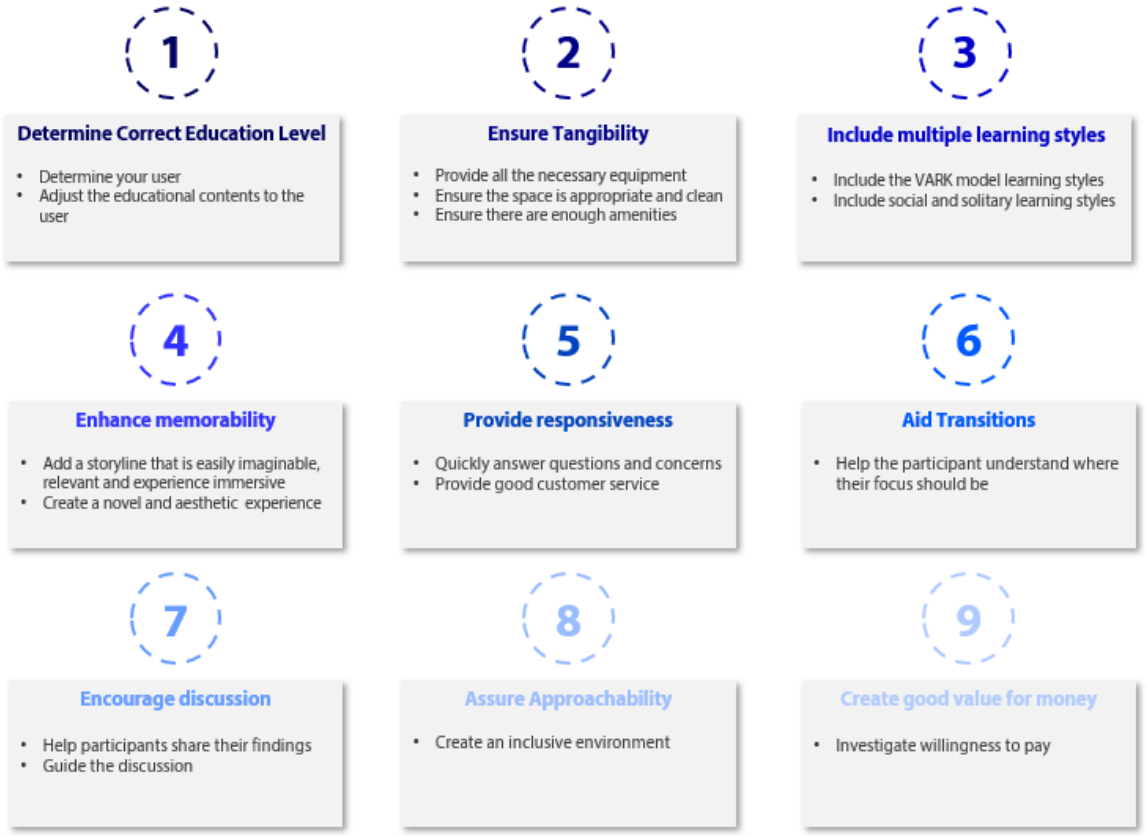


Figure 4.1: Design guidelines for the development of a satisfactory wine-tasting experience

Chapter 5

Defining the Educational Contents

As described in chapter 4: Prior Research on Wine Tastings, people are attracted to wine-tastings to gain educational knowledge on wine and their wine preferences. Additionally, it is stated that the educational level should be appropriate for beginners to create a satisfactory customer experience for novice wine drinkers. Therefore, this chapter aims to define the educational contents of the interactive technology wine-tasting experience. This information can be considered the essential base of what the interactive wine-tasting experience should teach novice wine drinkers.

This research does not aim to change the educational contents of traditional wine tastings. Therefore, to further define the novice-friendly educational level, the Wine & Spirit Education Trust (WSET) can be consulted. WSET is a global organisation that arrangers courses in the field of wine, beer, spirits and sake [58]. To set the educational level for novice wine consumers, the WSET level 1 course requirements are used [7]. The WSET level 1 course is intended for beginners with no prior experience in wine study. The course consists of two, three-hour lessons on grape growing, wine-making, distinguishing between several grape varieties and practices around storage, service and wine-tasting techniques.

Not all of these elements are important for a one-session wine tasting. Therefore, only the sections on wine-tasting techniques and characteristics of several grape varieties will be used as the information that should be provided to the participants.

5.1 Wine Tasting Techniques

Wine tasting can be systematically done, using wine tasting steps to ascertain the appearance, nose and palate of the wine [6], [7]. For novice wine drinkers, these steps can be a helpful tool to ascertain and describe the basic characteristics of a wine. The tasting steps can be further divided into the colour, nose intensity, nose aromas, palate intensity, palate aromas, acidity and the finish of the wine. Teaching how to assess each wine-tasting step is done in three parts: instruction on how to perform the assessment, trying the step yourself, and discussing the findings.

Here, the novice-friendly knowledge of these aspects and how to ascertain them is explained. This is the information that is used as a base for the interactive wine-tasting experience.

5.1.1 Appearance

The first characteristic of a wine that can be described is its appearance [6], [7]. Nevertheless, it is important to note that how a wine looks should primarily be used to describe the wine and not directly influence how the wine is perceived. The appearance should not create a false judgement on its taste or its quality. The appearance of a wine can be subdivided into many aspects, such as intensity, clarity, viscosity, spritz and tears. However, for novice wine drinkers, the focus should lie on describing the colour of the wine. To assess the colour of a wine, it is recommended to tilt the glass at an angle of 30° to 45° in front of a bright, white background.

The hue of the wine refers to the shade or tint of the colour. The colour of the wine can provide information about the grape maturity, duration of skin contact, fermentation cooperage, and age of the wine. For white wines, immature white grapes result in wines that can appear similar to water in colour, while over-mature grapes create a deeper yellow wine. As white wines age, they tend to become more golden.

For red wines, more mature grapes often enhance the intensity and depth of the colour. This is influenced by the duration of maceration, which refers to the contact of the grape skins with the juice during fermentation. Over time, red wines may lose colour density and take on a tawny brown shade. However, the differences in colours

in both white and red wines can often vary from theory when in practice. Therefore, especially for novice wine drinkers, colour should primarily be kept as a descriptor.

The WSET level 1 categorises wines into various colours, for white wines these colours are lemon, gold, and amber [7]. For rosé wines, these categories are pink, pink-orange, and orange. For red wines, the colour categories are purple, ruby, garnet, and tawny.

5.1.2 Nose

The second step is the evaluation of the nose [7]. During this step, the aromatic impression of the wine is noted. For novice wine tasters, these impressions are limited to the aromatic components and the intensity of the smell.

To assess the nose, the tasters begin by sniffing the wine with their noses almost fully in the glass [6], [7]. This initial sniff helps the taster identify the most prevalent odour in the wine before the more complex aromas are revealed. After the first sniff, the glass is swirled to release more aromatic compounds. This swirling motion allows the wine to interact with the air, intensifying the aroma. The bell shape of a wine glass is especially designed to facilitate heavy swirling while keeping the wine inside the glass, while also containing the aromatic components in the glass itself.

It is recommended to sniff the wine for at least half a second to two seconds to gather the maximum amount of aromatic information [6]. Inhaling for longer periods may result in adaptation to the wine's smell, leading to a loss of sensitivity to its aromas. It is also advised to avoid subsequent sniffs within 30 to 60 seconds, allowing the olfactory receptors to reset their sensitivity.

During this smelling the wine, it is important to take note of the aromatic fragrance components [7]. This can be a challenging task for inexperienced wine tasters. To help train their sense of smell, samples that mimic certain fragrances are often used. Alternatively, a fragrance and off-odour chart can be used to assist the taster in finding the right terminology for describing what they smell. There are a lot of aromas that can be distinguished in a wine. Therefore, to not overwhelm novice wine drinkers, the aroma chart can be simplified to about 20 white wine aromas and 20 red wine aromas.

In addition to recording the specific fragrance components, the nose intensity of the

overall olfactory sensation should be noted [7]. For novice wine drinkers, this intensity can be described as low, medium or high. The nose of the wine can be used to assess the quality of a wine. Overall, a wine is considered to be of higher quality when there are many fragrance components present and the nose intensity is high.

5.1.3 Palate

Assessing the palate of the wine involves tasting and experiencing its flavours and textures [6], [7]. The process usually begins by taking a small sip, typically around 6 to 10 ml, of the wine. While the wine is in the mouth active churning, also known as chewing, is recommended to thoroughly evaluate the wine's palate. By actively mixing the wine in the mouth, it introduces oxygen to the liquid and allows it to come into contact with all regions of the mouth. This enhances the flavours and helps to further identify the different taste profiles within the wine. Novice wine tasters should be taught how to describe the aromatic flavour components, the intensity, the acidity, and the finish of the wine's palate. x

Similar to the nose, the palate is also used to describe the aromatic flavour components and the intensity of the flavour [6], [7]. These flavour components can be, and often are, similar to those found on the nose, but might also vary. The intensity is judged on how much flavour the wine holds and can again be classified as low, medium or high. The flavour components and intensity of the wine can also be used to assess the quality of a wine. Again, a wine is considered to be of higher quality when there are many fragrance components present and the palate intensity is high.

The acidity of a wine is another characteristic that can be helpful to use when describing a wine [7]. However, it is important to note that the acidity, unless extreme, says nothing about the quality of a wine. The level of acidity can either be low, medium or high. Sugar or oak ageing can make a taster perceive the wine as less acidic, even if it is not. Therefore, an objective method can help the taster determine the correct acidity level of a wine. After churning and taking a sip, tasters take note of how much saliva is induced. The higher the acidity, the more the saliva will be produced in the mouth. In comparison, a wine with lower acidity may feel dryer on the palate. Therefore, being attentive to quantity of saliva produced can give insight into the acidity of the wine.

The finish of a wine, also known as cauladie, refers to the aromas and sensations that remain in the mouth after swallowing a small wine sample [6], [7]. It is the duration in which these aromas and sensations linger in the mouth, measured in seconds. The finish is caused by a thin film of wine that coats the mouth and throat after taking a sip. This film releases compounds into the nasal cavity, enhancing the perception of additional aromas. The finish is often subtle and brief due to the small amount of wine remaining in the mouth, lasting from several seconds to a few minutes. In general, a longer finish is preferred when evaluating a wine.

5.1.4 Assessment

The quality assessment of wine after noting the appearance, nose and palate, relies on various factors. These factors include the wine's complexity, intensity, balance, and the length of its finish.

Complexity is used to describe how many aromas are distinguishable in the wine, and how unique these aromas are. Many unique aromas found in the wine result in a complex wine, which is often related to higher quality wine. The **intensity** describes how much bold the wine smells and tastes. A high-quality wine should be very fragrant on the nose and highly flavourful on the palate. The **balance** signifies the harmonious interplay of its aromas, taste, and mouthfeel, avoiding dominance or dullness in flavour. Meaning no sensation or aroma should overpower the others. The **finish** indicates how the wine's flavours evolve after swallowing the wine, and how long it preserves its distinctive aromas. A higher quality wine should have a long finish, allowing tasters to enjoy the aromas for a longer period of time.

Although professionals try to avoid subjectivity, the individual interpretation of the tasting experience can also be taken into account for novice wine drinkers, noting if they enjoyed the wine or not. Especially, because developing wine preferences is also a reason for participating in a wine tasting, as suggested in 3.1.1.

5.2 Wine Selection for a Wine Tasting

In addition to the wine-tasting techniques, the wine-tasting aims to educate on different grape varieties that are used in winemaking. However, there are over 10,000 different wine grape varieties, each with its subtle differences [9]. The amount of wines tasted during a wine tasting often varies. However, for this tasting experience, four wines are selected. To narrow it down for novice wine drinkers, grapes that are commonly used for wine-making worldwide would be the most suitable. Furthermore, it is important to select wines for the experience that have characteristics that are distinctive enough for novice wine drinkers to detect. It can be helpful to compare two glasses of wine that are characteristically different from each other to understand how to describe the differences between them, gaining a better reference of what each characteristic means. For example, how to taste the acidity of a wine can be better put in perspective when a low-acidity wine is compared to a wine with a high acidity.

To allow for this comparison, this wine-tasting experience will include two white wines and two red wines. Both the white wines and the red wines used should be characteristically distinctive from one another. For that reason, a Sauvignon Blanc and a wooded Chardonnay are chosen. These grape varieties are commonly used for white wines worldwide and are characteristically different from one another in many aspects to allow for a good comparison. The red grape varieties selected for the experience are Merlot and Cabernet Sauvignon. Two popular red wine grape varieties. These wines are often blended in a Bordeaux blend, because they each have a very different profile on the nose and palate and complement each other in that way.

The Sauvignon Blanc selected for the wine-tasting experience is the Mount Vernon Sauvignon Blanc from New Zealand. This Sauvignon Blanc is pale lemon yellow in colour and has the typical green flavours that are usually associated with the grape, such as green bell pepper and grass. Furthermore, this wine properly represents an highly acidic wine. Additionally, this wine has a high intensity on the nose and palate and it lingers in the mouth after taking a sip, making it a wine with a long finish.

The Chardonnay used is the Lanzerac Chardonnay from South Africa. This warmer climate chardonnay has a golden hue. Furthermore, the wine has been aged on French oak, which gives it the typical vanilla notes found in oak barrel-aged wines. This

demonstrates what flavours can be added by ageing a wine in oak, a choice the wine-maker can make. This wine is low to medium in acidity, which contradicts the high acidity of the Sauvignon Blanc, clearly showcasing the differences between the two. As this wine comes from a warmer climate, the flavours of this wine are more on the riper side, compared to the Sauvignon blanc. This chardonnay has aromas of tropical fruits such as pineapple and passion fruit. Additionally, this wine has a medium intensity on the nose and palate, and has a shorter finish, when compared to the Sauvignon Blanc.

The Merlot that will be used for the experience is the Ironstone Vineyards Merlot from the United States. This Merlot is ruby red in colour and has a medium acidity level. Merlot wines are often described by their red fruits aromas, such as cherry and strawberry, which can also be found in this wine. This wine is low in acidity and has a high intensity on the nose and palate.

The Cabernet Sauvignon that has been selected, is the Catena Cabernet Sauvignon from Argentina. As this grape is grown at a higher altitude, the temperature is lower, giving the wine from these grapes a purple hue. In contrast with the Merlot, this wine has aromas in the black fruit category, such as black plum and cherry. The intensity of this wine is low on the nose, but medium on the palate, showing this difference as well. The acidity of this wine is medium and the wine has a short to medium finish.

Overall, these wines aim to demonstrate the differences in the appearance, nose and palate of a wine. However, the explanations of the wines above can be different from the observations of the participants. As they are novices in wine tasting, the descriptors do not have to be strict, but rather serve as guidelines to teach them about the different aspects of wine.

Chapter 6

Translating the Guidelines for a Satisfactory Wine-Tasting Experience into the Interactive Technology Domain

This chapter aims to answer the following sub-research question:

SQ-2: How can these guidelines be translated into the interactive technology domain, setting the requirements for the ideation of an interactive technology wine-tasting experience?

To answer this question, each guidelines set in chapter 4: Guidelines for a Satisfactory and Educational Traditional Wine-Tasting Experience is investigated through literature research and brainstorming sessions to see how they can be translated into an interactive technology domain. With these findings, the requirements for the ideation of the installation are formed. These requirements describe what is expected from the interactive technology installation and will be used for the ideation of the interactive technology wine-tasting experience.

The only guideline that is not further investigated is "good value for money", as the cost of the experience is not the main focus of this research.

6.1 Correct Educational Level

This research does not aim to change the educational contents of traditional wine tastings. It rather focuses on how these set educational contents could be better conveyed, using interactive technology. To ensure the educational level is correct for novice wine consumers, the interactive technology wine-tasting experience must focus on base-level information. The educational contents that will be included are further explained in chapter 5 Defining the Educational Contents.

As there is a lot of information available on the subject of wine, only essential, beginner-friendly information should be provided so as not to overwhelm the participants. Additionally, more in-depth information should be available if participants have more wine knowledge than expected.

The amount of wine knowledge participants have should be grasped during the beginning of the experience and the educational level should be adjusted accordingly. The wine tasting should be fully understandable for people with little to no knowledge about wine. The educational level should always be adjusted to the participants with the least amount of knowledge, as they are the main focus group of the experience. However, it should also be interesting for people who already have some knowledge of wine and wine tasting.

6.2 Tangible

To create a tangible interactive technology experience, a large table needs to be used to allow enough room for the participants and the equipment that is necessary: wine glasses, water glasses, spittoons, and water carafes. However, the customer should not be overwhelmed with too many additional items on the table. The room should be somewhat brightly lit during the appearance step, to allow for correct judgement of the colour of the wines, but could be dimly lit during the other wine-tasting steps. Moreover, during this appearance step, there should be a white background available to correctly assess the colour of the wine. Lastly, other amenities, such as bathrooms, should be readily accessible at any moment in time.

6.3 Approachable

To create an approachable interactive technology wine-tasting experience the novice wine drinkers should feel welcome. There are several ways that this could be accomplished. Firstly, complex wine terms should be avoided during the wine tasting. The wine terms that do need to be used should be explained in a way that is easily understood by everyone, using layman's terms. Furthermore, at no point during the experience should the user feel overwhelmed with the information or activities. Therefore, the duration of the experience should also be limited to a maximum of two hours.

Secondly, as mentioned in 6.2: Tangible there are already several items on the table: water glasses, wine glasses, spittoons, and water carafes. Therefore, it is important that the system created does not also require a lot of additional table space. This means the system should not add too many elements to the table if possible, limiting the extra items to one or two.

Thirdly, the system should be simple and easy to learn, as the focus should lie on understanding the educational wine-tasting information, not learning how the system works. Fourthly, wine tasting includes a lot of discussions on what elements can be found in the wine. Therefore, the wine tasting experience should create a safe environment for participants to speak up during such discussions. How a safe environment for discussion can be created is further explored in section 6.7 Create Room for Discussion.

Lastly, the marketing of the wine tasting experience should also portray the approachable element of the wine tasting. However, the marketing strategy is not further considered, as this aspect lies outside of the scope of this research project.

6.4 Memorable

According to research by [51], [52], creating an aesthetically pleasing experience plays a large role in enhancing the memorability of a wine-tasting experience. This could mean looking at the winescape, or unique location settings, but could also include themes and activities, novelty and educational aspects. A way to create such an aesthetically pleasing, novel and educational experience is through gamification or playification.

Gamification is the concept of using game elements, such as storytelling, problem-solving, competition and rewards, to encourage engagement of the user with a product or service [59]. Similarly, playificiation uses play-based interaction elements, such as problem-solving and storytelling, to make a product or service more engaging, enjoyable and motivational [60], but forgoes competition and rewards.

Gamification has been found to enhance entertainment and makes more mundane activities more fun and enjoyable [61]. Furthermore, several studies found that gamification is positively associated with brand experience, where fun and storytelling aspects of gamification have the most influence [59]. Similarly, in education, gamification elements have been successful in stimulating learning engagement and increasing interest in the subject, by creating positive motivation for learning. [62]–[64]. These findings were reported in both individual and collective activities and supported active participation [64].

More specifically, a storytelling element could help make the experience more memorable. According to several studies, storytelling can have a positive effect on the memorability of an event, further enhancing the customer's involvement with the wine [12], [65]–[68]. However, it is stated that, in education specifically, it is important that the information is provided through stories that are easily imaginable. Moreover, it is argued that the stories should be easy to imagine, relevant, and experienced immersive, such that they feel part of the story that is being told [66].

Additionally, souvenirs are often bought to remember an experience [69]. Perhaps, another way to enhance memorability is by providing a part of the experience that the customer can take home with them, as a souvenir. However, this aspect must fit within the story of the experience. What they take home can be a memorabilia, some educational information or their own tasting findings.

6.5 Responsive

To create a responsive experience, any questions or concerns the participants might have should be addressed promptly [50]. To ensure prompt answers, artificial intelligence could be considered, or a knowledgeable wine expert should be available during

the tasting. With either option, the artificial intelligence system or the expert should have the right amount of knowledge at the ready for novice wine tasters and any questions they may have. Responsiveness further entails that staff should have a positive attitude towards the participants [48].

6.6 Aid Transitions

To make sure each participant knows where their focus should lie during each step of the wine tasting, the transitions could be aided in several ways.

The instructor could help guide the participants with what they should be doing at any given moment, and steer them in the right direction when necessary. However, the system could also be built to include this information. For instance, the listening, doing, or discussion phases can be visualised to show the participants at each moment where their attention should be. Additionally, supporting visualisations can be used for each phase to further emphasise what phase is important at the moment.

The lighting in the room could also be used to guide the focus [70]. While the focus should be on the instructor, the lighting in the room could highlight that. Shining a light on the instructor and leaving the table dark could automatically move the attention towards the instructor. On the other hand, during the tasting steps, the table should be illuminated to have the focus on the wine glasses. Then, when the discussion is taking place, the whole room should be illuminated to showcase the discussion between everyone is taking place.

Music can help with attention and motivation [71]. Perhaps, background music could help the participants understand when they should be partaking in the solo activity of tasting. To have soft background music playing while they are looking, smelling and tasting the wine could encourage them to focus on their thoughts, instead of discussing their findings with other people in the group. Making the solo phase of trying the tasting step an interactive experience with the system, could also stimulate participants to keep their focus on their glass and thoughts.

These ways of aiding the transitions discussed serve as an example of what could be included in the system. However, these examples can be adjusted to better suit the

system at a later stage. How the discussion element can be better supported is further discussed in section 6.7: Create Room for Discussion.

6.7 Create Room for Discussion

Several aspects can be implemented to promote the discussions during the wine-tasting experience. This section ideates on possible methods to create room for discussion for the participants of the interactive technology wine tasting.

First, the discussions can be aided by an instructor to allow the discussions to run smoothly and answer any uncertainties there might be. Specifically for novice wine drinkers, it can be helpful to have a professional clear up any misconceptions. Furthermore, the instructor can guide the discussion towards certain important topics, or suggest talking points, such as any notes that the participants should have picked up on. As smelling and tasting notes can be somewhat subjective, an instructor can also ensure everyone knows there is no right or wrong answer. Moreover, if participants are nervous about starting the discussion, the instructor can start the discussion themselves, or ask the group a specific question to get them started.

Secondly, creating visual aids for tasting notes can also be helpful. A summary after tasting a wine, using visual aids, can allow participants to quickly scan what they have noted on the wine. This means they do not have to remember everything by heart, but have something to fall back on. Moreover, this helps participants to quickly compare their findings with each other, as well. In turn, this allows them to discuss these findings more effectively. A way this can be done is, for example, by showing the colours, displaying images of the aromas, or illustrating the tasting steps.

Thirdly, it is also important that the space is set for discussion. Therefore, the focus should be on all the participants, this could be done by somewhat brightening the overhead lightening, ensuring every participant is visible to one another. During the discussions, the system should also not be distracting, as the focus should be on each other, not the system.

6.8 Learning Styles Opportunities

To create an inclusive educational environment, multiple learning styles should be included as individuals prefer different learning styles. Most learning styles can be found in a traditional wine-tasting experience. All the elements of the VARK model are present in varying degrees. Auditory learning is achieved by orally explaining the elements of a wine, how to perform the wine-tasting steps and how to assess the wine. Visual learning is done by demonstrating how to perform the wine-tasting step. Kinesthetic learning is achieved by letting the participants try the tasting steps themselves. However, only the writing aspect of the read/write learning style is achieved, as during some tastings participants can find the time and space to write down their own findings.

Overall, the auditory learning style is the most present in the traditional wine-tasting experience. This creates an opportunity to create a wine-tasting experience that includes more of the other learning styles. Thus, including more visual aids, more kinesthetic activities, and more reading and note-taking opportunities.

Furthermore, traditional wine-tasting experiences mostly focus on the social learning style. Participants are asked to listen to the instructor, socialise and discuss and compare their findings with others. Perhaps the interactive technology wine-tasting experience can create an opportunity for solitary learners to reach their own conclusions at their own working pace.

6.9 Conclusion

For the requirement approachable, this means snobbish and hard-to-understand wine terms should be avoided if possible, or should be explained so that they are easily understood by everyone. Furthermore, the experience should not inhibit too much table space, possibly adding only a few items if necessary. Approachable also includes the limit on information that is provided. The system should be easy to learn and not too much additional educational information should be given during the tasting, adjusting the educational level to the knowledge of the participants. Lastly, a safe environment should be created for the participants to participate during the discussion

portion of the tasting steps.

To ensure a memorable experience, the system created should be aesthetically pleasing, include themes and activities, be novel and support the educational aspects. This can be done through gamification, more specifically focusing on the storytelling aspects of these two concepts. Additionally, having the users take home a memorabilia, additional educational information and/or their own tasting notes could also enhance memorability. Lastly, during the design process, it is important to be cautious of the length of activities and the level of repetition so as to not bore the participants.

For the experience to be responsive, any questions or concerns should be quickly addressed. Therefore, either artificial intelligence or a knowledgeable wine expert with a positive customer service attitude should be available. Participants should also be able to leave their concerns about the experience.

To properly aid the transitions during the tasting, the system should guide whether the focus is on the explanation, the individual's glass, or the discussion. This could be done by supporting visuals, type of activity, lighting or music. An instructor could also help guide the participants with what they should be doing.

Lastly, the participants should feel comfortable to discuss their findings. Therefore, the system should make sure there are no right or wrong answers. If participants are nervous about starting the discussion, this can be done by an instructor. Furthermore, the discussion could be aided by an instructor or the system by guiding participants towards certain topics. Visual aids could also be helpful for participants, providing them with a summary of what their findings were and what they can talk about. The space and ambience should also be appropriate for discussion, with a focus on all participants and no other distractions.

6.9.1 List of Requirements for the Ideation of an Interactive Technology Wine-Tasting Experience

This chapter aimed to answer the following sub-research question:

SQ-2: How can these guidelines be translated into the interactive technology domain, setting the requirements for the ideation of an interactive technology wine-tasting experience?

This chapter translated the guidelines for setting up a traditional wine-tasting, set in chapter 4: Guidelines for a Satisfactory and Educational Traditional Wine-Tasting Experience, into the interactive technology domain through literature research and brainstorming. With this information, the requirements for ideation of an interactive technology wine-tasting experience have been created.

The requirements that need to be considered when creating the system are listed using the MoSCoW method [72]. Each requirement is prioritised on whether they are a "must have", "should have", "could have", or "won't have". The requirements are used in 7: Ideation Based on the Non-Functional and Functional Requirements to score the ideas that are devised during the brainstorming sessions, and for the evaluation of the system in chapter 12: Evaluation of the Non-Functional Requirements.

The requirements are further subdivided into functional and non-functional requirements (NFR). The functional requirements (FR) specify what actions the installation will satisfy [73]. The non-functional requirements explain how easy, fast and well the system will perform.

6.9.1.1 Correct Educational Level

NFR-1 **Must** be fully understandable for participants with little to no experience with wine and/or wine-tasting

NFR-2 **Should** increase the participant's knowledge on how to describe the appearance, nose and palate of a wine

FR-1 **Should** educate on how to assess and describe the appearance of the wine, using the colour of a wine

FR-2 **Should** educate on how to assess and describe the nose of the wine, including intensity and type of aromas

FR-3 **Should** educate on how to assess and describe the palate of the wine, including intensity, type of aroma, acidity and finish

FR-4 **Should** educate on the differences between sauvignon blanc and chardonnay

FR-5 **Should** educate on the differences between merlot and cabernet sauvignon

FR-6 **Could** educate on how to objectively judge the quality of the wine

FR-7 **Could** adjust the provided information to the knowledge level of the participants

6.9.1.2 Tangibility

FR-8 **Must** include correct equipment: wine glass, water glass, spittoon and carafe-tasting

FR-9 **Must** provide enough space for the equipment: wine glass, water glass, spittoon and carafe

FR-10 **Must** be brightly lit during appearance step

FR-11 **Must** provide a white background for appearance step

FR-12 **Must** have bathroom readily available

FR-13 **Should** not add more than two additional items onto the table

FR-14 **Could** be dimly lit during other steps

6.9.1.3 Approachable

NFR-3 **Must** be concluded within two hours

NFR-4 **Should** be an easy-to-understand system

NFR-5 **Should** explain wine terms in easy-to-understand language

NFR-6 **Should** not overwhelm the participant

FR-15 **Should** exclude complex wine terms

FR-16 **Should** not add more than two additional items onto the table

6.9.1.4 Memorability

NFR-7 **Should** include a storyline that is easily imaginable, relevant and experienced immersively

FR-17 **Could** provide the participant something to take home to remind them of the experience

FR-18 **Could** provide the participant something to take home to teach them more about wine and wine-tasting

6.9.1.5 Responsiveness

NFR-8 **Should** answer any questions about the educational contents immediately

NFR-9 **Could** answer to any concerns about the experience within two weeks

6.9.1.6 Aid Transitions

NFR-10 **Should** create focus on element where the user should be focusing on: instruction, execution or discussion of the wine tasting steps

FR-19 **Could** include supporting visualisations to guide focus

FR-20 **Could** use lightening to guide focus

FR-21 **Could** music to guide focus

6.9.1.7 Have room for discussion

NFR-11 **Should** have the participant feel safe to speak up during the discussion

NFR-12 **Should** give participants enough time to formulate their own findings

NFR-13 **Should** make it easier for the participants to formulate their findings

NFR-14 **Should** ensure the user there are no right and wrong answers

FR-22 **Should** display visual representations of the tasting notes

FR-23 **Should** display the tasting note findings of the participants to allow for a quick comparison

FR-24 **Could** guide towards certain talking points

FR-25 **Could** initialise the discussion

FR-26 **Could** use lightening to guide focus to the discussion with the rest of the group

6.9.1.8 Learning Styles

FR-27 **Should** represent all learning styles: kinesthetic, auditory, visual, read/write, social and solitary

Chapter 7

Ideation Based on the Non-Functional and Functional Requirements

The requirements for the ideation of an interactive technology wine-tasting experience were set in chapter 6: Translating the Guidelines for a Satisfactory Wine-Tasting Experience into the Interactive Technology Domain, and the educational content were defined in chapter 5: Defining the Educational Contents. This provides all the information that is needed to start the ideation for the experience. This chapter considers several design ideas and decisions for an interactive technology wine-tasting installation. Each of the design decisions included in the concept is made based on the requirements set in chapter 6: Translating the Guidelines for a Satisfactory Wine-Tasting Experience into the Interactive Technology Domain. All of the design decisions in this chapter result in a final concept idea.

7.1 Having an Instructor Present

Based on the following requirements, it is advised to have a trained instructor present, to facilitate the experience. The instructor should have at least completed WSET level 2 [7], or have a similar certificate.

The interactive technology wine-tasting experience:

FR-1 **Should** educate on how to assess and describe the appearance of the wine, using the colour of a wine

FR-2 **Should** educate on how to assess and describe the nose of the wine, including intensity and type of aromas

FR-3 **Should** educate on how to assess and describe the palate of the wine, including intensity, type of aroma, acidity and finish

FR-4 **Should** educate on the differences between sauvignon blanc and chardonnay

FR-5 **Should** educate on the differences between merlot and cabernet sauvignon

FR-6 **Could** educate on how to objectively judge the quality of the wine

FR-7 **Could** adjust the provided information to the knowledge level of the participants

FR-24 **Could** guide towards certain talking points

FR-25 **Could** initialise the discussion

NFR-5 **Should** explain wine terms in easy-to-understand language

NFR-8 **Should** answer any questions about the educational contents immediately

NFR-9 **Could** answer to any concerns about the experience within two weeks

NFR-11 **Should** have the participant feel safe to speak up during the discussion

NFR-12 **Should** give participants enough time to formulate their own findings

During the interactive wine-tasting experience, the instructor will provide the participants with instructions on how to look at, smell and taste a wine and educate them on how to describe the characteristics and judge the quality of a wine based on their findings. Furthermore, they will guide the users in the right direction when they are executing the wine-tasting steps and lead the discussion of participants' findings. Additionally, aiming to make them more comfortable to discuss their findings.

The instructor will also set the pace for the experience, making sure the participants get enough time to formulate their findings. Moreover, an experienced instructor can assess the knowledge level of the participants quickly and possibly adapt the level of information that is taught to the participants' level. Additionally, having someone present allows for questions and concerns to be addressed promptly and, if done correctly, should ensure good customer service.

7.2 Storyline

Based on the section 6.4 Memorable, the following non-functional requirements should be met.

The interactive technology wine-tasting experience:

NFR-7 **Should** include a storyline that is easily imaginable, relevant and experienced immersively

Therefore, the decision is made to add a story element to the experience. According to [66], the story must be easy to image, relevant and experienced immersively to create an enhanced factor of memorability. Therefore, these aspects will be used in judging possible storylines for the experience.

To investigate possible storyline ideas, an ideation session is conducted by the researcher to create a possible storyline for the experience. First a list of associations with the word "wine" is ideated, after which possible storylines for each of these associations are ideated upon with the use of a mind-map. This process can be seen in appendix A.

According to the requirements set in section 6.4, the storytelling element should be easy to image, relevant and experienced immersively, making the user feel like they are a part of the story that is being told. Therefore, the storyline should meet these expectations.

One of the ideas that most fit these requirements is chosen as a storyline:

The participant is a wine reviewer who just started working for a new magazine, 'the Sommelier'. To make sure their tasting notes are in line with the magazine's the first wine review they are writing is in combination with someone who has worked at the magazine for a long time and is a huge name in the wine industry, this will be their instructor. The instructor will show the reviewer how he looks at, smells, and tastes a wine and what elements of the wine should be noted in a wine review.

Additionally, the functional memorability requirements can be used to further de-

velop this storyline by adding a hand-out.

The interactive technology wine-tasting experience:

FR-17 **Could** provide the participant something to take home to remind them of the experience
FR-18 **Could** provide the participant something to take home to teach them more about wine and wine-tasting

Therefore, at the end of the session, the user gets a magazine printout with several articles:

1. *An advertisement for the interactive technology wine-tasting experience, which they can give to their friends and family to recommend the experience.*
2. *An article on how to taste wine, so they can try the tasting steps at home.*
3. *A review of the wine, complete with their own individual tasting notes incorporated in the review.*
4. *An article describing what wines they could try next.*

7.3 Comparing Two Wines

Based on section 5.2 Wine Selection for a Wine Tasting, it can be helpful to compare two wines with different characteristics, which is why the following requirements were set. The interactive technology wine-tasting experience:

FR-4 **Should** educate on the differences between sauvignon blanc and chardonnay
FR-5 **Should** educate on the differences between merlot and cabernet sauvignon

Therefore, the decision is made that the second white and the second red wine are poured into a new glass, allowing the user to compare the glass with the first wine with the second wine for each of the wine-tasting steps. With the wines chosen based on their distinctive characteristics, comparing the two wines can help the user better perceive these differences in appearance, nose, and palate.

7.4 Turning the Wine-Tasting Steps into an Interactive Technology Experience

The wine-tasting steps each consist of three parts: instructions on the wine-tasting step, execution of the wine-tasting step, and discussing the wine-tasting step. This section explores how each of these parts could be represented through interactive technology.

7.4.1 Instructions on the Wine-Tasting Steps

With a traditional wine-tasting experience, the instructions on how to assess the appearance, nose and palate of a wine are explained and demonstrated by the instructor before the participants get to try it themselves. As discussed in chapter 4 Guidelines for a Satisfactory and Educational Traditional Wine-Tasting Experience, this mainly addresses the auditory learning style and kinesthetic learning style, while including a few aspects of the visual. Therefore, the interactive technology wine-tasting experience should try to further encompass the latter learning style, as well as, include a write/read learning style aspect. This can be done by adding more supporting visual aids, as well as, written text explaining how to look at, smell and taste the wine. Therefore, including the following requirements:

FR-1 **Should** educate on how to assess and describe the appearance of the wine, using the colour of a wine

FR-2 **Should** educate on how to assess and describe the nose of the wine, including intensity and type of aromas

FR-3 **Should** educate on how to assess and describe the palate of the wine, including intensity, type of aroma, acidity and finish

FR-27 **Should** represent all learning styles: kinesthetic, auditory, visual, read/write, social and solitary

7.4.2 Execution of the Wine-Tasting Steps

After the participants have been explained how to assess the wine, it is time for them to note their findings. The execution of the wine-tasting steps should:

Therefore, further exploring the requirements:

FR-1 **Should** educate on how to assess and describe the appearance of the wine, using the colour of a wine
FR-2 **Should** educate on how to assess and describe the nose of the wine, including intensity and type of aromas
FR-3 **Should** educate on how to assess and describe the palate of the wine, including intensity, type of aroma, acidity and finish

During traditional wine tastings, this is often done through a discussion with the group on everyone's findings. This means this aspect of the wine tasting mainly utilised the social learning style described in chapter 4 Guidelines for a Satisfactory and Educational Traditional Wine-Tasting Experience. However, to incorporate more of the solitary learning style, participants should first be encouraged to note their findings individually, before discussing it with the group.

Therefore, this is an ideal aspect of the wine tasting to ideate on possible interactions the participant could have with the system to help them formulate their findings.

7.4.2.1 Method

For each of the descriptors the participants should be able to note the appearance, nose and palate of the wine, as described in 5 Defining the Educational Contents, a mind mapping session is done. This means a central topic is placed in the centre of the mind map. Nodes of secondary or tertiary thoughts related to the central topic are added to the mind map until all ideas have been exerted.

To form each central topic the mind maps are divided into the seven wine-tasting steps: colour, nose intensity, nose aromas, palate intensity, palate aromas, acidity, and finish. During this first part of the ideation process, the only restrictions placed are that the idea should aim to explain the specific wine-tasting step and the user should be able to interact with the system, so as not to limit possible ideas.

After completing the mind maps, which interactions will be included in the design of the interactive technology wine-tasting experience need to be chosen.

This decision is based on the following requirements set section 6.9.1 List of Requirements for the Ideation of an Interactive Technology Wine-Tasting Experience:

The interactive technology wine-tasting experience:

NFR-4 **Should** be an easy-to-understand system NFR-6 **Should** not overwhelm the participant
FR-16 **Should** not add more than two additional items onto the table

These requirements are taken into account, as they are aimed at the interaction element of the system. Therefore, any idea that meets all three of these requirements is highlighted. The highlighted ideas are then combined to create an interactive concept that allows the participant to select their findings.

7.4.2.2 Results Mind-Map Ideation Sessions

The appearance step for novice wine drinkers focuses on the colour of the wine. Therefore, a mind map with initial ideas on how to create an interactive activity to investigate the colour of the wine is created. The mind map on the ideation of interactive activities during the appearance phase can be seen in figure 7.1.

For the nose step, a mind-map session on investigating the intensity and the aromas is conducted. The mind map on the ideation of interactive activities during the nose step can be seen in figure 7.2.

For the palate step, the ideation session focuses on finding interactive activities for investigating the intensity, the aromas, the acidity, and the finish. This mind map can be seen in figure 7.3.

As the nose intensity and the palate intensity use a similar aspect of the wine, the ideas generated are similar. Therefore, the ideation session of the palate intensity is kept to a minimum.

To further elaborate on the findings, the selection process of why several ideas in the appearance mind map have not been selected is explained. The ideas that have not

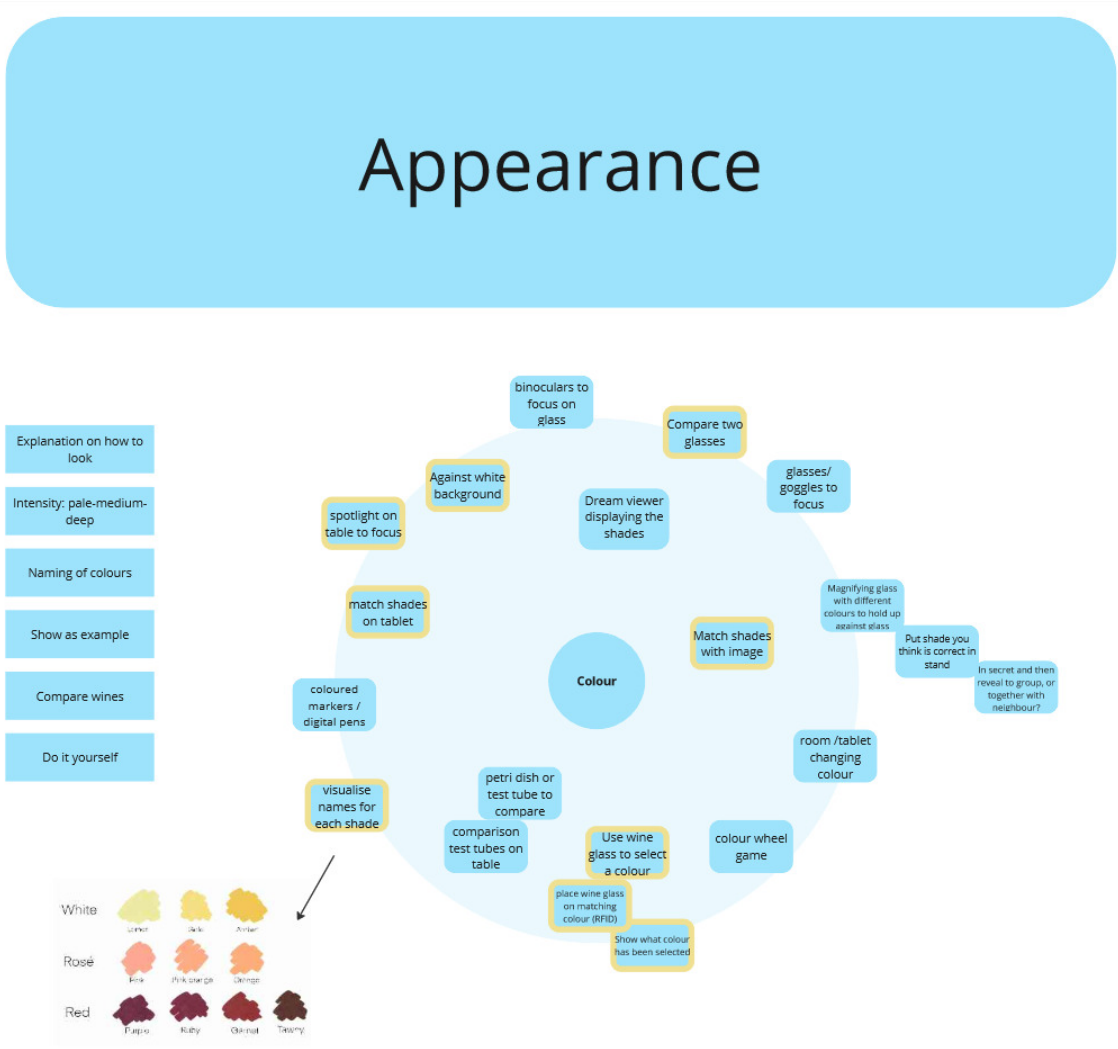


Figure 7.1: Mind map of ideation session on possible interactive activities for the appearance step

been highlighted have not been chosen because they do not resonate with one or more of the requirements of section 7.4.2.1. Several ideas, such as, "magnifying glasses with different colours" added too many items to the table, contradicting the approachable requirement "**Should** not add more than two items to the table". Furthermore, not all interactions were considered intuitive enough, such as a "dream viewer displaying the shades" which is not in line with the approachable requirements "**Should** be an easy-to-understand system" and "**Should** not overwhelm user".

With this selection process, all possible ideas have been highlighted, as can be seen in figure 7.1, 7.2, and 7.3. All of the highlighted ideas meet all three of the requirements

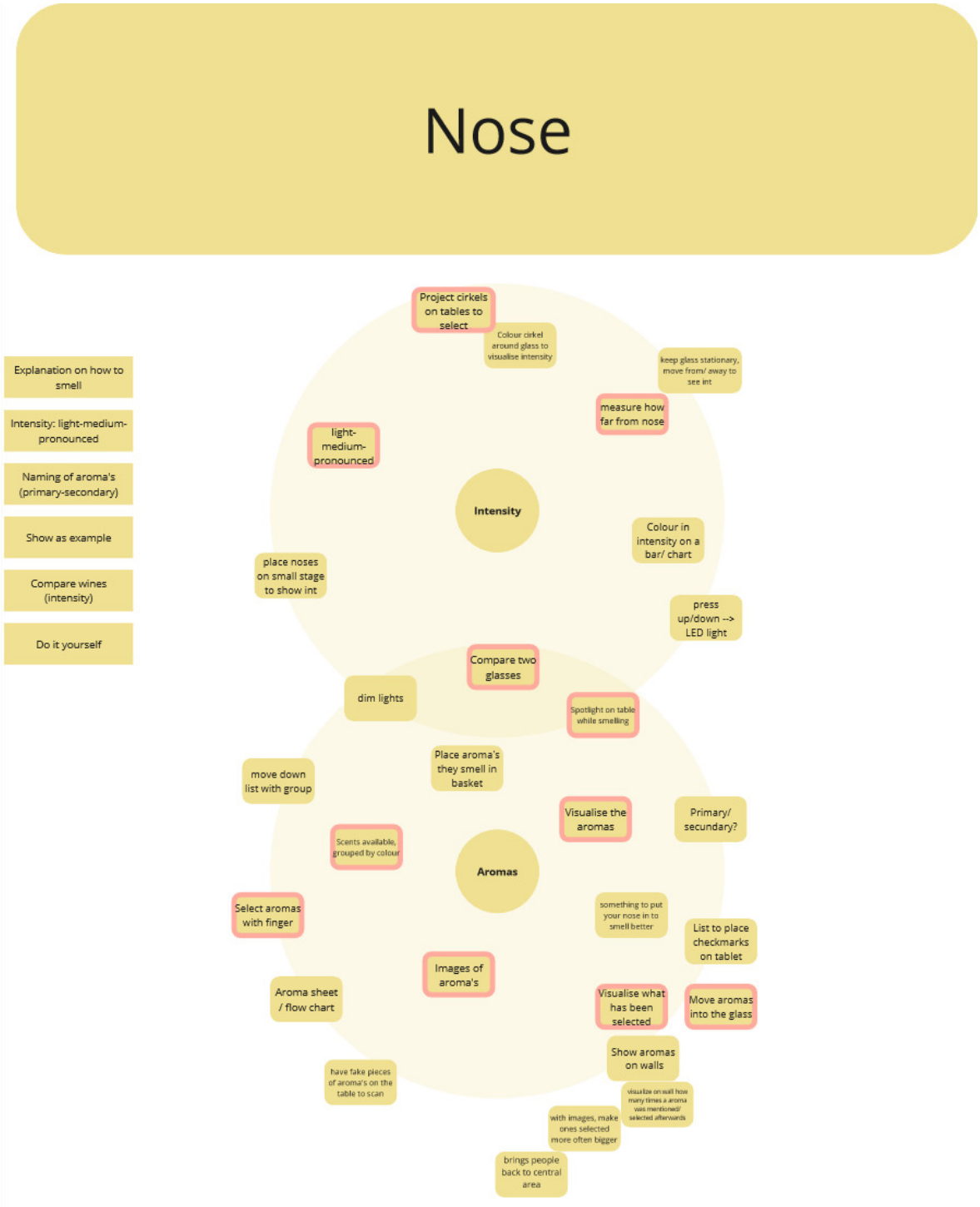


Figure 7.2: Mind map of the ideation session on possible interactive activities for the nose step

as set above.

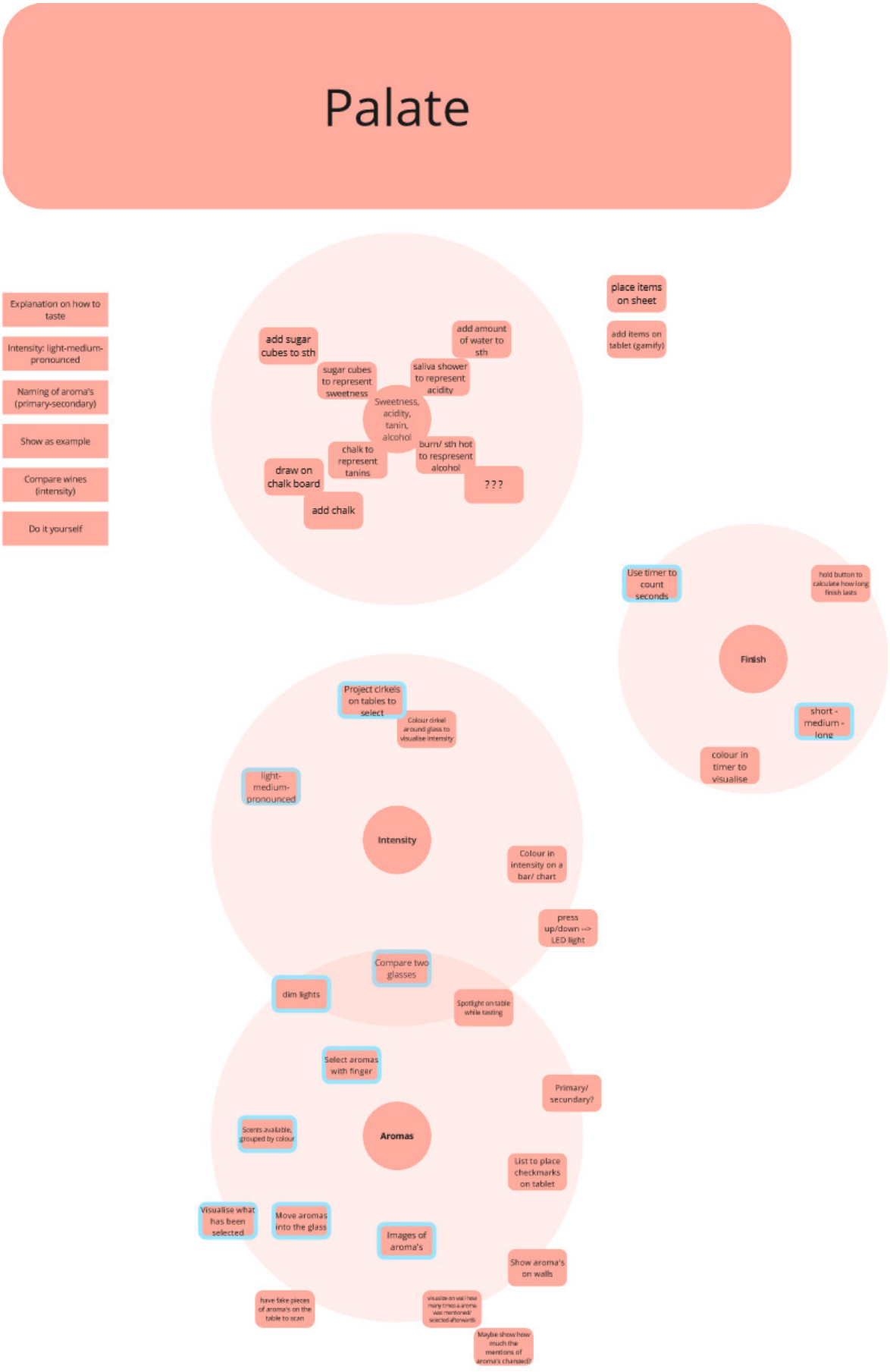


Figure 7.3: Mind map of the ideation session on possible interactive activities for the palate step

7.4.3 Discussion of the Wine-Tasting Step

Several requirements have been set to ensure the participants feel that there is enough room for discussion. Therefore, these requirements are used to design the discussion section of the interactive technology wine-tasting experience.

The interactive technology wine-tasting experience:

NFR-11 **Should** have the participant feel safe to speak up during the discussion
NFR-12 **Should** give participants enough time to formulate their own findings
NFR-13 **Should** make it easier for the participants to formulate their findings
NFR-14**Should** ensure the user there are no right and wrong answers
FR-22 **Should** display visual representations of the tasting notes
FR-23 **Should** display the tasting note findings of the participants to allow for a quick comparison
FR-24 **Could** guide towards certain talking points
FR-25 **Could** initialise the discussion
FR-26 **Could** use lightening to guide focus to the discussion with the rest of the group

To make sure the first requirement is met, there should be enough time between the execution of the wine-tasting step and the discussion of the wine-tasting step to allow the participants to make their selection first. To make sure this does not take too long, the instructor can nudge the participants in the right direction. Then, it is time for the participants to share their findings with the rest of the group.

To make it easier for the user to formulate their findings and to make people feel comfortable to discuss, it would be helpful if the user has an overview of their tasting notes. By showing them what selections they have made during all of the previous execution steps during the discussion, they have a quick overview of what to discuss.

The discussion itself already has aspects of the auditory and social learning styles. Therefore, the overview could provide the user with visual, written and solitary learning styles. This can be done by visualising their findings visually, as well as, labelling the findings. Having the overview itself further supports the solitary learning style, as users can compare their findings with those of the others, without having to speak up and

join the discussion if they do not feel like it.

Lastly, the system should never mark or correct the findings of the user, as there should be no wrong answers in wine-tasting observations for beginners. Users should feel free to discuss their findings without judgement. This is also something the instructor could additionally clarify.

7.5 Interactive Table

Based on the design decisions formulated in this chapter, the decision to create an interactive table is made. Firstly, the interactive table would be able to facilitate the interactive concepts described in section 7.4: Turning the Wine-Tasting Steps into an Interactive Technology Experience.

Secondly, as no items are further added to the table, this should leave enough room for the participant to use the interactive table, and placement of the wine glasses, water glasses, spittoons and carafes. Therefore meeting the tangibility requirement:

The interactive technology wine-tasting experience:

FR-9 **Must** provide enough space for the equipment: wine glass, water glass, spittoon and carafe

Lastly, an interactive table would work well within the group, as wine-tasting is a social activity that includes the instructor and other participants. An interactive table can display additional information, without distracting the participants from the group. Furthermore, the interactive table could even guide the participants on where their focus should lie during each tasting step. Therefore, meeting the aid transitions requirement:

The interactive technology wine-tasting experience:

NFR-10 **Should** create focus on element where the user should be focusing on: instruction, execution or discussion of the wine tasting steps

Chapter 8

The Interactive Technology Wine-Tasting Experience

With the design decisions made in chapter 7 Ideation Based on the Non-Functional and Functional Requirements, the initial concept of the interactive wine-tasting experience is defined:

The interactive wine tasting experience is an experience where novice wine drinkers can learn how to taste and describe wine, in an interactive manner, using a systematic approach. The total experience takes up approximately two hours. During these two hours the participants are first welcomed to take a seat at the table. Each participant's name is projected on the table at a seat where they can take place. Once everyone is seated, the introductory story will start:

"Welcome to the headquarters of the renowned wine magazine, the Sommelier. Today, you have started your job as our newest wine reviewers. To make sure we are all on the same page, I will help you write your first review. Your task today is to look at, smell, and taste the wines I will present to you. And I will show you what elements of the wine should be definitely be noted in the review. At the end of this session, the notes and observations you make will be incorporated into the final wine review that will be featured in the magazine. So, pay attention, take it all in, and trust your palate."

After the introduction, the instructor will introduce themselves and the tasting experience starts. The instructor explains that tasting a wine consists of three steps:

appearance, nose and palate, and that for each step several characteristics of the wine can be noted. They further explain that during the tasting, the participants will be instructed on what to do during each step, then try it themselves, using the interactive table, and then discuss their findings with the group.

At this point, the first wine is poured into one of the wine glasses for each participant, a Sauvignon Blanc. First how to look at a wine to assess the colour is explained by the instructor, with supporting visuals that are projected on the table in front of each participant. After these instructions, the participants can try to assess the colour for themselves. During this step the projections on the table will help the participant make their choice.

During the do-it-yourself step, the projections will show the options that the participants can choose right in front of them. For colour, these options are lemon, gold or amber for white wine and purple, ruby or garnet for red wine. The participant can place their glass on the colour they feel most coincides with the colour of the wine in the glass. The instructor can further advise the participants on what to do, if they seem to be stuck. Once the participant places the wine on that colour, an animation will show what colour they have selected. At this point, they can still pick up their glass to pick another colour. After everyone has selected one of the colours, the instructor moves on to the discussion portion of the appearance step.

A large part of wine tasting is discussing one's findings. Therefore, during the discussion, the participants can explain what colour they chose and why. This discussion is aided by the instructor. In front of every participant, their findings are projected, so they can quickly see what colour they have chosen in the previous step.

Finishing up the appearance steps, it is time to move onto the nose. Now, the instructor will explain how a wine is smelled and what aspects of a wine can be noted: the intensity of the smell and the aromas found in the nose. The projections on the table will show supporting visualisations on how to sniff a wine. After the instructions, the participants are asked to try it themselves.

To note the intensity, the projection on the table will once again show the options, where the participant can place their glass to select the level of intensity they smell. After everyone's selection is complete, the same can be done for the aroma picking.

The aromas they smell in the wine can be selected by pressing virtual buttons that are projected onto the table. Again, after every do-it-yourself step, the summary of what each participant has picked will be visualised before them to help them start discussing their findings with the rest of the group, guided by the instructor.

After smelling, the instructor will explain how to taste a wine and what aspects of the palate are important: the intensity of the taste, the aromas found in the palate, the acidity level of a wine, and how long the finish is. Similarly to the nose intensity and picking the nose aromas, the participants can use the virtually projected buttons on the table to select their findings. The acidity level can also be selected by placing the wine glass on the circle that corresponds to the acidity in the glass (low, medium or high).

To time the finish, a timer will be projected in front of the participants. Once they swallowed their wine, they can hit the start button. At the moment they do not taste the wine anymore, they press stop. This is how long the taste lingers in the mouth, which will automatically be visualised in terms of short, medium or long finish.

After this last step, the summary will be visualised again. However, this time the aspects that are important for rating a wine are highlighted. The instructor explains that these characteristics of a wine can be used to objectively judge the quality of a wine.

All of the tasting steps will then be repeated for a Chardonnay, a Merlot and a Cabernet Sauvignon. The two white wines and two red wines can also be compared to each other during the steps. During the last wine, the Cabernet Sauvignon, the participants will one by one be asked to give the how-to instructions of each of the wine-tasting steps. To aid them in this process, the visuals of how to do the step are projected on the table in front of them.

At the end of the experience, each participant receives a magazine printout with an advertisement for the experience, an article on how to taste like a pro, a review of each of the wines with their own tasting notes included, and an article describing what type of wines they could try next.

Chapter 9

Specifying the Interactive Technology Wine-Tasting Experience

In this chapter, the interactions of the technology wine-tasting installation are specified further. Each of the design decisions that are made to create the experience are explained in further detail. This specification results in several additional functional requirements that need to be met while realising the installation, which are outlined at the end of this chapter.

The interactive installation consists of a projector that projects on the surface of the table and a board for each participant that holds the sensors that register the participant's input. These sensors can detect a wine glass on the table and the touch of the user, in certain areas. Furthermore, at the end of the interactive wine-tasting experience, each participant receives a personalised printout of a magazine.

The experience takes place in an open place at a large table, with about 6-8 participants. Each table space reserved for a participant holds one interactive board underneath the tablecloth, creating a new, slightly higher, table surface. On top of the board, each participant's space holds two wine glasses, a water glass, and a small spittoon. During the experience, an expert (WSET level 2 or higher) is present to instruct the participants and guide the process.

The interactive wine tasting experience consists of an introduction, the wine-tasting steps, and the ending. Each of the wine-tasting steps are further divided into three parts: instructions on how to do a wine tasting step, having the participants execute

the wine tasting step using the interactive table, and discussing their findings with the group.

9.1 Introduction to the Interactive Wine-Tasting Experience

When the participant enters the wine-tasting room, their name will be projected at one of the table placements. This is done to make sure that the user input that is recorded is connected to the correct participant, which is necessary for the magazine hand-out to reach the correct participants at the end of the experience.

After all participants are seated, the introduction will start. To support the wine magazine story explained in chapter 9: Specification, an image of the front page of the magazine, which they will receive at the end, is projected on the table in front of each participant.

When each of the wines is poured into the glasses, the table in front of the participants will show which wine number they are on. The instructor can decide what aspects of the wine they would like to share with the participants, depending on the level of knowledge participants might have, or if they want to do a blind tasting where participants don't know anything about the wine. Therefore, the grape variety, winemaker and origin are not specified on the projection.

9.2 Instructions on How To Do a Wine-Tasting Step

As explained in section 5.1, the first part of teaching the participants how to do a wine-tasting step is by giving an explanation on what to do.

For each of the wine-tasting steps, the participant needs to look at, smell, or taste the wine in a certain way. As the instructor is present, these steps are all explained by the instructor. However, to aid the verbal instructions, visual and read/write learning styles are incorporated. In addition to the verbal explanation, illustrations and a short description of how to do each of these steps are provided as a projection on the table in front of them.

These steps are performed for every wine, which means that the instruction is given four times in total. After the first explanation and execution of a step, most participants might already be familiar with how to do the step. Therefore, the explanation page can be simplified for the second wine by removing the description on how to do the step, only showing the visual aids and the name of the descriptor.

For these projections, the background is black with a white explanation on top, which makes the table surface somewhat dim, when compared to a bright white background. This is done, because the main focus of the participants should be on the instructor, with the illustrations and explanation on the table only serving as additional visual aids. Whether the participants are about to do an appearance, nose or palette step is visualised by an illustration of an eye, nose or mouth, respectively.

9.3 Execution of the Wine-Tasting Step Using the Interactive Table

After each explanation on how to look at, smell, or taste the wine, it is time for the participants to execute each of these steps themselves. During these sections of the tasting, the interactive table aims to aid the participants to execute the step, as well as, to allow them to record their finding. These projections have a white background, with the brightness ensuring that the focus of the participants is on the table in front of them.

9.3.1 Interaction to Select the Corresponding Colour

To select the colour of the wine, the users are asked to match the wine in their wine glass to one of the three shades visualised on the table. The shades are visualised as three circles, slightly larger than the base of a wine glass, placed horizontally, as can be seen in figure 9.1. The visualised shades give them a visual point of reference to compare the wine in their glass to. The shades names are also labelled next to the shades, connecting the colours to the correct names of the wine colours.

If the user has decided which shade matches best, they can select that shade by placing their wine glass onto that shade on the table. At this point, the system senses

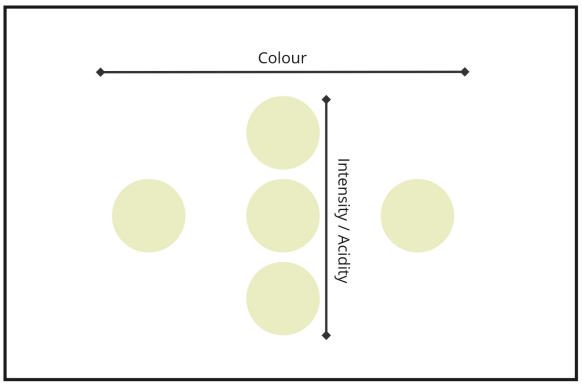


Figure 9.1: The placement of the load cells. The colour options are placed horizontally, while the intensity and acidity are placed vertically.

the placement of the wine glass and recognises which colour has been selected. To show that they have selected a colour, the circle under their wine glass starts to pulse. By having to place the wine glass on the table to make a selection, there is a clear end for this step. Additionally, it provides a quick overview of which users are finished with the step and which users are still using their glass to find the colour they feel suits best.

Through the sentence "Place your wine glass on the corresponding colour", the participants are prompted to place their wine glasses on the colour they think best suits the colour of the wine in their glasses. After placing their glass on one of the colours, the prompt turns grey instead of black, to make it less bidding. However, it is still visible as a reminder of which action the participant has just taken. If they pick their glass back up, their selection is removed.

During this step, the participant needs enough light to properly see the wine. Therefore, the lights above the table should be bright and white during this step. However, to create a more relaxed ambience during the other parts of the experience the lighting can be more dim and yellow. For this purpose, an adaptable light, such as the Phillips Hue lights can be used [74].

Furthermore, the background where the three circles are displayed upon should be white for two reasons. Firstly, to give the users a white background against which they can look at the wine. Secondly, a bright background shows the participants that they should be focusing on the table in front of them.

9.3.2 Interaction to Select the Corresponding Nose Intensity

The interaction to select the corresponding intensity is similar to selecting the colour. Identical to selecting the colour, there are three circles the user can select, because there are also three nose intensity levels. However, now these circles are placed vertically instead of horizontally, as can be seen in figure 9.1. This is because the nose intensity is determined by how far you can still smell the wine. Thus, visually presenting this on the table as well. The circles are labelled, "light", "medium", "pronounced", to show the user what the exact intensity options they can select are.

The users are asked to select the option they think suits best with the wine in their glass by seeing how far they can still smell the wine. Again, they select the intensity by placing their wine glass onto the corresponding circle on the table, where the system recognises the placement. Resulting in the pulsing of the circle underneath the glass.

The circles grow in size and colour intensity the further away they are, to visualise that placing the glass further away, means a higher nose intensity. The circles are different shades of blue, as blue is a neutral colour because it is not associated with either white or red wine. The users are guided to decide on a circle to place their glass on by displaying the question they should be answering. For the nose intensity, this question is: 'How far can you still smell the aromatic components of the wine?'. In this sentence, 'aromatic components' is written in bold as this is the main subject in describing the nose intensity. Again, the background is white, placing the focus of the participants on the table in front of them.

9.3.3 Interaction to Select the Corresponding Nose Aromas

There are 19 white wine aromas and 19 red wine aromas that can be selected. This means there are too many aromas to use the same interaction, using the wine glass, to select the aromas. Therefore, for this interaction, the user selects their aroma choices with their finger.

To visualise the aromas the participants can select, an illustration of each of the aromas is used. Each illustration is placed in a circle, essentially creating a virtual button. Each button is labelled with the name of the aroma, to make sure the user knows what each illustration portrays.

Aromas can be further categorised into subsets, such as “herbaceous” and “Stone fruit”. For novice wine drinkers it can sometimes be hard to distinguish an aroma immediately. First determining which overall category they are smelling or tasting can be helpful. Therefore, the aromas are also visually categorised into these subsets. Moreover, these categories are coloured with the colour most commonly associated with those types of aromas.

Participants can select aromas by touching the projection of the aroma on the table, with their fingers. To show the participant which aromas they have selected, the a smaller illustration of the aroma is visualised at the top of the projection. Additionally, the illustration of the aroma they have selected turns black-and-white, with a black return arrow on top of it. If they press the black-and-white aroma button, with the return arrow, again, they can undo their selection. This removes the smaller illustration at the top and turns the aroma button back to its original colours, without the return arrow on top.

During this step, finding none of the aromas in the glass can also be an option. If a participant is not able to find an aroma themselves, the instructor should try to guide the participants through the process. However, if they still can not ascertain one of the aromas, selecting none is also an acceptable answer.

9.3.4 Interaction to Select the Corresponding Palate Intensity

This step is almost identical to that of the nose intensity. Therefore, the same interaction is used. The interaction to select the corresponding palate intensity is described the same as the interaction to select the corresponding nose intensity, described in section 9.3.2.

For the palate intensity, the question shown on the table is: "How pronounced are the flavours of the wine?".

9.3.5 Interaction to Select the Corresponding Palate Aromas

This step is the same as selecting the nose aromas, only now with tasting the wine. Therefore, the interaction is exactly as described in section 9.3.3.

9.3.6 Interaction to Select the Corresponding Acidity

The acidity is also divided into three step "low", "medium", and "high". Therefore, the same interaction for the acidity is used as the nose and palate intensity steps described in 9.3.2.

For the acidity, the question displayed on the table is: “How acidic is the wine?”.

9.3.7 Interaction to Select the Corresponding Finish

As the finish is something that can be described in seconds, a timer is used to visualise this step. To create a realistic timer, and for the participants to quickly realise the projection on the table is a timer, a stereotypical digital timer font can be used. The projection further explains what to do with the sentence: “time how long the taste lingers after taking a sip”.

After taking a sip, the participants can start the timer by pressing on a green “start” button. This will start the timer and turn the “start” button into a red “stop” button. If they no longer taste the wine, they can touch the “stop” button to stop the timer. The timer now displays the finish of the wine in seconds. The colours used, green and red, are used as they commonly indicate “start” and “stop”, such as in traffic lights [75]. The “stop” button is once again turned into a “start” button, which allows the participant to execute this tasting step again. Once the “start” button is pressed again, the timer will once again start from 00:00:00.

The amount of seconds that were timed can be translated into the finish labels "short", "medium", and "long". Anything under seven seconds can translated into "short", between 7 seconds and 15 seconds constitutes a "medium" finish, and anything above 15 seconds is considered "long".

9.3.8 Summary & Discussion of the Wine-Tasting Steps

After every execution step, the projection moves to the next visualisation: the summary for the discussion.

Before showing the summary, the system needs to make sure the wine glasses on the table are not in the way of the summary and not already in one of the recognised

locations for the next step. Therefore, the participants are prompted to place their wine glass on the circle in the top right corner. This prompt is created through moving animation of circles moving towards the middle of the circle, and text reading: "place your wine glass here". Once the glass is no longer placed on one of the load cells, the animation stops, the text is removed from the page and the summary is displayed.

The summary shows a short visualisation and description of the analysis they have done for each of the steps up until that point. The visualisations and descriptions aim to support the user in describing their findings with the rest of the group. These visualisations are similar to those in the execution step, which allows the participants to quickly recognise the descriptors they have selected during the steps.

After the first step, assessing the colour, the summary shows a circle in the colour they have selected next to the icon of an eye, a reminder that this is a descriptor of the appearance of a wine. The colour is also labelled with the word “colour” and the name of the colour itself. This gives the participants a reminder of what was assessed during this tasting step, and what the actual name of the colour is.

For the nose, the intensity and the aromas they have selected are displayed next to the icon of the nose. The intensity is visualised through circles that are similar to those the participants saw during the execution of this step. The amount of circles displayed depends on the intensity level the participant selected. For “light”, this is one circle, for “medium” two, and for “pronounced”, this is three circles. Again the circles are labelled with the name of the tasting step and the category the participant has placed the wine in. The aromas that the participant had chosen are displayed through small illustrations of the aromas.

After each of the steps where the intensity, aromas, acidity and finish of the palate are analysed, these are also displayed next to the mouth icon. The intensity and aromas of the palate are described in the same way as the intensity and aromas of the nose. The acidity and finish also use the same concept as the intensity, where the amount of circles represents the level of acidity and length of the finish.

From the timer, the finish can be translated into “short”, “medium”, or “long”, depending on how many seconds it took for the taste to be gone. If the taste is gone within 7 seconds, the finish is short, if the taste lingers between 7 and 15 seconds it is

categorised as medium, and anything longer than 15 seconds can be considered long.

After the last wine-tasting step, timing the finish, the summary will highlight some of the descriptors: the nose intensity, the nose aromas, the palate intensity, the palate aromas, and the finish. This is done to explain that these aspects of a wine can be used to objectively assess the quality of a wine. While colour and acidity can only be used to describe the wine, the other aspects say something about how good the wine is. With this, it can be explained that a higher intensity, more aromas and longer finish are usually associated with better quality wines.

9.4 Magazine Handout

At the end of the experience, after having noted the descriptors of all four wines, the participants are given a handout of a magazine. This magazine consists of four articles. The first is an advertisement text about the new wine-tasting experience they have just completed. The second article explains how to taste wine. The third article is a personalised review of the wines they have just tasted, where the input of the participants is used to describe the wines. The third is an article about what wine grape varieties they can try next if they like any of the ones they have just tasted.

9.4.1 Advertisement for the Interactive Wine-Tasting Experience

The advertisement aims to excite and inform readers about the interactive wine-tasting experience. As this is a handout after the fact, the participants have already done the experience. However, this text might help them enthuse others, or provide them with a small overview of what the experience was and how they can explain it to their friends and family.

9.4.2 How to taste wine like a Pro

This article briefly explains how to assess the appearance, the nose and the palate of a wine and what aspects can be noted. This can be helpful if the participants want to try tasting wine at home, following the practices of the interactive wine-tasting experience.

9.4.3 Personalised review

During the wine-tasting experience, the participants are constantly giving input on the wines they are tasting. For each of the wines, they give input on what they think the colour of the wine is, the intensity of the nose and palate, which aromas they smell and taste, the acidity of the wine, and they time how long the finish lasts. All of this input is used to create a personised review of the wines for the magazine they receive. In the text, the personalised input is bolded, to show the participants their addition to the piece. The review is also subtitled with "a review by *name of participant*", where the first name of the participant is used to fill in the *name of participant*.

9.4.4 What to try next

The last article is to educate the participants on what wine grapes they can try next if they liked any of the wines they have tasted during the wine-tasting experience. There are many grape varieties, which might make it hard for participants to know what they should try next. Therefore, this article explains what wine varieties have similar flavour profiles to the ones they tried during the tasting.

9.5 Additional Functional Requirements

Based on the specification of the experience, several functional requirements need to be considered when creating the system. The functional requirements are the technical aspects that list how the installation should operate. The requirements are prioritised using the MoSCoW method. Each requirement is categorised on whether they are a "must have", "should have", "could have", or "won't have". These requirements are later used to evaluate the system in chapter 11: Evaluation of the Functional Requirements.

The following functional requirements for the realisation of the interactive technology wine-tasting experience can be added.

The interactive technology wine-tasting experience:

FR-28 **Must** detect wine glass on the five circle locations on the table

FR-29 **Must** detect the finger of the user on 22 locations on the table

FR-30 **Must** record the colour, nose intensity, nose aroma, palate intensity, palate aroma, acidity, and finish selection of the user

FR-31 **Must** display instructions on how to do a wine-tasting step on the table

FR-32 **Must** display the summary of the wine based on the selections of the user on the table

FR-33 **Must** be waterproof

FR-34 **Must** be controlled by the instructor

FR-35 **Should** display feedback of the selection the user had made

FR-36 **Should** automatically fill in the personalised review with the selections of the user

FR-37 **Should** print the magazine hand-out at the end of the experience

FR-38 **Should** be visible during daylight

FR-39 **Should** feel flat and smooth, similar to a tabletop

FR-40 **Could** be modular

Chapter 10

Realising the Installation

This chapter explains how the installation is realised, elaborating on the hardware and software necessary to create the installation. Answering the following sub-research question:

SQ-3: What components, both hardware and software, are necessary to create an interactive technology wine-tasting experience?

An overview of the installation, from the participants' perspective can be seen in figure 10.1. A detailed overview of the setup of the installation, listing all the elements, can be seen in figure 10.2.

10.1 The Board: Sensing User Input

To realise the installation described in chapter 9: Specifying the Interactive Technology Wine-Tasting Experience, the system needs to recognise a wine glass placed on the table, which aromas have been selected, and if the timer has been started/stopped. To sense this input, a board containing all the necessary sensors is built. This board lies flat and is placed on top of the table, essentially creating a new table surface. Each user will have their own board with sensors in front of them. The board is laser-cut into the shape of a box that is 65cm by 55cm by 3cm. The box is 3 centimetres thick to leave enough room for all of the components to be placed inside.

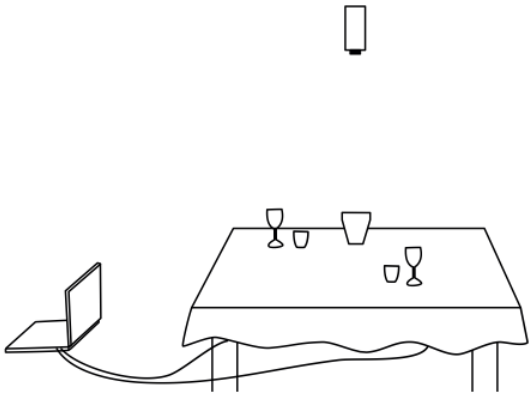


Figure 10.1: Overview of the Setup of the Installation, as seen by the user

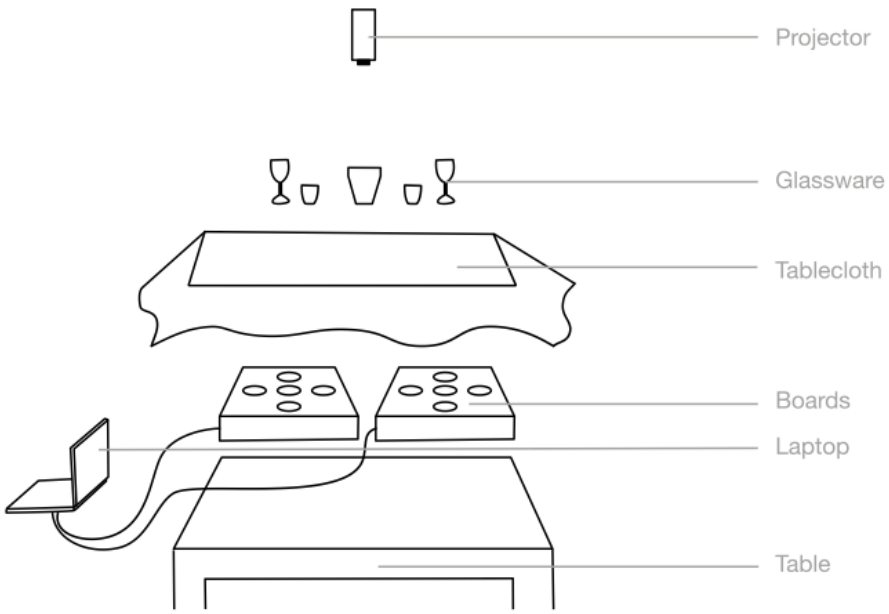


Figure 10.2: Detailed overview of the setup of the installation, listing all elements

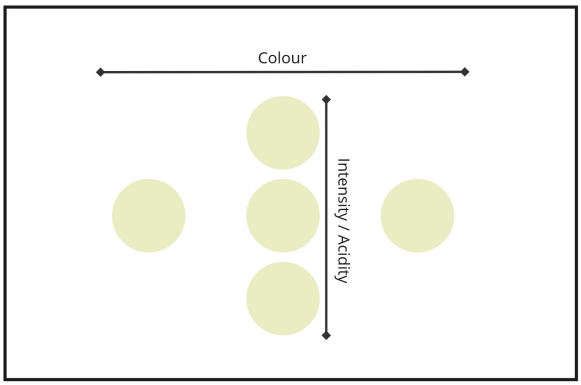


Figure 10.3: The placement of the load cells. The colour options are placed horizontally, while the intensity and acidity are placed vertically.

10.1.1 Detecting the Wine Glass

In total there are five locations on the board where the wine glasses should be detected. These locations can be seen in figure 10.3.

To detect if a wine glass is placed on one of these spots, load cells are used. Load cells can convert pressure into an electrical signal that can be standardised and measured in, for instance, grams [76]. With these load cells, the weight of the wine glasses when empty and the weight of the wine glass when full can be specified. This means the system only reacts when a weight between these specific numbers is placed on the predetermined areas. Thus, only reacts when a wine glass is placed upon the sensor, ignoring other items of a user resting their arm on the area. Furthermore, the sensors can be calibrated every time they power up, providing a reliable weight reading every time they are used.

To measure the pressure in the specific circles, the board in these circles needs to be able to move freely. Thus, a cutout of these circles is made on the board. The cutout circles are 10 centimetres in diameter, which is slightly bigger than the base of a wine glass. These circles are attached to the load cell, as shown in figure 10.4, and placed back into the board. Now, these circles are flush with the surface of the board, but the system can sense the weight of the wine glass when placed upon one of these circles.

The load cells are connected to an Arduino Nano through an HX711 load cell amplifier module, also seen in figure 10.4 This amplifier allows the Arduino Nano to read the small changes in the signal that are sent from the load cell. With an Arduino

sketch, The load cells are calibrated to return the correct weight of the items placed upon them. Then, the Arduino sketch reads the signals received from the load cells and provides a signal when this weight is between 160 grams, the weight of an empty wine glass, and 500 grams the weight of a full wine glass. This is how the system registers if a wine glass is placed on one of the circles. For the Arduino sketch, refer to Annex 2.

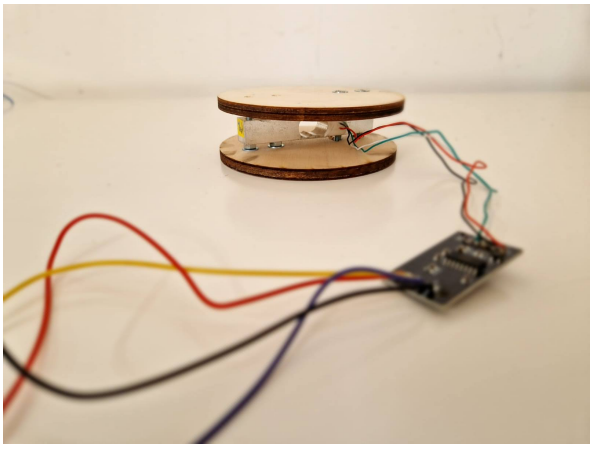


Figure 10.4: Load cell, attached to the cutout circles, connected to the HX11 load cell amplifier module.

10.1.2 Selecting Aromas

During the wine-tasting experience, the users will be asked to select the aromas they can distinguish when smelling and tasting the wine. To allow the system to sense which aromas have been selected, capacitor sensors are used. More specifically, the Adafruit CAP1188 Breakout sensor is used, as this is a capacitive sensor with eight individual built-in touch pads. The Adafruit CAP1188 Breakout sensor can be seen in figure 10.5.

This sensor is ideal as it can be used alongside other Adafruit CAP1188 Breakout sensors to allow for the amount of aromas that should be able to be selected. Moreover, the sensor automatically handles all the filtering and automatically re-calibrates when it is powered up. Furthermore, the sensitivity of the touch can be configured to be more or less sensitive, depending on how close the finger should be when touch is sensed.

21 buttons need to be created. Therefore, three Adafruit CAP1188 Breakout sensors are used. These sensors are connected to the same pins on the Arduino Nano. To use all three sensors on the same Arduino pins, the I2C address of two of the sensors need

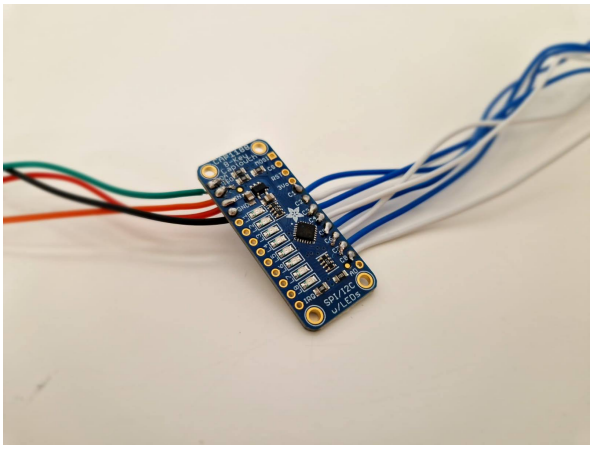


Figure 10.5: Adafruit CAP1188 Breakout sensor.

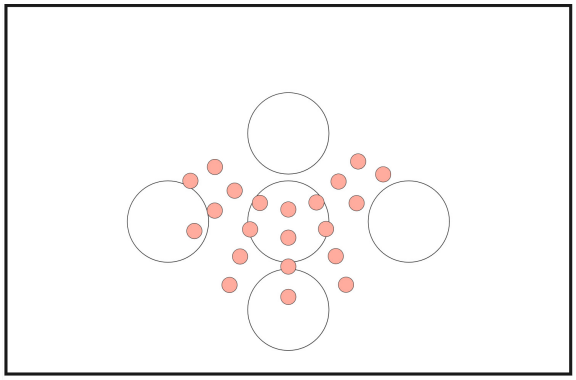


Figure 10.6: Placement of the capacitive touch pads.

to be changed from the default 0x29 setting. This is done by connecting AD to 3Vo on one of the sensors, resulting in the I2C address 0x28, and connecting AD to ground with an 300K resistor, resulting in the I2C address 0x2B. By changing the I2C address on two CAP1188 Breakout sensors from the default setting, the Arduino can distinguish which of the 24 capacitive touch pads is being touched.

The capacitive sensors need to be able to detect touch at specific locations on the board. These locations can be seen in figure 10.6. For the touch pads to reach these places, copper wires are soldered to the eight individual built-in touch pads on each of the sensors (white and blue wires in figure 10.5). In each of the touch locations, a small hole is drilled through the top of the board to lead these wires through. In total, 20 touch pads are used to accommodate all the aroma locations of the white and red wines. The ends of these wires are then stripped and twisted into a circular pattern to

Figure 10.7: Copper wire connected to the touch pads of the Adafruit CAP1188 Breakout sensor, twisted into a circular pattern.

create a touchable surface area the size of the buttons, as can be seen in figure 10.7. By laying the wires flat on the board and adding a tablecloth on top, these wires should not be felt during the experience.

The Arduino code adds labels to each of the 21 buttons that have been created. Thus allowing the system to know which button has been pressed, and in turn, know which aroma has been selected.

10.1.3 Timing the Finish

During the wine-tasting experience, participants can time this finish themselves by using the digital timer. To start and stop the timer, one of the capacitive touch buttons from the aromas is used. The button used is the button that is highlighted in figure 10.8. When the middle-lowest button is pressed, the timer will turn on, and similarly, when it is pressed again the timer will turn off.

10.1.4 Finalising the Board

The load cells and CAP1188 Breakout sensors are connected to an Arduino Nano, which sends the signal to a processing sketch on a computer.

The inside of the board, with all the sensors in place, can be seen in figure 10.9, with

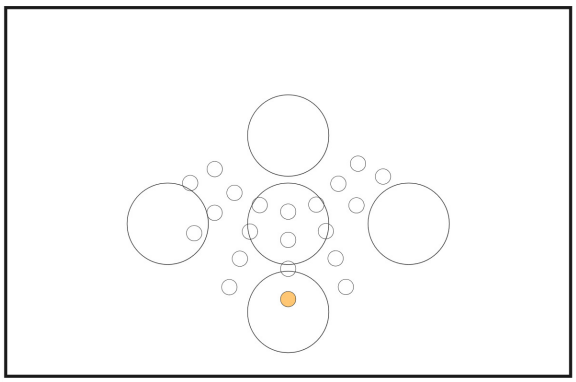


Figure 10.8: Location of the touch sensor for the timer button

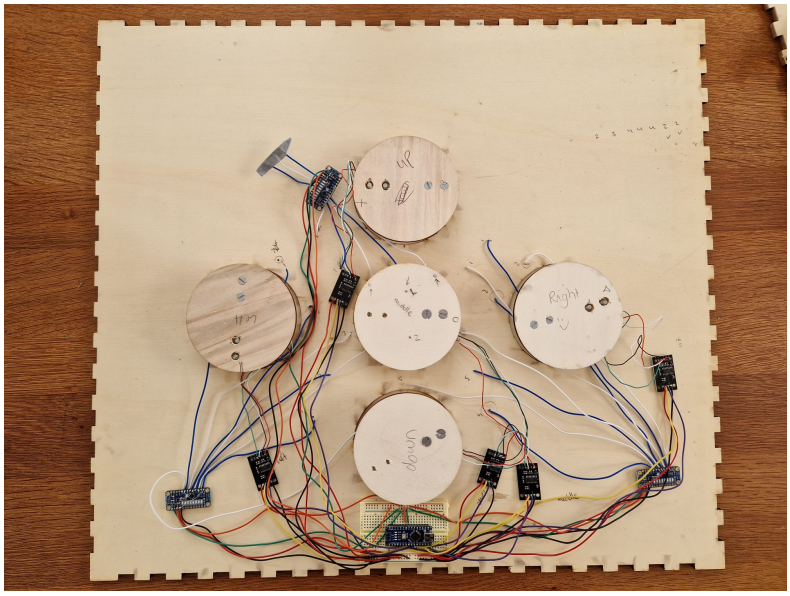


Figure 10.9: The sensors and wires inside of the interactive board.

a close up of the connections to the Arduino Nano in figure 10.10. The full Fritzing schematics of how all of the sensors are connected to the Arduino Nano can be seen in appendix C. Now the board can be closed, as can be seen in figure 10.11a.

The Arduino sketch, programmed to receive the input from the sensors and send it to Processing can be found in Annex 2. The Processing sketch created can be found in Annex 3.

During a wine-tasting, there is a possibility of wine being spilled onto the table. To make the board waterproof, a layer of thin plastic is wrapped around the board, as can be seen in figure 10.11b. This ensures that no liquid can reach the electrical components inside. The board is then placed on a table, with a white tablecloth on

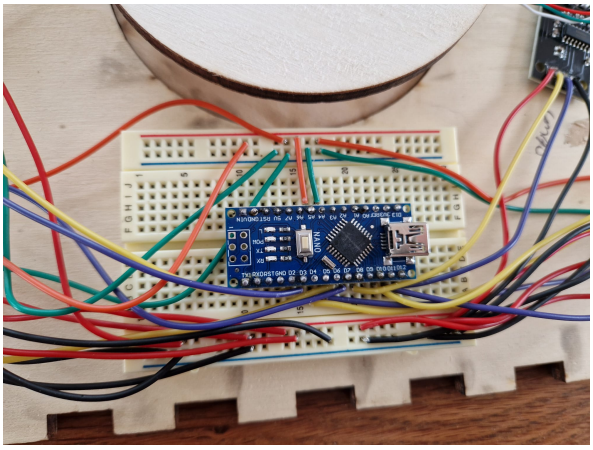


Figure 10.10: The connections to the Arduino Nano inside of the board.

(a) (b)

Figure 10.11: The board all closed up (a), and wrapped in plastic (b).

top.

10.2 Projecting the Visualisations

A projector positioned above the table projects the wine-tasting visuals described in section 9: specification on the table surface. To ensure the projections are clearly visible, an ironed white tablecloth is placed over the interactive boards on the table.

The visualisations that are projected on the interactive boards are used to provide the participants visual support of the information that is provided, to prompt the user to use the interactive table to give their input, and to provide feedback on their input. Some of these visualisation are still illustrations, while others make use of animations.

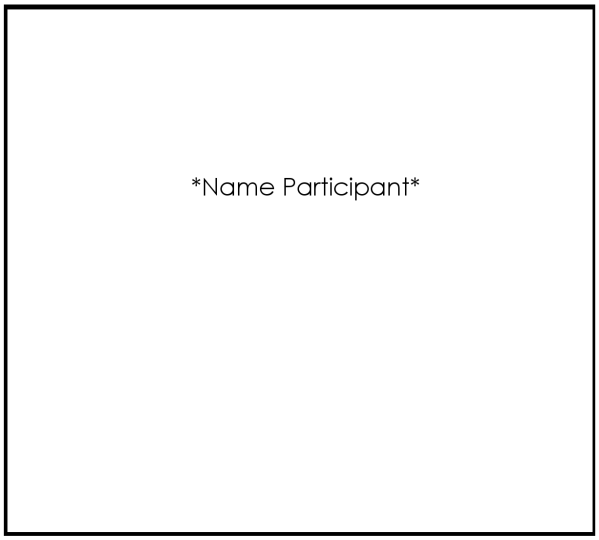


Figure 10.12: Projection showing the name of the participant.

The visualisations can be categorised into: the introduction to the experience, explanation of the wine-tasting step, execution of the wine-tasting step, and summary & discussion of the wine-tasting steps.

To create the animations that will be visible on the table, Processing is used. Processing is a software sketchbook, which uses the Java language for the creation of visual design projects. By connecting Arduino to Processing, the serial data that the Arduino receives from the sensors can be sent to Processing, where it can be used as input for the visual animations. The still illustrations are created using Adobe Illustrator, after which they are imported into the Processing sketch.

10.2.1 Introduction to the Interactive Wine-Tasting Experience

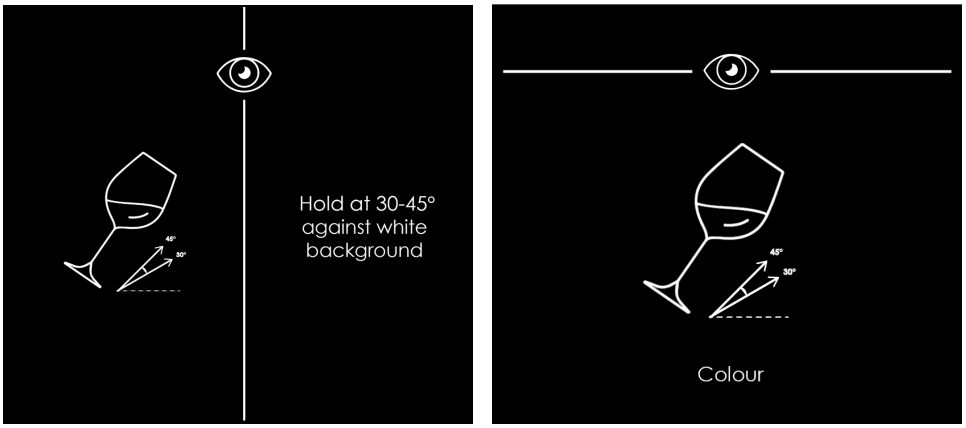
The projection of the name of the participant can be seen in 10.12, the image of the magazine that is projected can be seen in figure 10.13, and an example of the wine number projection can be seen in figure 10.14

10.2.2 Explanation of the wine-tasting step

To judge the appearance of the wine, the participant should look at the colour of a wine. This is done by holding the wine at a 30-45 degree angle against a white background, as described in the illustration in figure 10.15.

Figure 10.13: Projection of the magazine that the participants will receive at the end of the Interactive Wine-Tasting Experience.

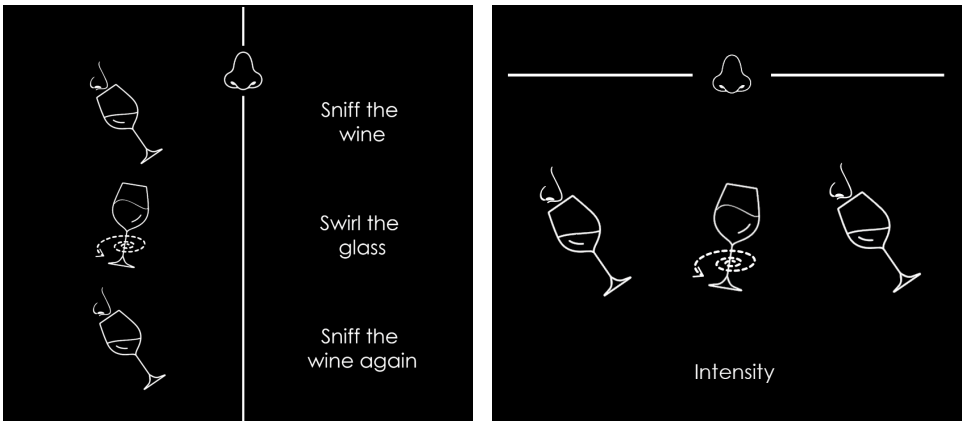
Figure 10.14: Projection showing the wine the participants are receiving.



(a) (b)

Figure 10.15: The projection of the process of how to assess the colour of a wine. The visuals with explanation (a) are shown during the first wine and only the visuals (b) are shown for wine 2-4.

To properly assess the nose of a wine, the wine is sniffed with the nose of the participant in the glass. After which the glass is swirled to add oxygen to the wine, releasing more aromatics. Now the intensity and the aromas of the nose can be determined. This step is displayed in figure 10.16

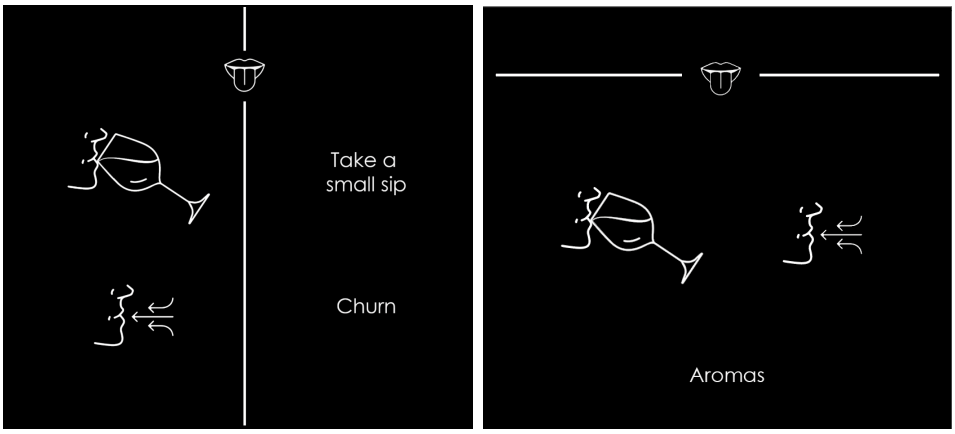


(a) (b)

Figure 10.16: The projection of the process of how to assess the nose intensity and aromas of a wine. The visuals with explanation (a) are shown during the first wine and only the visuals (b) are shown for wine 2-4.

How to assess the intensity and the aromas of the palate is seen in figure 10.17. The participant takes a small sip and churns the wine to add oxygen to the wine, again

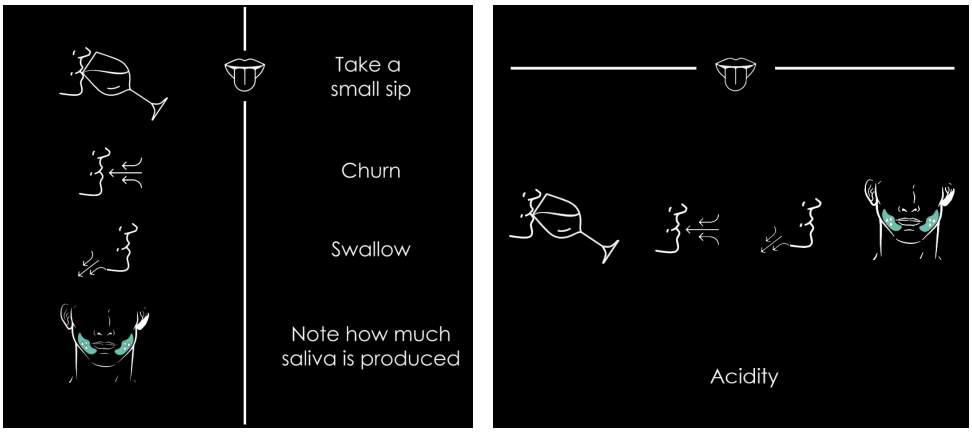
making it release more aromatics.



(a) (b)

Figure 10.17: The projection of the process of how to assess the intensity and the aromas of a wine. The visuals with explanation (a) are shown during the first wine and only the visuals (b) are shown for wine 2-4.

The acidity can be assessed by taking a small sip of wine. Then, churning this wine, making sure it moves all around the mouth. After swallowing the sip, the participant should note how much saliva is produced to assess how acidic the wine is. This process is visualised in figure 10.18

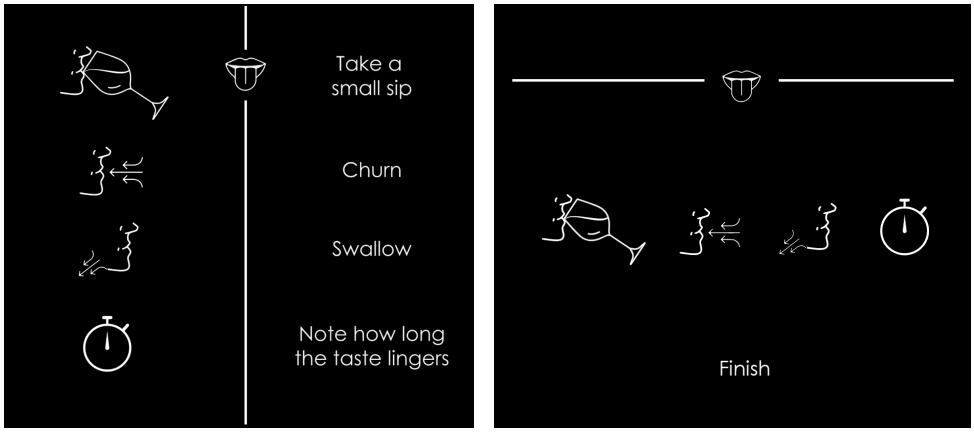


(a) (b)

Figure 10.18: The projection of the process of how to assess the acidity of a wine. The visuals with explanation (a) are shown during the first wine and only the visuals (b) are shown for wine 2-4.

Lastly, how to assess the finish is explained, as depicted in figure 10.19. Similar to

the acidity, the participant churns a small sip in their mouth. After swallowing they time how long the taste lingers in their mouth.



(a) (b)

Figure 10.19: The projection of the process of how to assess the finish of a wine. The visuals with explanation (a) are shown during the first wine and only the visuals (b) are shown for wine 2-4.

10.2.3 Execution of the Wine-Tasting Steps

10.2.3.1 Colour

First, the participants are encouraged to analyse the colour of the wine. On the table, each colour that can be noted is visualised and labeled, as can be seen in figure 10.20a for white wines, and in figure 10.20c for red wines. The labels are 'lemon', 'gold', and 'amber' for white wine, and 'purple', 'ruby', and 'tawny' for red wines.

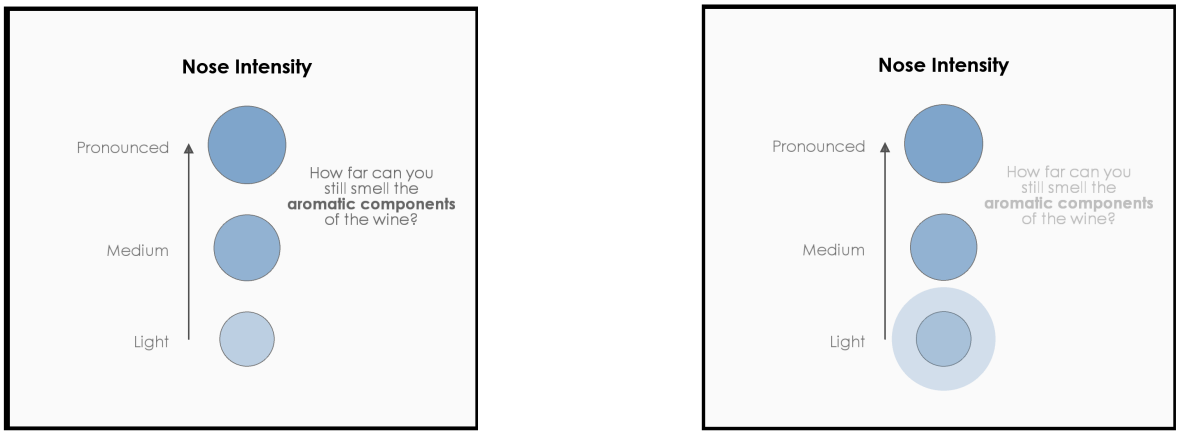
By placing their glass on one of the circles, they select their answer and the circle starts to pulse, showing them which colour they have chosen, visible in figure 10.20b. Furthermore, the prompt turns grey instead of black. If they pick up their glass, the projection goes back to its original state of figure 10.20a.

10.2.3.2 Nose Intensity, Palate Intensity & Acidity

The projections that aim to help the participants determine the nose intensity, palate intensity and acidity are almost the same and can be seen in figure 10.21a, and figure

(a) (b) (c)

Figure 10.20: The projections during the execution of the appearance step, where the participants are asked to place their wine glass on the colour corresponding to the white wine in their glasses (a). The projection after the participant has selected "amber" as the corresponding colour (b). The projection with colours for red wine (c).



(a) (b)

Figure 10.21: The projections during the execution of the nose step to assess the intensity, where the participants are asked to place their wine glass on the circle corresponding to the nose intensity of the wine (a). The projection after the participant has selected "Light" as the corresponding nose intensity (b).

10.23. With figure 10.21b showing the projection when the "light" option has been chosen.

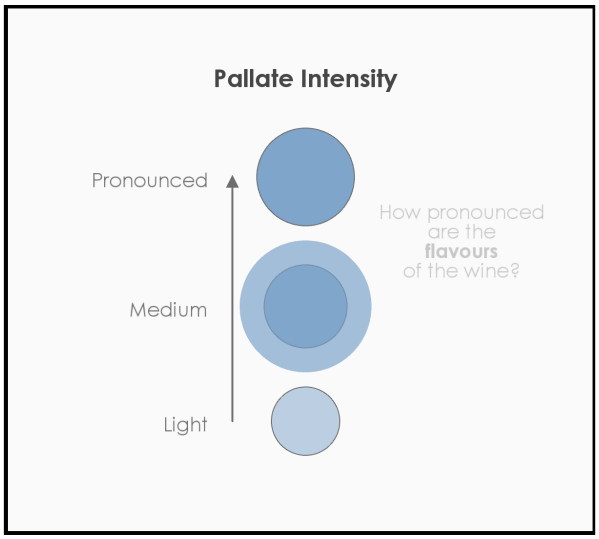


Figure 10.22: The projections during the execution of the palate step to assess the intensity, where the participants are asked to place their wine glass on the circle corresponding to the palate intensity of the wine. This is the projection after the participant has selected "medium" as the corresponding palate intensity.

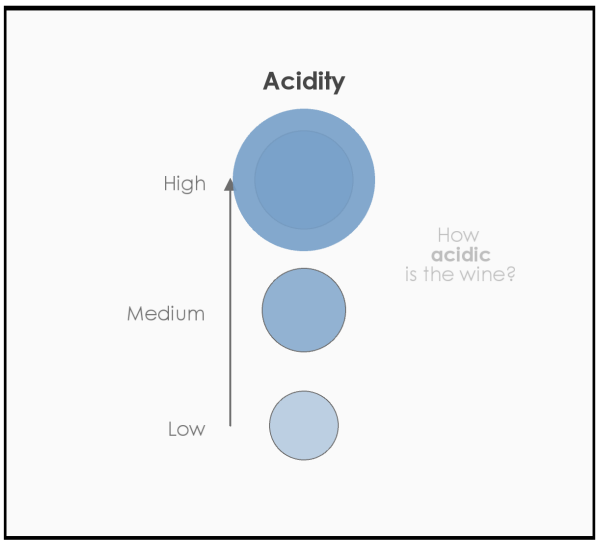
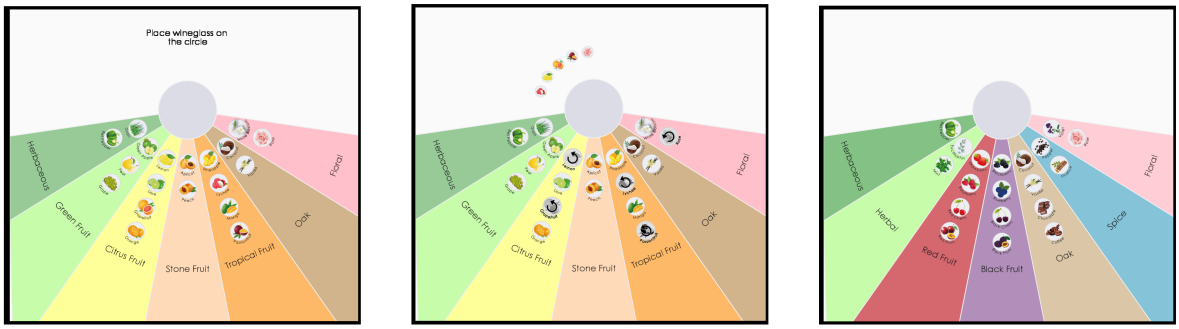


Figure 10.23: The projections during the execution of the palate step to assess the acidity, where the participants are asked to place their wine glass on the circle corresponding to the acidity level of the wine. This is the projection after the participant has selected "high" as the corresponding acidity level.



(a) (b) (c)

Figure 10.24: The projections during the execution of the nose and palate steps to distinguish the aromas of a white wine (a). The projection after participants have selected several aromas (b). The aroma selection for red wines (c).

10.2.3.3 Nose Aromas and Palate Aromas

The aromas the participants can select are visualised through a projection onto the table, as can be seen in figure 10.24a for white wines, and in figure 10.24c for red wines. Figure 10.24b shows the projection after the user has made their selection. Each of the aromas are sketched with ptrocreate, a digital illustration application [77]. To make sure the wine glass does not interfere with any of the buttons, the participants are asked to place their wine glasses on a circle at the top of their table section.

10.2.3.4 Finish

To time the finish, a timer is projected onto the table, as can be seen in figure 10.25a.

After taking a sip, the participants can start the timer by pressing on the green "start" button. This will start the timer and turn the "start" button into a red "stop" button, seen in figure 10.25b. If they no longer taste the wine, they can touch the "stop" button to stop the timer. The timer now displays the finish of the wine in seconds, see figure 10.25c.

10.2.4 Summary & Discussion of the Wine-Tasting Steps

Before showing the summary, the participants are prompted to place their wine glass on the circle in the top left corner, as shown in figure 10.26.

(a) (b) (c)

Figure 10.25: The projections during the execution of the palate step to distinguish the finish of a wine (a). The projection after participants have started the timer (b). The projection when the participant has stopped the timer(c).

The summary shows a short visualisation and description of the analysis they have done for each of the steps up until that point. After the colour step, the summary looks like 10.27a. After completing all the steps, the summary looks like 10.27b.

10.27b shows the highlighting of the descriptors of the nose intensity, the nose aromas, the palate intensity, the palate aromas, and the finish.

10.3 Setting the Pace of the Experience

During the interactive wine-tasting experience, the instructor is in charge of the pace. The system is created to allow the instructor to quickly move to the next element by pressing on the space-bar of the computer.

10.4 Magazine Handout

The magazine handout is created using Adobe InDesign. The front and back pages of the magazine can be seen in figure 10.28a and 10.28b. The full text of the articles can be found in appendix B.

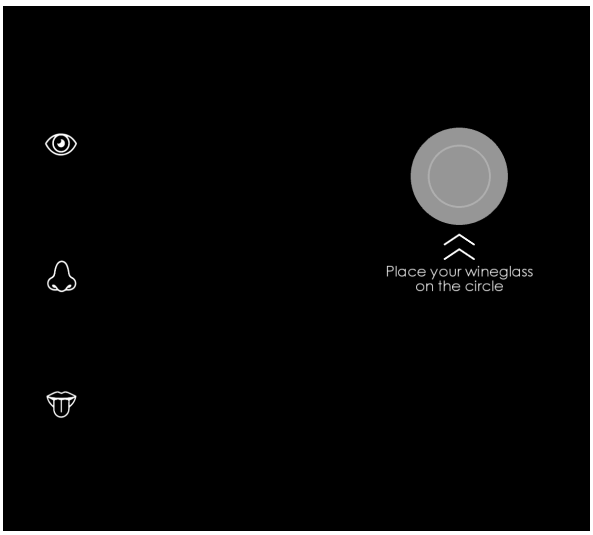
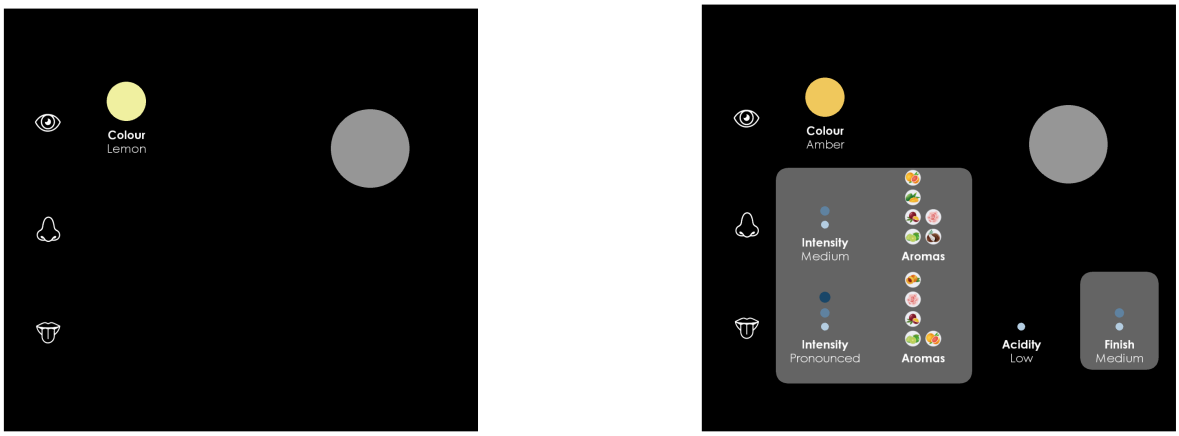


Figure 10.26: The projection of the summary if the wine glass is still placed on one of the load cells.



(a) (b)

Figure 10.27: The projection of the summary after the colour step (a). The projection of the summary, after the finish step, which is the final step. Highlighting the elements that can be used to judge the quality of a wine objectively (b).

(a) (b)

Figure 10.28: The front(a) and back(b) cover of the magazine

10.4.1 Advertisement for the Interactive Wine-Tasting Experience

The advertisement of the interactive wine-tasting experience can be seen in figure 10.29 and the full text of the article can be found in appendix B.1.

10.4.2 How to Taste Wine like a Pro

The how to taste wine like a pro article, can be seen in figure 10.30 and the full text of the article can be found in appendix B.2.

10.4.3 Personalised Review

The personalised review can be seen in figure 10.31 and the full text of the article can be found in appendix B.3.

The review is supposed to be personalised by adding the tasting notes the participant had found during the experience into the article. However, due to time constraints, this feature was not added to the design of this installation.

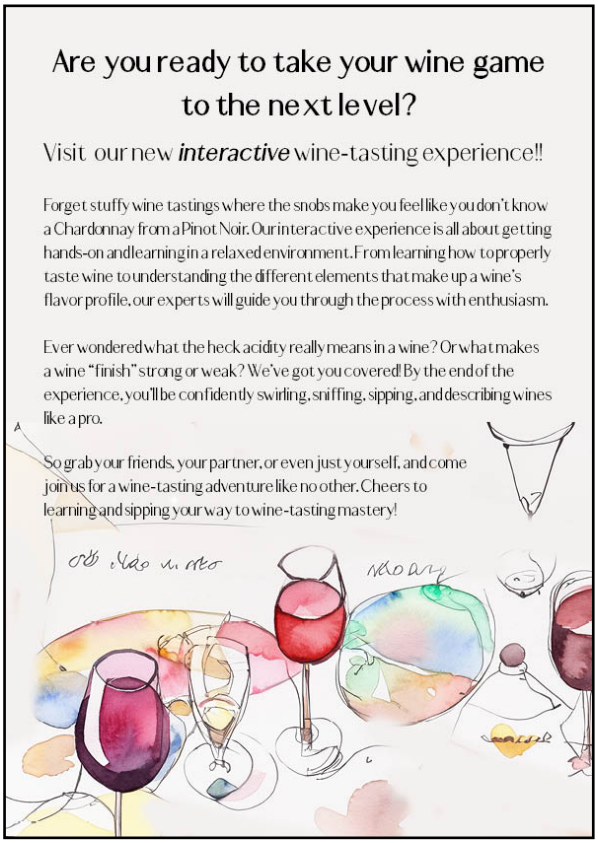


Figure 10.29: Advertisement for the Interactive Wine-Tasting Experience

10.4.4 What to try next

This last article is seen in figure 10.32 and the full text of the article can be found in appendix B.4.

10.5 Conclusion

This chapter aimed to answer the following sub-research question:

SQ-3: What components, both hardware and software, are necessary to create an interactive technology wine-tasting experience?

To realise the installation, force sensors were used to create the locations where the wine glass of the user can be detected. Additionally, Adafruit CAP1188 Breakout sensors were used to sense the user's touch. Both of these sensors were connected to an Arduino Nano. An Arduino sketch was created to read the input of the sensors,

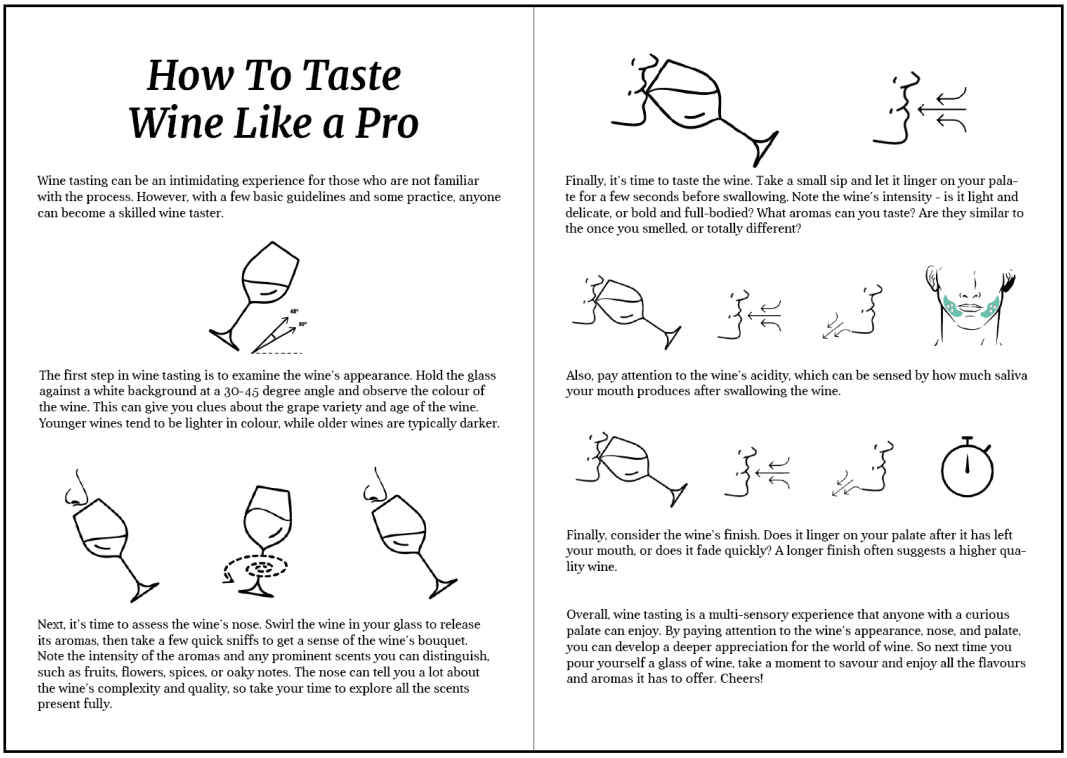


Figure 10.30: Article on how to taste wine like a pro.

after which a Processing sketch was created to use this input to program the visuals of the experience. Lastly, a magazine was designed to hand out to the participants at the end of the experience.

Figure 10.31: Personalised review of the wines that were tasted during the Interactive Wine-Tasting Experience, based on the input of the participant.

If you liked...
Try...

1. Sauvignon Blanc

For those who enjoy sauvignon blanc's crisp acidity and grassy notes, a natural next step would be to try a refreshing glass of Pinot Grigio or Vermentino. These Italian whites offer similar zesty flavors with a touch of minerality that will tantalize your taste buds.

2. Chardonnay

Fans of rich and buttery chardonnay might enjoy exploring Rhône Valley whites like Viognier or Marsanne. These wines often have luscious textures and aromas of apricot, honeysuckle, and spice that will satisfy your palate.

3. Merlot

For red wine lovers who appreciate the velvety smoothness of merlot, consider trying a bottle of Barbera or Sangiovese from Italy. These reds boast vibrant acidity and juicy red fruit flavors that will complement a wide range of dishes.

4. Cabernet Sauvignon

Lastly, fans of bold and powerful cabernet sauvignon may find themselves drawn to Argentine Malbec or Australian Shiraz. These wines offer robust tannins, dark fruit flavors, and a hint of spice that will leave you wanting more.

Overall, exploring different varietals and regions is a great way to expand your wine knowledge and find new favorites to enjoy. Cheers to your next wine adventure!

Figure 10.32: Article which explains which wines the participants can try next if they liked any of the wines tasted during the Interactive Wine-Tasting Experience

Chapter 11

Evaluation of the Functional Requirements

This chapter aims to evaluate whether the functional requirements set in chapter 6 Translating the Guidelines for a Satisfactory Wine-Tasting Experience into the Interactive Technology Domain and chapter 9 Specifying the Interactive Technology Wine-Tasting Experience have been met. Therefore, answering the first part of the last sub-research question:

*SQ-4: How can the **functional** and non-functional requirements be evaluated?*

First, all of the functional requirements are evaluated by the researcher, which is done through an initial functionality test. Afterwards, several requirements are again evaluated through a functional usability test, including six participants. This is done to see if the system also functions properly with the input of users other than the researcher. The ethics request for this research can be found in Annex 4 [1].

11.1 Initial Functionality Test

During the initial functionality test, all of the functional requirements are evaluated. Figure 11.1 shows which of the functional requirements set in chapter 6 Translating the Guidelines for a Satisfactory Wine-Tasting Experience into the Interactive Technology

[1]The ethic request was approved and can be found in the University of Twente ethical review portal: Application nr 230254

FR1 Should educate on how to assess and describe the appearance of the wine, using the colour of a wine	☑	FR15 Should exclude complex wine terms	☑
FR2 Should educate on how to assess and describe the nose of the wine, including intensity and type of aromas	☑	FR16 Should not add more than two additional items onto the table	☑
FR3 Should educate on how to assess and describe the palate of the wine, including intensity, type of aroma,	☑	FR17 Could provide the participant something to take home to remind them of the experience	☑
FR4 Should educate on the differences between sauvignon blanc and chardonnay	☑	FR18 Could provide the participant something to take home to teach them more about wine and wine-tasting	☑
FR5 Should educate on the differences between merlot and cabernet sauvignon	☑	FR19 Could include supporting visualisations to guide focus	☑
FR6 Could educate on how to objectively judge the quality of the wine	☑	FR20 Could use lightening to guide focus	☐
FR7 Could adjust the provided information to the knowledge level of the participants	☑	FR21 Could music to guide focus	☐
FR8 Must include correct equipment: wine glass, water glass, spittoon and carafe-tasting	☑	FR22 Should display visual representations of the tasting notes	☑
FR9 Must provide enough space for the equipment: wine glass, water glass, spittoon and carafe	☑	FR23 Should display the tasting note findings of the participants to allow for a quick comparison	☑
FR10Must be brightly lit during appearance step	☑	FR24 Could guide towards certain talking points	☑
FR11 Must provide a white background for appearance step	☑	FR25 Could initialise the discussion	☑
FR12 Must have bathroom readily available	☑	FR26 Could use lightening to guide focus to the discussion with the rest of the group	☑
FR13 Should not add more than two additional items onto the table	☑	FR27 Should represent all learning styles: kinesthetic, auditory, visual, read/write, social and solitary	☑
FR14 Could be dimly lit during other steps	☑		

Figure 11.1: Evaluation of the functional requirements set in chapter 6 Translating the Guidelines for a Satisfactory Wine-Tasting Experience into the Interactive Technology Domain

Domain have been met. Figure 11.2 shows which of the functional requirements set in chapter 9 Specifying the Interactive Technology Wine-Tasting Experience have been met.

11.1.1 Results

The results of the initial functionality test show that most functional requirements have been met. The details on the evaluation of all the requirements can be found in appendix E. This section focuses on the reasons why several requirements have not been met.

FR-20 Could use the lighting of the room to guide focus

Other than lighting up the room more brightly during the appearance step, this possibility of using the lighting in the room has not been explored.

FR-21 Could music to guide focus While classical music is softly playing in the back-

FR28 Must detect wine glass on the five circle locations on the table	☑
FR29 Must detect the finger of the user on 22 locations on the table	☑
FR30 Must record the colour, nose intensity, nose aroma, palate intensity, palate aroma, acidity, and finish selection	☑
FR31 Must display instructions on how to do a winetasting step on the table	☑
FR32 Must display the summary of the wine based on the selections of the user on the table	☑
FR33 Must be waterproof	☐
FR34 Must be controlled by the instructor	☑
FR35 Should display feedback of the selection the user had made	☑
FR36 Should automatically fill in the personalised review with the selections of the user	☐
FR37 Should print the magazine handout at the end of the experience	☐
FR38 Should be visible during daylight	☑
FR39 Should feel flat and smooth, like a tabletop	☐
FR39 Could be modular	☐

Figure 11.2: Evaluation of the functional requirements set in chapter 9 Specifying the Interactive Technology Wine-Tasting Experience

ground throughout the experience, the possibility of using music to guide the focus of the participants has not been explored.

FR-33 Must be waterproof

The plastic wrapping around the board should make the system waterproof. However, the board is currently wrapped in a thin layer of plastic, leaving small possible openings or holes. Therefore, during the initial functionality test, whether the system is waterproof is only tested with water with a liquid volume that amounts to the amount of wine that will be held in the glasses, about 75 millilitres. In future iterations of the system, the board should have a uniform plastic layer around the elements to protect them. However, for this research, it is sufficient for the system to be waterproof enough to handle small spills.

FR-36 Should automatically fill in the personalised review with the selections of the user

Due to time constraints, this requirement was not met. Therefore, the magazine handout the participants received did not contain a personalised review, but rather the tasting notes of the wines as found by the researcher.

FR-37 Should print the magazine hand-out at the end of the experience

This requirement was not met. As mentioned in the paragraph above, the review in the hand-out was not personalised. Therefore, there was no need to print the magazines at the end of the experience. Thus, the magazine hand-outs were printed beforehand.

FR-39 Should feel flat and smooth, similar to a tabletop

With a tablecloth over the installation, the sensors and circle cutouts can still be somewhat felt. However, it does not seem to take away from the experience. This requirement is further tested with the functional usability test, including participants.

FR-40 Could be modular As the system uses one board for each participant, the amount of boards can be adjusted to the table size. This allows for the system to be modular. However, currently, the system still uses two projectors and two computers to run the experience for two individuals. Adding more participants in this way increases the

amount of computers and projectors by one per individual. Therefore, a solution to run the sketch for multiple boards on one computer/projector should be created for the system to be fully modular. As this functional requirement was categorised as a requirement that 'could' be added, this does not pose a problem for this research. However, adding this functionality would be preferable for future iterations.

The boards can fit onto any square or rectangular table. However, as the boards are rectangular, it does not work for round or oval tables. The board itself is somewhat larger than half of the standard table width, which makes it hang 10 centimetres over the edge. As the boards create a new table surface this should not be a problem. However, this does mean that the boards that are being used should be attached to one another so that leaning on the edge does not tip the board. Furthermore, a thin rubber mat should be placed between the table and the board, creating friction, so that the board does not move around on the table.

11.2 Functional Usability Test

Several of the functional requirements are further tested through a functional usability test, including six participants. The researcher is already very familiar with the system. Therefore, they already understand how to use the system. The functional usability test aims to see how other participants use the system. Thus, investigating if the system is intuitive to use, if the participants use the system in the same way, and how the system performs whith the input of other users. The test will also further test if there is indeed enough space on the for all the equipment while performing the interactive tasks and if the participants would notice the circle cutouts and the capacitive touch sensor buttons when using the system.

The functional requirements that will be tested with participants through a functional usability test are the following:

FR-28 **Must** detect wine glass on the five circle locations on the table

FR-29 **Must** detect the finger of the user on 22 locations on the table

FR-35 **Should** display feedback of the selection the user had made

FR-39 **Should** feel flat and smooth, similar to a tabletop

11.2.1 Participants

Six participants will be asked to also participate in the functional user testing. Participants will be gathered by the researcher through social and academic connections. If possible, these participants should range in age and level of affinity with technology. Participants can only be included if they:

- Are above the age of 18
- Are Dutch or English speaking
- Have not participated in more than 5 wine tastings
- Have no history of alcohol or substance abuse

The demographics of the participants included can be found in appendix D.1.

11.2.2 Method

For the functional usability test, the participant will go through the steps of the wine-tasting experience, using the interactive technology system, as described in 8 The Interactive Technology Wine-Tasting Experience. The wine tasting will be conducted using alcohol free wine and is led by the researcher (WSET level 2 Award in wines). The experience will take place in a setting similar to that of a wine-tasting room. In total, one usability test should take about 2.5 hours.

The research is conducted with one participant at a time because evaluating the functional requirements does not focus on the interaction between participants, but rather focuses on whether the interactive board functions properly. By including one participant at a time, the full attention is on one of the participants using the system.

After every two participants, the requirements are assessed. If one or more of the functional requirements have not been met, the system should evaluated and improved. After which this new iteration can be tested with the next two participants. If the system still does not meet the requirements after six participants, more participants should be included until all requirements are met.

During the interactive wine-tasting experience, the participant will be prompted by the researcher to complete a list of tasks. This list can be found in appendix F in

section F.1. The list of tasks is based on the functional requirements mentioned above and aims to investigate whether these functional requirements have been met.

The participants will be unaware of this task list, as they will not see the list. Rather, it will be ticked off by the researcher throughout the experience. Some of these tasks will be completed by the user without any further incentive. However, any that are not already completed should be prompted by the researcher during the final two wines that are assessed.

If the user has not yet deselected an aroma, for example, this can be done by saying: "I am not sure I agree with the lemon you have selected, could you maybe find a different aroma that would suit better?".

During the functional testing, the participants will be audio and video recorded and they will be asked to think aloud. With the think-aloud method, participants are asked to verbalise their thoughts as they navigate the system [78], [79]. While thinking aloud, the participants can give verbal descriptions of what they want to do and how the system is responding. This helps the researcher gain an understanding of the decision-making process of the participants. Furthermore, it can help the researcher gain insights into any frustrations the users might have with the system.

At the start of the the functional testing, the participants are asked to "think aloud while using the system" and to "talk as much as possible". Emphasising that it is valuable to know what they are thinking when they interact with the system, not necessarily what their opinions of the product are [78]. During the test, they are also prompted to think aloud, by asking "what do you intend to do?" and "What is going through your mind?". However, this additional probing is kept to a minimum, as to not frustrate the participants.

The interactive wine-tasting experience is timed to determine how long the experience takes. It is important to note that using the think aloud method might result in the experience taking longer than without the think aloud method [79]. Therefore, if the experience is only concluded after more than two hours, additional tests need to be performed to conclude the actual length of the interactive wine-tasting experience.

After completing the wine-tasting experience, the participant will be asked several questions based on their experience using the system. The questions asked during this

short interview can be found in in appendix F in section F.2. These questions further investigate the functional requirements listed above.

11.2.3 Results

During the functional usability test, several types of data are recorded. First, the list of tasks that were completed during the wine-tasting experience is recorded, as well as, the video recordings of the experience, and the audio recording from the interview. This section shows the results of this data collection for every set of two participants.

11.2.3.1 Findings Tests 1 and 2

After the first two functional tests, the participants were able to complete almost all tasks. The wine glasses were detected on the table if the participant placed them on one of the circles. The participant was able to select the colour, intensity and acidity using their glass. Deselecting these aspects, by picking up their glass also worked as intended.

Additionally, the user was able to select and deselect the aromas they smelled and tasted in the white wines using their finger. However, the images for the red wine aromas were not aligned to fit the buttons, as they still corresponded to the buttons of the white wine aromas. This meant the buttons the participants pressed did not correspond to the aromas they wanted to select.

The only task that could not be completed at all was timing the finish, as the timer did not always stop after the participant pressed the stop button. Furthermore, when the timer did stop it did so with a delay. This delay was large enough for the participants to press the button again, which made the timer start again from zero seconds.

Other than the mix-up with the red and white aromas during the red wine aromas step, the projections matched up with the sensors and the participant was able to place the glass correctly and press the corresponding aromas buttons.

During the first wine, the instructions on how to look at the appearance of the wine were properly projected. However, the second time the illustrations needed to be projected, the screen was black. This is something that should also be corrected for

the next set of tests.

The instructor was able to quickly navigate through the experience by pressing the space bar on the laptop. Eventually, moving the laptop to an unseen location would make better use of the space, and a simple button moving to the next step would be ideal.

After the wine-tasting experience, the participants said they were able to slightly feel the capacitive buttons for the aromas, but did not find it bothersome. They did not notice the circle cutouts where the glasses could be placed. Furthermore, both participants experienced that they had enough space on the table to interact with the system and have a place for their wine glass, water glass, and spittoon.

11.2.3.2 Iterations of the System After Tests 1 and 2

To improve the system, several adjustments were made to the Processing sketch, which controls the visualisations. The first problem the users encountered was the unalignment of the buttons with the red wine aromas. Therefore, the placement of the aroma illustrations was altered to fit the correct placement of the red wine aroma buttons.

Additionally, the code of the timer for the start and stop button was adjusted to decrease the delay of the button, as well as, make the button more sensitive to the touch of the user.

Lastly, the projection showing the illustrations on how-to step assess the appearance of the wine was added back into the code.

11.2.3.3 Findings Tests 3 and 4

After functional user tests three and four, the participants were able to complete all the tasks. However, the timer still did not work as desired. The capacitive sensor responsible for starting and stopping the timer did not always respond to the touch of the participants, which resulted in them having to time the finish a couple of times to complete the task. This next set of tests also made it noticeable that the participants pressed the start/stop buttons in different manners. The first set of participants used their whole hand to press the button, while participant 3 only used one finger. Between the last two participants, touching the button with only one finger seemed to cause the

most amount of malfunction.

Participant 3 was unaware that they could touch the illustrations of the aromas and was hesitant about what to do during that step. After the interaction was explained by the instructor during the first encounter with the buttons, they did not experience a problem with the interaction again.

Participant 3 said they did not feel the buttons of the capacitive sensors, but participant 4 said they did notice them. The latter said it did not necessarily bother them, but it was not something they were expecting. They would prefer not to feel the wires. Both participants were unaware of the circle cutouts of where the glasses were placed. Additionally, each of the participants said that they felt like they did not need more space for the items on the table.

11.2.3.4 Iterations on the System After Tests 3 and 4

To fix the malfunction of the timer, the Arduino code for the timer was rewritten, as to better register the touch of the user. Afterwards, the new code was tested by the researcher by pressing the button in various ways (with the left hand, with the right hand, with one finger, with two fingers, with a fist, etc.), until all manner of touch seemed to register and start and stop the timer ten times in a row.

11.2.3.5 Findings Tests 5 and 6

During these two tests, all tasks were completed without malfunctions. Again, both of the participants were able to feel the buttons of the capacitive sensors but did not notice the circle cutouts. Participant five mentioned that they did not mind that they could feel the wires of the capacivite touch sensors. While participant six said they would rather have a fully smooth surface. Furthermore, both participants noted they had enough space to have all the needed items on the table and perform the interactions.

11.3 Conclusions on the Evaluation of the Functional Requirements

In this chapter the following sub-research question was answered:

*SQ-4: How can the **functional** and non-functional requirements be evaluated?*

In this chapter, the functional requirements set in 9 Specifying the Interactive Technology Wine-Tasting Experience have been investigated through initial functional testing by the researcher and several functional usability tests which included six participants. After several iterations on the system, almost all of the functional requirements have been met.

The requirements that have not been met include: "the system must be waterproof", "the system could be modular", and "the system should feel smooth and flat, like a tabletop".

Firstly, as explained in section E Detailed Results of the Initial Functionality Test. Currently, the system is waterproof enough to conduct the research. However, when developing the final prototype, the board should be fully waterproof to handle any spills of wine or water. Secondly, the system can be added to any square or rectangular table. However, the rectangular shape of the board can prove difficult to add to round or oval tables.

Lastly, almost all users were able to notice the wires of capacitive touch sensor buttons. Although most did not find it bothersome, in future iterations of the board, these wires could be made less noticeable. This can be done by either using smaller and thinner wires or by creating a thicker surface between the wires and the user's finger with, for instance, a thicker tablecloth.

During the functional usability test, it was clear that not all interactive elements were intuitive to do without explanation from the instructor, such as touching the aroma buttons to select them. However, this is something that is further investigated during the evaluation of the non-functional requirements.

Overall, the functional requirements have been evaluated to work well enough to continue with the non-functional evaluation of the interactive technology wine-tasting experience.

Chapter 12

Evaluation of the Non-Functional Requirements

This chapter aims to evaluate whether the non-functional requirements set in chapter 6 Translating the Guidelines for a Satisfactory Wine-Tasting Experience into the Interactive Technology Domain have been met.

Therefore, answering the second part of the last sub-research question:

*SQ-4: How can the functional and **non-functional** requirements be evaluated?*

The interactive technology wine-tasting experience is evaluated with the use of a non-functional evaluation study. The non-functional evaluation study consists of five parts: completing a knowledge test before the experience, the experience, filling in the System Usability Scale (SUS) questionnaire [80] after the experience, followed by an interview, and completing a knowledge test two weeks after the experience. The evaluation study will take place in a setting similar to that of a wine-tasting room and will take about 2.5 hours. The ethics request for this non-functional evaluation study can be found in annex 4 [1].

[1]The ethic request was approved and can be found in the University of Twente ethical review portal: Application nr 230254

12.1 Participants

12 participants are included in the non-functional evaluation study. These participants are different from the 6 participants that were included for the functional evaluation study. The evaluation study is conducted with two participants at a time. Thus, in total 6 evaluation studies will be conducted. Two participants are included in every evaluation study, as to also see the interaction between the participants. Participants will be gathered by the researcher through social and academic connections. Participants can only be included if they:

- Are above the age of 18
- Are Dutch or English speaking
- Have participated in at least one wine-tasting
- Have not participated in more than 5 wine tastings
- Have no history of alcohol or substance abuse

Participants are included if they have participated in at least one wine-tasting, as this allows for a comparison between the interactive technology wine-tasting experience and a traditional wine-tasting experience. The demographics of the participants included can be found in appendix G.

12.2 Method

Several types of data will be collected during the evaluation study. This data consist of the answers of the knowledge test before the experience, the video recordings during the experience, answers to the SUS questionnaire, audio recordings of the interview, and the answers of the knowledge test two weeks after the experience.

12.2.1 Comparing the Results of the Knowledge Test Taken Before and After the Interactive Wine-Tasting Experience

Before starting the wine-tasting experience, the participants will be asked to complete a series of questions on wine and wine-tasting terms and techniques to test their

knowledge of the subject. Two weeks after the participants have done the interactive wine-tasting experience, they will be asked to complete this test again. These two tests will then be compared, to see if non-functional requirements ensuring the correct educational level have been met:

NFR-1 **Must** be fully understandable for participants with little to no experience with wine and/or wine-tasting
NFR-2 **Should** increase the participant's knowledge on how to describe the appearance, nose and palate of a wine

It is explicitly mentioned that this test is not something they have to be good at, but aims to evaluate their current wine and wine-tasting knowledge level. Therefore, it is okay if they leave questions they do not know the answers to blank.

The 23 questions, with the correct answers, of this knowledge test can be found in appendix H section H.1. The answers are scored based on what elements are present. If all elements are present in an answer, the total answer scores one point. Therefore, a total of 23 points can be scored with this test.

There are a few questions that can have different answers than the one required, which are also correct. Question 3, for instance, can have more or different responses than just colour. As colour is the main aspect of the appearance step, this is the answer that will score points. Any other reasonable answers, such as viscosity or intensity, will receive a score of 0.2 points, with a maximum of 1 point total. This means the participants can score 24 points in total. This last point is counted as a bonus point, as this information is not provided during the interactive wine-tasting experience.

Two weeks after the evaluation study, the participants will be asked to fill in another knowledge test to see how much of the knowledge explained during the interactive wine-tasting experience they were able to remember. This test is identical to the first test. After the first test, the participants do not receive their final score, their answers to the questions, or the correct answers to the questions.

12.2.2 Analysing the Video Footage of the Interactive Wine-Tasting Experience

After completing the knowledge test, the wine-tasting experience will start, as described in 8 The Interactive Technology Wine-Tasting Experience. The participants will go through the steps of a wine-tasting, with alcohol-free wine, using the interactive technology system. The wine tasting will be led by the researcher (WSET level 2 Award in wines). During the interactive wine-tasting experience, the participants will be video recorded.

The video recordings will be used to analyse if the following non-functional requirements have been met

NFR-3 **Must** be concluded within two hours
NFR-10 **Should** create focus on element where the user should be focusing on: instruction, execution and discussion of the wine tasting steps

The video footage is used to determine how long each of the experiences lasted, as well as, to analyse where the focus of the participant is during the interactive wine-tasting experience.

To analyse the data, the video recordings are annotated to see where the participants are looking at during the instruction, execution and discussion portions of the wine-tastings steps. The annotations are done using ELAN, a free annotation tool for audio and video recordings [81]. The annotations are divided into: looking at the projections in front of them, looking at the instructor, looking at the other participant or looking at the projections of the other participant, and looking elsewhere. Therefore, the data provides an overview of where the focus of the participants is during each part of the wine-tasting experience.

It is hard to distinguish if the participant is looking at the other participant or looking at the projections of the other participant. Therefore, these categories have been grouped together. For each set of two participants, only recordings of the first and second wine will be recorded. This is done to save time, as the results of the third and fourth wines will likely be similar to the first two.

12.2.3 Calculating the SUS score

After completing the wine-tasting experience, the participants are asked to fill in the SUS questionnaire, a usability scale that can be used to globally assess the ease of use of the system [80], [82]. Each item of the questionnaire can be scored, resulting in a SUS score between 0 and 100. They are asked to fill in this questionnaire before the interview to record their immediate response to the system.

For the likert scale, a rating from 1 to 5 is used, each answer gets a score from 1 to 5. With one corresponding to 'strongly disagree' and 5 corresponding to 'strongly agree'. To calculate the SUS score, each item score's 0 to 4 points based on the answers of the participants. Items 1, 3, 5, 7, and 9 have a score equal to the scale position minus one. For the other items, 2, 4, 6, 8, 10, the score is 5 minus the scale position. To get the SUS score, the total score of all items is multiplied by 2,5. This score represents the overall value of the system usability between 0 - 100. [80], [82]. The overall SUS benchmark score is an 68 on average. To fall in the top 10%, the SUS score should be 80.3 or above [80]. Therefore, the SUS score of the interactive technology wine-tasting installation should be above 80.3 for the non-functional requirement to be fully met.

The questions of the SUS questionnaire can be found in appendix H section H.2. One of the standard SUS questions is adapted to fit the context of the interactive wine-tasting experience. The question "I think that I would like to use this system frequently" is too ambiguous in the context of wine tastings. It could suggest the desire to use the system frequently in day-to-day life, or the desire to often use the system during wine tastings. Therefore, this question is adapted to: "I think that I would like to use this system during every wine tasting"

With the SUS-questionnaire the usability of the system can be evaluated. Therefore, this question aims to see if the following non-functional requirement on the approachable aspect of the system has been met:

NFR-4 **Should** be an easy-to-understand system

12.2.4 Analysing the Answers to the Interview Questions

Then, an interview will be conducted with the participants. The participants will be asked questions based on their experience. These questions are constructed based on the non-functional requirements. The participants are interviewed individually. The list of questions can be found in appendix H section H.3. During the interview, the participants will be audio-recorded.

The interview with the participants after the experience will be used to evaluate if the following non-functional requirements have been met:

12.2.4.1 Correct Educational Level

NFR-1 **Must** be fully understandable for participants with little to no experience with wine and/or wine-tasting
NFR-2 **Should** increase the participant's knowledge on how to describe the appearance, nose and palate of a wine

12.2.4.2 Approachable

NFR-3 **Must** be concluded within two hours
NFR-4 **Should** be an easy-to-understand system
NFR-5 **Should** explain wine terms in easy-to-understand language
NFR-6 **Should** not overwhelm the participant

12.2.4.3 Memorability

NFR-7 **Should** include a storyline that is easily imaginable, relevant and experienced immersively

12.2.4.4 Responsiveness

NFR-8 **Should** answer any questions about the educational contents immediately
NFR-9 **Could** answer to any concerns about the experience within two weeks

12.2.4.5 Aid Transitions

NFR-10 **Should** create focus on element where the user should be focusing on: instruction, execution or discussion of the wine tasting steps

12.2.4.6 Have room for discussion

NFR-11 **Should** have the participant feel safe to speak up during the discussion
NFR-12 **Should** give participants enough time to formulate their own findings
NFR-13 **Should** make it easier for the participants to formulate their findings
NFR-14 **Should** ensure the user there are no right and wrong answers

To structure the analysis of the answers to the interview, the answers are divided into the following sections: initial thoughts, educational level, approachable, have room for discussion, responsiveness, memorability, good value for money, and final remarks. The interview is semi-structured, mostly following the same order of questions. However, the researcher can stray from this structure based on the responses of the participants.

12.3 Iterations on the Experience After the First Non-Functional Evaluation Study

During the first evaluation study, the projections of one of the participants were not sharp, which made it hard for them to distinguish some of the aromas. This was caused by the connection with the projector, as mirocast was used to cast the visuals to the

projector instead of an HDMI cable. This was solved after the first experience by connecting the projector to the computer via HDMI cable.

Furthermore, during the interview, this first participant mentioned that they would have liked some sort of introduction to the interactive aspect of the wine tasting. This was done for all the following evaluation studies. At the start of the experience, the instructor mentioned that the participants would give their input through an interactive table that recognises their touch and the location of their wine glasses.

Additionally, the other participant in this first evaluation had trouble with the aroma buttons. The buttons were sometimes slow to react, which caused the participant to be frustrated. This was caused by a delay in the Processing code. This problem was also solved before the next evaluation study.

12.4 Results

To evaluate the data collected, the answers to the knowledge test, the SUS questionnaire, and the interview are analysed, as well as, the video recordings of the interactive wine-tasting experience.

12.4.1 Comparing the Results of the Knowledge Test Taken Before and After the Interactive Wine-Tasting Experience

The answers given by the participants, including the scoring, of the test before the experience can be seen in appendix J in figure J.1 and figure J.2. The answers of the test after the experience can be seen in appendix J in figure J.3 and figure J.4.

To compare the results of both tests, they are plotted in a graph, see figure 12.1. As can be seen in this figure, all participants had a better score after the experience. The average score of the participants before the experience is 9,36 out of a maximum 23 points. While the average score of the participants after the experience is 16,72 out of a maximum of 23 points. This means that the participants which were included in this study improved with an average of 7,36 points. Additionally, the scores of all participants improved in the test after the experience. As the sample size of this non-functional evaluation study is very small, no statistical test is done to prove the

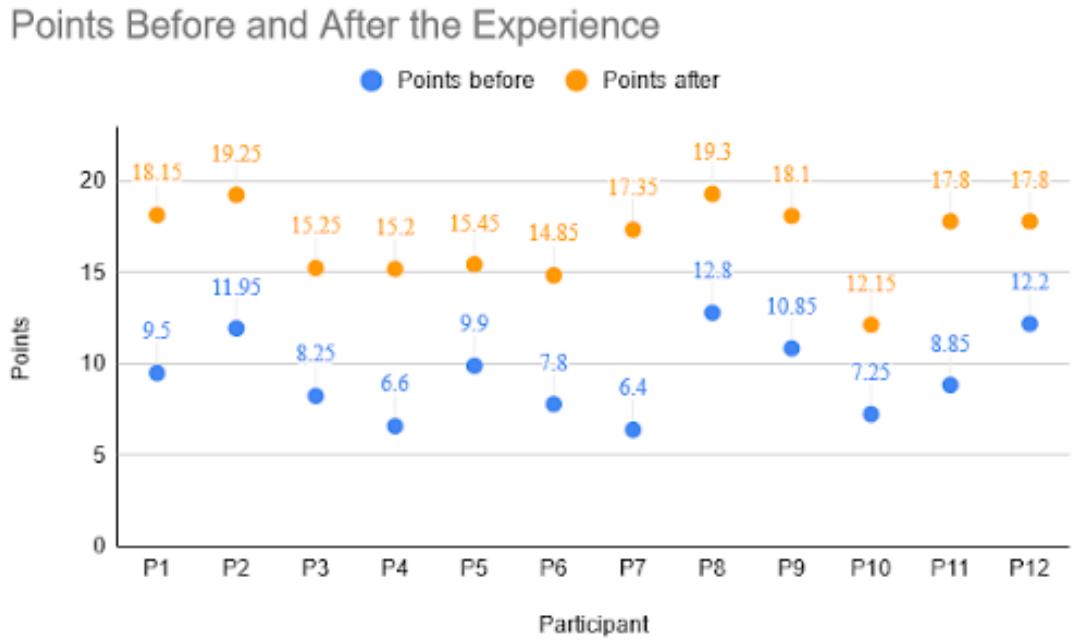


Figure 12.1: Spread of points scored on the knowledge test, before (blue) and two weeks after (orange) the experience per participant.

statistical significance of this difference in mean scores before and after the experience.

Table 12.1 shows that three questions of the second knowledge test received perfect scores. These questions were:

- The aromas that you smell on the nose are the same once you taste on the palate. [True/False] (12)
- How can you make the flavour of wine more pronounced in your mouth? (12)
- A higher quality wine has a shorter finish. [True/False] (12)

However, two of these questions were also answered correctly by all participants in the first test.

Additionally, several questions received a near-perfect score, where at least ten of the participants answered the question correctly:

- What three tasting steps are used to assess a wine? (10.8)
- What aspect of a wine can you describe during the appearance step? (11.6)
- How do you assess the intensity of the nose? (11)
- The intensity of a wine says something about the quality of the wine? (11)

Question	**Total score of all participants before the experience** (out of 12)	**Total score of all participants after the experience** (out of 12)
Q1	8.9	10.8
Q2	2.9	5.2
Q3	9.2	11.6
Q4	1.5	6.75
Q5	2.1	6.8
Q6	7	6.5
Q7	3.2	8.5
Q8	1	11
Q9	0	7.9
Q10	9	9
Q11	7	8
Q12	6	7.5
Q13	3.55	4
Q14	0	1
Q15	0	7.9
Q16	7	11
Q17	12	12
Q18	9	12
Q19	0	7.2
Q20	2	11
Q21	8	11.5
Q22	1	11.5
Q23	12	12

Table 12.1: The sum of the scores of the first and second knowledge test of the participants per question.

- How can you recognise if a wine has a high acidity? (11)
- What does 'the finish' of a wine mean? (11.5)
- How is the finish of a wine measured? (11.5)

The following questions were answered incorrectly by more than half of the participants:

- How do you assess the appearance of the wine?
- What aspect of a wine can you describe during the palate step?
- How do you assess the intensity of the palate?

It can be noted that the question on how to assess the intensity of the palate was only answered correctly by one participant.

12.4.2 Analysing the Video Footage of the Interactive Wine-Tasting Experience

All experiences were concluded within the two hours, with all of the experiences lasting between 1 hour and 1,5 hours.

The results of the annotation can be seen in tables 12.2 12.3, 12.4, and 12.5. These results are presented based on the different sections of the interactive technology wine-tasting experience: The introduction, the instructions, the execution, and the discussion.

12.4.2.1 Introduction

		Total	**Instructor**	**Projection**	**Participant**	**Wine Glass**	**Other**
Average [s]		41.13	25.36	11.61	2.66	0.00	1.50
Percentage		100.0%	61.7%	28.2%	6.5%	0.0%	3.6%

Table 12.2: Average time and percentage that the participant looks at the instructor, the projection, the other participant, their wine glass, or other, during the introduction of the experience.

During the introduction of the experience, the focus of the participants is mostly on the instructor, 61.7% of the time. The next item of focus is on the projections on

the table, taking up 28.2% of the time. The participants also spend a small amount of time focusing on each other, which is 6.5% of the time. During this stage there was no focus on the wine glass.

12.4.2.2 Instructions

		Total	Instructor	Projection	Participant	Wine Glass	Other
Average [s]		231.50	95.34	90.51	6.93	30.03	8.69
Percentage		100.0%	41.2%	39.1%	3.0%	13.0%	3.8%

Table 12.3: Average time and percentage that the participant looks at the instructor, the projection, the other participant, their wine glass, or other, during the instructions of a wine-tasting step

During the instruction part of the wine-tasting steps, their focus is almost equally shared between the instructor and the projections, with 41.2% of the time and 39.1% of the time respectively. Next, at 13% of the time the participants focus on their wine glasses. Again, the smallest amount of time is focussed on the other participant, which is 3.0% of the time.

12.4.2.3 Execution

		Total	Instructor	Projection	Participant	Wine Glass	Other
Average [s]		1269.38	210.76	515.15	353.61	133.28	56.58
Percentage		100.0%	16.6%	40.6%	27.9%	10.5%	4.5%

Table 12.4: Average time and percentage that the participant looks at the instructor, the projection, the other participant, their wine glass, or other, during the execution of a wine-tasting step

When executing the steps, the participants are mainly focused on the projection on the table (40.6% of the time), followed by the focus on the other participant (27.9%). About 16.6% of the time they are focussed on the instructor, and 13% of the time they are looking at their wine glass.

12.4.2.4 Discussion

		Total	Instructor	Projection	Participant	Wine Glass	Other
Average [s]		472.88	120.47	237.69	99.09	0.00	15.63
Percentage		100.0%	25.5%	50.3%	21.0%	0.0%	3.3%

Table 12.5: Average time and percentage that the participant looks at the instructor, the projection, the other participant, their wine glass, or other, during the discussion of a wine-tasting step

During the discussion of their findings, the participants are mainly focussed on the projections on the table (50.3% of the time). This is followed by an almost shared focus between the instructor and the other participant, with 25.5% of the time and 21.0% of the time respectively.

12.4.3 Calculating the SUS score

The answers to the SUS questionnaire can be found in appendix K. Based on the questionnaire answers of the non-functional evaluation study SUS score calculated is 82,92. This means the installation scores above the 80.3 benchmark, scoring in the top 10% of SUS scores.

12.4.4 Analysing the Answers to the Interview Questions

The interview with the participants was conducted in Dutch. The full answers of the participants are paraphrased and translated into English and can be found in appendix I: Answers to the Non-Functional Evaluation Study. The overall findings of the interview will be described below. These findings are categorised into: initial thoughts, educational level, tangibility, approachable, have room for discussion, responsiveness, memorability, good value for money, and final remarks.

12.4.4.1 Initial Thoughts

The initial thoughts of the participants are further subdivided into the overall impression, the best part of the experience, the worst part of the experience, the com-

parison between the interactive technology wine-tasting experience and a traditional wine-tasting experience, and suggested changes.

Overall impression

All of the participants were positive about the experience they just had. Most participants mentioned that they enjoyed the interactive or visual aspect of the experience.

Best Part of the Experience

Overall, the participants mentioned that they thought the interactive and visual elements were their favourite part of the experience. Two participants mentioned that the visualisations made it easier to compare your findings with the others.

Another participant said that they liked how you do the steps yourself, but still get to interact with the others. Someone else explains that they liked that they were guided through the steps to learn more about wine. Similar to this, another participant mentioned that they thought the structure was the most effective aspect of the tasting.

Additionally, a participant liked that their input mattered. Which is in line with the statement of two other participants, who said that they liked that things were added to the summary after each step, so they could see their progress.

Worst Part of the Experience Several items of frustration were mentioned during the interviews. Firstly, one participant found it frustrating that where they placed the wine glass during the summary resulted in the wine glass being in the way of the text during the next step.

Secondly, two participants mentioned they felt like the board on the table was not entirely stable. One of these participants bumped against the board, which made it move, causing the sensors to be unaligned with the projections. The board had to be moved back by the instructor before the experience could continue.

Third, a participant would have liked it if the aromas in the summary would also visualise the aroma category they are from, so they could quicker compare the aroma findings between participants. Lastly, one participant felt like they needed more options between the three current options for the intensity and acidity steps.

Suggested Changes

Several suggestions were given by the participants. Firstly, a participant suggested adding the names of the steps to the instruction slides. Secondly, two participants found it frustrating that the wine glass was in the way of the text at one point during the interaction. Therefore, they suggested making the participants move the glass to another position in the summary step. Thirdly, another participant thought it would be helpful to add the colour of the aroma category to the background of the aroma during the discussion step. Fourthly, it was suggested to add a way to rate the wines they have tasted on both the quality of the wine and how well they liked the wine. Fifth, two participants felt like there should have been more aroma options, as they were not able to find the aroma they were smelling/tasting. Finally, the last participant said that any additional interactions would be nice.

The Interactive Technology Wine-Tasting Experience Compared to Traditional Wine Tasting

According to most of the participants, they found this experience more educational when compared to a traditional wine tasting. Half of the participants mentioned that a traditional wine tasting is often about whether you like a wine or not, instead of the educational aspect. Two participants said that the visualisations helped them gain a better reference of what each wine descriptor means. These visuals also helped one participant with finding the aromas in the wine: "traditionally, you have to come up with the flavours yourself, but that is not something I am good at". Furthermore, several participants mentioned that the visuals helped them understand each step better, as well as, comparing two wines with each other.

Additionally, several participants mentioned that during the interactive technology wine-tasting experience you are challenged to think about something yourself and are less likely to be influenced by others. One participant said that in a traditional tasting it is more likely that people who are comfortable with wine will be more likely to speak up, while this experience more people will be inclined to participate.

Another aspect that differs from the traditional wine-tasting experience, according

to the participants, is that the interactive system helps you easily register your answers and compare your findings to those of the other participant. Lastly, it was mentioned that this experience was less chaotic when compared to a traditional tasting, due to the systematic approach. One participant stated, "you know what you have to do at any point".

Understanding the Interactive Elements All the participants were able to complete the interactive tasks during the experience. However, not all participants knew that they could place their glass on the circles, or touch the aromas immediately. Therefore, some participants needed some guidance from the instructor on what to do. After the first time, they had placed their glass on one of the circles during the colour step and had selected the nose aromas with their fingers, all other interactions were clear. None of the participant had troubles with understanding how to start and stop the timer.

12.4.4.2 Educational Level

Almost all participants expressed that they feel like they have more knowledge about wine and wine tasting now and no one found the information provided too difficult or too easy. Even the participants that already knew a lot about wine, did not find the information frustrating. However, some participants had problems translating the English text in the projections to Dutch. Additionally, two participants found some aspects of the experience too repetitive, mainly mentioning the instructions of the wine tasting steps.

12.4.4.3 Tangibility

All participants mentioned there was enough space on the table to use the interactive table and place their wine glass, water glass, spittoon, and shared water carafe on the table.

12.4.4.4 Approachable

None of the participant found the experience snobbish. As an explanation, one participant said that it "felt very down to earth".

Several participants did feel inexperienced during the experience. One participant, for example, stated that they struggled to identify the aromas. "All I could think was "I taste wine"." Regardless, they did say that the illustrations of the aromas helped them. Otherwise, "I could not have found any aromas at all". Three other participants said that they appreciated that the instructor could guide them in the right direction, or provide context.

Additionally, the participants did mention that they gained more confidence throughout the experience. One participants mentioned that they would have liked to receive some more in-depth information during the experience in the form of more information about the wines that were poured, or the wine labels.

12.4.4.5 Have Room for Discussion

Each participant said they had enough time to formulate their own findings before moving to the discussion.

During the discussion, most participants did not feel there were wrong answers during the discussion. Some participants did feel that the instructor was trying to nudge them in a more correct direction (ie. if the wine had a high acidity, but the participant thought it was a low acidity). One participant further explained this with: "there was no hard wrong".

One participant mentioned that they always find it a bit scary to report their findings. However, they did find it easier when they realised "I just have to say what I see in front of me". All other participants also mentioned that the visuals helped them during the discussion.

12.4.4.6 Responsiveness

According to the participants, any questions that the participants had were quickly answered by the instructor.

12.4.4.7 Memorability

Most of the participants had trouble understanding the storyline or the relevance of the story told at the beginning of the experience. However, one participant mentioned

that it did "help them get into it". Two participants suggested that it could have been more elaborate, or sold better.

Regardless of the storyline, all but one were positive about the magazine handout. The participants were positive about the fact that their feedback mattered and that one of the articles was personalised. Several participants mentioned that they liked that it can help you investigate what you enjoy further. Additionally, one participant was positive about comparing your findings with your friends who also took part in the experience afterwards. Another participant said they might even take the magazine with them when they are trying new wines to follow the steps.

Several suggestions were made to improve the magazine. One participant suggested adding the visualisations of the summary page into the personalised review. Another participant proposed adding coupons for a discount on the wines that are tasted.

What participants thought about the level of repetitiveness varied. Several participants mentioned that they liked the level of repetitiveness because they feel 'repetition is key' in learning. Others found that they would have rather moved through some aspects quicker, such as the instruction steps.

All participants said they would recommend this experience to friend and/or family in varying degrees.

12.4.4.8 Good Value for Money

Almost all participants said that they would pay money for the experience. The amount of money they would pay for the experience varied from from 15 to 80 euros per person.

12.4.4.9 Final Remarks

Two participants mentioned that they would have enjoyed snacks during the participants. With the latter mentioning crackers. Two other participants suggested that the system could even be adjusted for people to use at home when trying new wines. Additionally, a participant mentioned that they see a potential for trying this with other types of wines. Lastly, two participants mentioned that they enjoyed that they were asked to explain the last wine themselves. With one of these participants explaining "It shows that if you know something you can do it yourself".

12.5 Conclusions

In this chapter the second part of the following sub-research question was answered:

*SQ-4: How can the functional and **non-functional** requirements be evaluated?*

In this chapter, the functional requirements set in 6 Translating the Guidelines for a Satisfactory Wine-Tasting Experience into the Interactive Technology Domain have been investigated with a non-functional evaluation study, which included twelve participants in groups of two. These requirements were evaluated by comparing the knowledge tests taken before and after the experience, evaluating the SUS score, annotating the focus of the participants with the video footage, and analysing the answers to the interview questions.

12.5.1 Comparing the Results of the Knowledge Test Taken Before and After the Interactive Wine-Tasting Experience

The knowledge test aimed to investigate whether the participants gained more knowledge after completing the interactive technology wine-tasting experience. Thus evaluating the following non-functional requirements:

NFR-1 **Must** be fully understandable for participants with little to no experience with wine and/or wine-tasting
NFR-2 **Should** increase the participant's knowledge on how to describe the appearance, nose and palate of a wine

The results show that all of the participants' scores had been improved after the experience. This suggests a trend of knowledge gained. However, with the limited amount of participants, it can not be said if this difference is significant. Furthermore, it can be expected that the scores of the participants improved after an experience where knowledge is shared. Additionally, this testing method can only say that knowledge has been gained, and does not prove if more knowledge has been gained compared to a traditional wine tasting. However, it might be a good indicator that the information was retained two weeks after the experience.

However, the results do show what knowledge was still difficult for these participants to retain, even after the experience. Overall, only one participant could properly define how to assess the palate intensity. Furthermore, the results show that several participants confused the palate intensity with the finish of the wine. In the second knowledge test, five of the participants described how to assess the palate intensity as how long the taste lingers, which is the description of the finish. Interestingly, four of these participants did describe the finish correctly.

This could suggest that the participants either did not fully understand how to assess the palate intensity during the tasting or were not able to retain or describe this information after the experience. Possible reasons for this could be that the palate intensity was not properly explained, that the concept was too vague to understand, or that the wines during the tasting did not have the right frame of reference to show the participants the difference between a low and high palate intensity. Perhaps a follow-up interview with the participants could shed light on why the participants had difficulty recalling this information two weeks after the experience.

12.5.2 Calculating the SUS score

The SUS for the interactive technology wine-tasting experience was scored at 82,92 points. Therefore, this system ranks in the top 10% of SUS scores on the system usability scale. This score has been based on a limited number of participants, but does suggest that the following non-functional requirement has been met"
NFR-4 **Should** be an easy-to-understand system

12.5.3 Analysing the Video Footage of the Interactive Wine-Tasting Experience

The video footage was analysed to see where the focus of the participants was during the experience. As stated in 6, during the introduction and instruction on a wine-tasting step, the focus of the participants should be on the instructor. During the execution of the wine-tasting step, the focus should be on the projection, and during the discussion, the focus should be between the other participant and the instructor.

The results show that during the introduction the focus of the participants was mostly on the instructor. During the instruction, this focus was shared between the instructor and the projection almost equally. This could be the case because the projection shows the visualisations and written instructions of the step in front of them as well. Even though this result was not expected, it is not considered a problem, as it might suggest that some participants prefer to read or visually see the instructions, which corresponds to the learning styles discussed in chapter 4 Guidelines for a Satisfactory and Educational Traditional Wine-Tasting Experience.

During the execution part of the wine-tasting steps, the participants were mostly focused on the projection. However, about 28% of their time, they were also looking at the other participant or their screen. This could either mean that they were interacting with the other participant, or see what the other participant was selecting.

Lastly, during the discussion, the focus of the participants was mainly on the projections, with a shared focus on the instructor and the other participant coming in second and third place. This means that they were looking at the projections more than expected. This could be explained, because the participants were mostly explaining their own findings during the discussion, which were summarised in front of them.

Lastly, all of the experiences were concluded within the limit of two hours. Moreover, the results show that even though the participants mostly focus on the element they should be focusing on, at certain points during the experience the participants seem to focus more on the screen than expected. Especially, during the instruction and discussion of a wine-tasting step. However, as the projections visualise additional information that supports the user in the instructions and discussion, this might not be a negative result.

Overall, these findings suggest that the following requirements have been met:

NFR-3 **Must** be concluded within two hours
NFR-11 **Should** create focus on element where the user should be focusing on: instruction, execution and discussion of the wine tasting steps

12.5.4 Analysing the Answers to the Interview Questions

The interview questions aimed to investigate whether the following non-functional requirements have been met:

12.5.4.1 Correct Educational Level

NFR-1 **Must** be fully understandable for participants with little to no experience with wine and/or wine-tasting

Based on the answers of the participants, there was no information that was too difficult to understand for these participants. Additionally, participants who already had more wine knowledge did not find the information too easy to understand. However, some participants did want to receive more information during the experience.

12.5.4.2 Approachable

NFR-4 **Should** be an easy-to-understand system
NFR-5 **Should** explain wine terms in easy-to-understand language
NFR-6 **Should** have the participant feel safe to speak up during the discussion
NFR-7 **Should** not overwhelm the participant

All participants were able to complete the tasks using the interactive table. However, some participants did need some guidance from the instructor on what to do the first time they had to select their findings with the interactive table. The second time they saw a similar task, all participants did directly know what to do.

Therefore, the system is not considered to be immediately intuitive. However, as the instructor is always present during the experience to guide the participants, having to explain what to do is not considered a negative outcome. Nevertheless, it can be investigated how the design of the projections could further support the intuitiveness of the interactive aspects of the system.

With all the participants having Dutch as their first language, the experience was provided in Dutch. However, the text on the projections was still in English. Some

participants had difficulties translating this text to Dutch, or linking the oral terms to the written terms. Therefore, the written text should be adjusted to the language of the experience.

12.5.4.3 Memorability

NFR-8 **Should** include a storyline that is easily imaginable, relevant and experienced immersively

Overall, the storyline was the most confusing or unnecessary aspect of the experience for the participants. Even though some participants liked the story, it was not well received by most participants. The magazine handout, on the other hand, was very positively reviewed, especially as something that could teach them more about wine.

Therefore, the storyline should be reconsidered. Either the story needs to be sold better, or the storyline should be changed. Perhaps, a new storyline could be built around the magazine handout.

12.5.4.4 Responsiveness

NFR-9 **Should** answer any questions about the educational contents immediately
NFR-10 **Could** answer to any concerns about the experience within two weeks

All questions and concerns were immediately addressed by the instructor and the participants were positive about the customer service. However, it is important to mention that customer service is highly dependent on the instructor of the experience. Therefore, this requirement can only be evaluated based on the experience with the researcher as the instructor. There were no concerns during the experience.

12.5.4.5 Have room for discussion

NFR-12 **Should** give participants enough time to formulate their own findings
NFR-13 **Should** make it easier for the participants to formulate their findings

NFR-14 **Should** ensure the user there are no right and wrong answers

All participants said they had enough time to formulate their findings before moving to the next step. Additionally, most participants mentioned that the system made it easier to formulate their findings, as well as helped them feel more comfortable discussing these findings. In particular, the visual aspect was mentioned as the reason they felt comfortable to speak up during the discussion. Most participant felt like there were no wrong answers, but some said they did feel guided by the instructor to think in a certain direction.

12.5.4.6 Good Value for Money

Even though the value for money is not investigated in this research, all participants said that they would be willing to pay for the interactive technology wine-tasting experience. With the amounts they would be willing to pay varying from 15 euros to 80 euros per person.

Chapter 13

Discussion

This research explored the potential of an interactive technology installation to teach novice wine consumers about wine. In particular, how to taste, describe and assess a wine. In turn, teaching them to better explain their wine preferences for future use.

In this chapter, the relevant context of the Interactive Wine-Tasting Experience, as well as, the implications of this research is discussed. Additionally, limitations and recommendations of the methods used and the interactive technology installation are examined. Lastly, several future research opportunities are explored.

13.1 Context

It can be hard for novice wine consumers to decide what wines they enjoy, and why. To aid in this process, wine tastings can help novice wine drinkers learn more about how to taste, describe, and objectively assess a wine. This can help the consumer understand what wines they might enjoy, why they enjoy them, and how to describe these wines.

This research shows that people are attracted to wine tastings for social or educational purposes. During a wine tasting, participants can learn a lot about their preferences, how to taste wine, the regions where the wine comes from, the history of wine, vinification techniques and how to pair food and wine. Furthermore, they can be there to have a good time with friends, family or strangers, or enjoy the sensory perception of tasting and exploring wines.

This need for education on wine is reflected in the products and projects that have

already been developed. These mostly aim to help the user learn more about wine, how to select a wine, or enhance the wine-tasting experience. This further shows that there is a need for education about wine and selecting wines, while creating a novel experience.

Therefore, the interactive technology wine-tasting experience was designed: a novel wine-tasting experience that educates novice wine consumers on how to taste, describe and objectively evaluate a wine.

None of the products and projects investigated for this research function as an interactive technology to support the educational content of a wine-tasting experience. Additionally, no similar projects or experiences to the one created have been found. This suggests that the interactive technology wine-tasting experience is novel in terms of enhancing a wine tasting.

13.2 Answering the Main Research Question

The goal of the research is to answer the research question set in chapter 1: Introduction.

How to design a satisfactory interactive technology installation that increases the educational knowledge on wine tasting, for novice wine drinkers?

This research was successful in creating an interactive technology wine-tasting experience that allows novice wine consumers to learn more about how to taste a wine. To design the interactive technology installation, first the traditional wine-tasting experience was investigated. This resulted in the nine design principles for a satisfactory wine-tasting experience. These guidelines were then translated into the interactive technology domain, creating the non-functional requirements for an interactive technology wine-tasting experience. The non-functional requirements were the base for the interaction brainstorming sessions and design decisions during the ideation phase. With these design decisions, an initial concept for the interactive technology wine-tasting experience developed. Further specification of this concept resulted in the functional requirements for the interactive technology wine-tasting experience. Which were used to realise the system. The system was evaluated on the functional and non-functional

Figure 13.1: Guidelines to for a satisfactory interactive technology learning experience

requirements, through an initial functionality test, a functional usability test, and a non-functional evaluation study. Based on these findings almost all functional and non-functional requirements have been met.

13.3 Implications

Nine design principles for the development of a satisfactory and educational traditional wine-tasting experience were identified and translated into the interactive technology domain. These nine principles formed the base for creating an educational interactive technology experience.

Perhaps, these design guidelines could also be used to support the design of other educational interactive technology experiences. Therefore, based on the findings of this research, the guidelines for a satisfactory interactive technology learning experience are determined, as can be seen in figure 13.1.

13.3.1 Determine correct educational content

The first step of designing an interactive technology for an educational experience is to determine who your user is and to adjust the education level to that user.

For this research, the educational level was based on an already existing wine course for novice wine consumers, the WSET Level 1 course [58]. This was very helpful, as the goal was not to change the educational contents of an educational wine-tasting, but to enhance the experience using interactive technology. Therefore, it is suggested to look at already existing educational content for your user group to determine the correct educational content.

However, if such a benchmark is not available for your user group, research should be done to fully investigate the needs and goals of the user. This can be done through surveys, interviews, and focus groups with potential users or educators on the subject [83]. Additionally, creating several user personas can be helpful in further understanding these wants and needs [84]. Moreover, market research can help understand what educational content exists on the subject and how this can be adapted to your user [83].

13.3.2 Ensure Tangibility

For any experience it is important that the correct equipment is available, the space is appropriate and there are enough amenities. What this means can vary depending on the type of experience. Therefore, it is advised to investigate what the appropriate tangibility is for your educational experience. Again, it might be helpful to look at what experiences already exist to understand how to ensure tangibility.

13.3.3 Include Multiple Learning Styles

To ensure the learning experience is engaging, it can be helpful to include as many learning styles as possible. Information can be relayed auditory. However, a system can be further designed to support the auditory learning style with visual and written information. Additionally, try to incorporate the kinesthetic learning style by letting the users experience or investigate the topic themselves. Furthermore, ensure that the

participants have both solitary as social educational interactions with the system and each other.

13.3.4 Enhance Memorability

Including gamification has also been suggested to enhance the memorability of the experience. However, only the storytelling element of gamification has been considered in the design of the interactive technology wine-tasting experience. Therefore, implementing gamification could be further explored to further engage the user [61], [62], [64], [85].

This research found that the storytelling element of gamification can be beneficial in enhancing the memorability of an experience if it is easily imaginable, relevant and experienced immersively. However, the storyline introduced in this research did not seem to meet any of these criteria and was mostly received negatively in the non-functional evaluation study. Therefore, it could be reconsidered if the element of storytelling is necessary for such an experience or if the story should be adapted to meet these criteria.

Additionally, it is advised to create a novel experience. For the design of the interactive technology wine-tasting experience, a design gap was found, as none of the related work showed similar projects and products that have already been created. Therefore, to develop a novel experience it is suggested to investigate related work to find a possible design gap.

Furthermore, the user could be sent home with something to remember the experience by. For the interactive wine-tasting experience, this was the magazine hand-out, which was very well received during the non-functional evaluation study. Based on this research, the memorabilia could either reiterate on what they have learned during the experience or guide them on what to do next to continue the educational journey.

13.3.5 Provide Responsiveness

To ensure that the user's questions were answered quickly, a trained expert on wine was used for the interactive technology wine-tasting experiences. This resulted in any questions being answered immediately. However, if your system does not allow for an expert to be available, the system should be able to reply to any questions or concerns

itself.

13.3.6 Aid Transitions

To help the user understand where in the experience they are and what they should be focusing on, visual aids proved to be helpful in the interactive technology wine-tasting experience. The design of the interactive technology wine-tasting experience showed that visuals were very helpful in guiding the focus of the participants.

Additionally, research showed that music and sounds or the lighting in the room could also help guide the attention of the user. However, this was not tested in this research.

13.3.7 Encourage Discussion

As explained, it is also important for the user to share their findings. For the interactive technology wine-tasting experience, participants of the non-functional evaluation study found the summary and visual aids the system provided useful in comparing and discussing their findings. This further supports that visual aids should be used in the design of interactive technology for an educational experience. Moreover, if the participants are asked to give their input, it can be helpful to automatically create a (visual) summary, which they can use to articulate their findings.

Additionally, the participants stated that the instructor was important in feeling comfortable discussing their findings, either by initialising the discussion or by guiding the topics during the discussion. To guide the discussion, it is important to look at how the system could suggest topics to initialise the discussion or guide the user towards certain topics.

13.3.8 Assure Approachability

To create an approachable system, it is important that the installation is easy to understand. Therefore, it is advised to test the system on its usability using the SUS scale [80], where it should at least score above the average of 60 points, but ideally above 80.3 points. Furthermore, difficult language should be avoided. Any terms related to

the topic that need to be explored should be explained so that anyone within the user group can understand it. Visual aids could also be used to support the explanation.

During the experience, the user should be focused on understanding the educational content, using the equipment provided. Therefore, it is advised not to add too many items to the experience, so as to not to distract the user.

Lastly, the experience should aim to create an inclusive environment. The goal of the experience is to educate the user on a topic. However, the system should not judge the input of the user too harshly. In the interactive technology wine-tasting experience, for example, the installation gives no feedback on the input of the users. To create an inclusive educational environment, the system should guide the user towards the correct answer.

13.3.9 Create Good Value for Money

How to create good value for money was not fully explored during this research. However, two suggestions are considered. First, willingness to pay by the user group should be investigated early to understand the value of the interactive technology experience. Second, expensive technology should be avoided where possible to minimise costs.

13.4 Limitations and recommendations of the research

The methods used in this research are characterised by some limitations. This section discusses these limitations and proposes several recommendations for future research.

Only 6 participants were included in the functional usability test and 12 participants were included in the non-functional evaluation study. These small sample sizes may not offer enough feedback on the usability and functionality of the system. Additionally, issues with the system may have been overlooked.

Additionally, the interactive technology wine-tasting experience was designed to be conducted with 6-10 participants. However, due to limited resources and time constraints, only two interactive systems were created, which means only two participants could be included at a time. The research did set out to investigate the interaction between the participants as well, but as the group size is limited, this research is not

fully successful in doing so.

If the group size is increased, the instructor might have a harder time with the overview the experience, because their focus needs to be divided over more people. Furthermore, the focus of the participants may be altered as well, as they can be more distracted by other participants. However, having more participants could also lead to more active discussions between the participants. Therefore, it is recommended that for future research, additional interactive boards are created to test the interactive technology wine experience tasting with at least six participants.

This research only investigated the knowledge gained from this experience. This was done by comparing the results of a knowledge test taken before the experience to the results of a knowledge test taken two weeks after the experience. This means no conclusions can be drawn on the difference in educational value between a traditional wine-tasting experience and the interactive technology wine-tasting experience created.

Furthermore, due to time constraints, the second knowledge test was taken two weeks after completing the experience. After two weeks, the participants seemed to have gained more knowledge on how to taste and describe a wine. However, this might be expected after only two weeks after the experience. Overall, the long-term learning effects of the educational knowledge have not been properly investigated. Adding another knowledge test two months after the experience could better evaluate the knowledge retention of the wine-tasting experience.

Still, even after only two weeks, only participant was able to properly recall how to assess the intensity of the palate, often confusing it with the palate. This suggests that the explanation of the palate intensity should be better portrayed in the experience.

Moreover, the knowledge test only focuses on the theoretical aspects of the wine-tasting experience. It evaluates if the participants were able to recall how to describe and assess a wine. However, it does not measure if the participant can put this knowledge into practice and are able to distinguish these differences when tasting a new wine or are able to describe their preferences. Therefore, it is recommended to interview the participants on their wine-tasting skills and preferences one month after the experience.

Only the memorability of the educational information that was provided was investigated during this research. Thus, whether the system and experience itself was

memorable was not adequately tested. Further research should be conducted to understand how memorable the experience or the use of the system is. This could be done by asking the participants to perform the steps using the system, without any aids from an instructor. Furthermore, questions about the experience itself after one month of participating in the experience.

13.5 Limitations of the System and Suggestions for Future Iterations

Based on the feedback from the participants in the non-functional evaluation study, several improvements can be made to the system. This section explains what improvements would be recommended for future iterations of the interactive technology wine-tasting experience.

13.5.1 The Hardware

Currently, the boards are not connected to each other. This means the boards can still move around on the table if someone bumps against them a little too hard, which causes the projections to be unaligned with the sensors. Therefore, the next iteration of the system should create a method in which the boards can be connected to create one large surface. Additionally, a thin rubber layer should be added between the table and the board to make sure it cannot move around.

Additionally, as mentioned in section 11 Evaluation of the Functional Requirements, currently the board is not entirely waterproof. As spillage of water or wine can always happen during a wine tasting, the interactive table should be fully waterproof. Therefore, further research is needed into what materials should be used to allow for a waterproof system that is still able to detect the wine glasses on the table.

Furthermore, the system uses two projectors and two computers to run the experience with two participants. To make the system entirely modular for any group size between 6-12 participants, only one or two projectors should be necessary. The projectors used should have a large enough projection size to reach the entire table. However, this might mean that the installation could not be set up in a room with low

ceilings. Additionally, to accomplish this, the Processing sketch needs to be adjusted to accommodate more input sources from the board, as well as, projection outputs per screen.

13.5.2 Instruction on the wine-tasting steps

The instructions for the wine-tasting steps were mostly clear. However, one participant suggested that the instructions currently only show whether it is an appearance, nose or palate step, but do not explain which sub-step is explained exactly (e.g. intensity, acidity, finish, etc.). Future renditions of the system could add this information in the instruction projection to further clarify where in the process the participants are.

At the start of the summary, the participants are prompted to place their wines in the top right corner. The wine glass is still in this position when the instructions for the next wine-tasting step start. During the first instructions on the acidity of the wine, this resulted in the wine glass being in the way of the instruction text. To solve this problem, the user should be prompted to place their wine glass a little further in the corner.

Most wine-tasting steps were understood by the participants. However, the intensity of the palate seemed to be a difficult concept to grasp. Therefore, the explanation of how to assess the palate of the wine needs to be reconsidered. Perhaps, for the first two wines, a wine with an extremely light intensity could be compared to a wine with an extremely high intensity to give the participants a good frame of reference.

13.5.3 Execution of the steps

The interactions with the table were not entirely intuitive for the users. Even though the instructor could guide the participants on what to do, the system could also be adapted to make the interactions more intuitive. This could be done by further visualising what the expected interaction is. To let the participants know they can place their wine glass on one of the circles through a visualisation, a small illustration of a wine glass could be placed in the centre of each circle.

To make the pressing on one of the aromas more intuitive, the aromas that can be selected can be designed to look more like buttons. Now, the visualisations of the

(a) (b)

Figure 13.2: Example of buttons with a 3D effect from (a) [1] and (b) [2].

aromas are portrayed as flat illustrations. Creating more of a 3D effect with shading, as can be seen in figure 13.2a and 13.2b, could make the aroma projections look more like a pressable button. Even though the participants had no trouble with the timer button, this effect could also be added to make the start/stop visualisation look more like an intuitive button.

Additionally, an animation that aims to prompt the user to complete a task could also be helpful. However, this should only be used during the following steps: colour, nose intensity, palate intensity, acidity and finish. During the aromas step, the participant should not be further prompted to select an answer if they have not yet done so through an animation. This is because it can take a while before novice wine drinkers can distinguish an aroma and finding no aromas should also be acceptable for novice wine consumers.

To prompt the participant into placing their wine glass on one of the circles, movement towards the circles can be used. Therefore, an animation of a circle decreasing in size in each of the coloured circles is suggested. To prompt the user to press the start button during the finish step, a flashing arrow pointing at the button could be illustrated. To understand when these animations should start, the average time it takes to complete the tasks could be consulted, an aspect which was noted during the video annotations in 12.2.2 Analysing the Video Footage of the Interactive Wine-Tasting Experience. The animation should start at about 25% into the execution step, to make sure the participants still have enough time to finish noting their findings.

Figure 13.3: Example of an interaction to rate the quality of the wine, allowing the user to give the wine one to five stars, retrieved from [3]

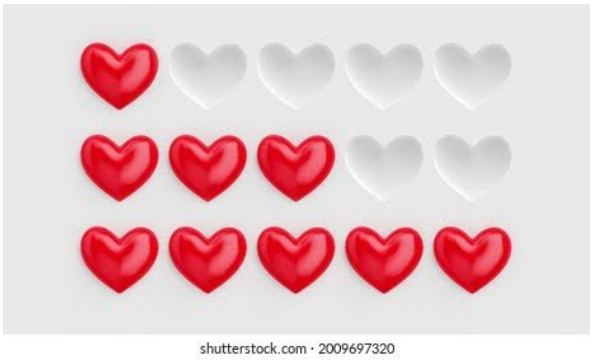


Figure 13.4: Example of an interaction to allow the user rate how much they liked the wine, giving the wine one to five hearts, retrieved from [4]

13.5.4 Discussion of the Wine-Tasting Steps

At the end of the summary, the participants are explained that they can assess the quality of a wine based on their findings. However, this quality assessment is not registered by the system. Therefore, an interaction that could be added is rating the quality of the wine. This could be done by giving the wine one to five stars with the interactive table, as can be seen in figure 13.3.

A wine tasting is also about finding your preferences. Therefore, the participants could additionally rate the wine based on how much they enjoyed it. This could be done through the same interaction of rating the quality, but with hearts instead of stars, as visualised in 13.4. In this way, the participants also have an overview of the quality of the wines and how much they enjoyed the wines for future reference.

To better compare the aromas during the discussion of the wine-tasting steps, the background colour of these aromas could be the same colour as the aroma categories.

13.5.5 Magazine Story / Handout

According to section 6.4, adding a storyline can make an experience more memorable. However, the story told during the experience did not resonate with the participants. The story was mostly considered unclear or unnecessary. On the other hand, participants were enthusiastic about the magazine handout and its contents. Especially enjoying that they could see their input in the magazine.

Therefore, this suggests that the content and layout of the magazine are strong, but the storyline told during the experience should be adapted. Either the story which is currently told should be sold better and returned more throughout the experience, or the story should be changed altogether. Therefore, it is advised to organise a focus group with novice wine consumers to understand what storyline would be fitting for such an experience.

Furthermore, in this iteration of the experience, the magazine hand-out did not include the personalised review as intended. Due to time constraints, the handout was not personalised and instead contained the tasting notes of the researcher. For future iterations of the experience, it is encouraged to include this personalised addition to the magazine handout.

13.5.6 Role of the Instructor

The researcher also served as the instructor during this research. However, in future applications of the interactive technology wine-tasting experience, this might not be the case. Therefore, it is advised that a protocol for the experience is written so that any other trained expert on wine tastings can instruct the experience.

Additionally, in the current setup the instructor has to press the spacebar to continue to the next step. Ideally, however, the use of the computer could be omitted and a remote clicker can be used to move through the wine-tasting steps.

13.5.7 Other

The interactive wine-tasting experience is not only limited to wine tastings for novice wine drinkers. The interactive technology system could also be utilised during wine tastings with more experienced wine drinkers to help them quickly select their findings. However, to accommodate more experienced wine drinkers, the system should include all possible aroma options. Furthermore, the system could also be adapted to be used for other beverages, such as beer or whisky tastings.

13.6 Research Opportunities

Several research opportunities could be explored to continue the research set in this report.

Firstly, a new framework to turn other educational experiences into an interactive technology learning experience for novices was suggested in 13.3: Implications. This framework should be further investigated to see if it holds up for other educational experiences as well.

Secondly, there are several ways in which the system and the evaluation method could be improved, as discussed in section 13.4: Limitations and recommendations of the research and 13.5: Limitations of the System and Suggestions for Future Iterations. Therefore, future research could aim to improve these limitations to continue working on the installation and turn the prototype into a product. Additionally, the interactive technology wine-tasting experience should be compared to a traditional wine-tasting experience to evaluate the knowledge gained through each of these experiences.

Thirdly, market research could be done to see how viable it is to turn this installation into a business. Examining potential customers could be helpful to understand if there is an interest in the experience. Furthermore, it could investigate how the experience could take form. Perhaps it is only useful as an addition to traditional wine tastings, or maybe it could be a new unique experience.

Lastly, the installation could also be transformed into a wine-tasting activity that could be done at home. Therefore, it could be investigated how the interaction could be turned into a stand-alone activity, without the help of an instructor. Furthermore, how

this installation could take form in someone's household could be considered, possibly turning the experience into an application.

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Appendix A

Storyline Brainstorm

- **Vineyard**
  - Participant is starting a wine farm and need to learn the elements of wine and how they associate with the making steps
  - Participants is buying an already existing wine farm and wanting to discern what the different grape variety are that are plotted
    * Not beginner-friendly
- ~~**Tastings**~~ Already a tasting
- ~~**Snob/prestigious**~~ Installation wants to combat snobbish image
- **Wine reviewer**
  - User just started working for a magazine and is reviewing the first wine together with someone from the magazine to make sure their tastes are aligned
    * Steers towards tasting more objectively, not only if they like it
  - User is an avid wine reviewer ready to review more wines to score them globally
- **Wine countries**
  - User is visiting different countries to taste the wines, seeing the differences in each country

    * Not applicable for types of wine chosen, for beginners it is more about differences in common grapes

- **Wine tourism** User needs to sell wines, but needs to know what they are selling first
- ~~**White, rose, red**~~ types of wine, not enough for a storyline
- ~~**Drunk**~~ not the message you want to send
- **Grapes** Bring in the grapes of the grape variety to see how they turn into different types of wines
- ~~**Wineglass**~~ small part of the tasting is based around the glass
- **Fruit**
    - Bring different types of fruit to see what can be found in the glass
        * Only one specific part of the tasting
        * Tasting a fruit can change the flavour profile
- **Wine label** User is designing a wine label, but needs to know what to put on it. Therefore needs to know how to describe the wine
- **Cellar**
    - Virtual tour through a cellar where the user learns about each part of the wine making process Not specific to tasting
- **Sommelier**
    - User is training to be a sommelier in a restaurant, needs to know how to taste the wines properly & explain them Too confusing with already existing wine courses, they are not actually training to be a sommelier and cannot be called that after one session

Appendix B

Magazine Handout Articles

This appendix holds the full text of the articles that are printed in the magazine handout described in section 10.4: Magazine Handout of chapter 10: Realisation.

B.1 The Advertisement for the Interactive Wine-Tasting Experience

Are you ready to take your wine game to the next level?

Introducing our new interactive wine-tasting experience, where novice wine drinkers can expand their knowledge and palate in a fun and approachable way.

Forget stuffy wine tastings where the snobs make you feel like you don't know a Chardonnay from a Pinot Noir. Our interactive experience is all about getting hands-on and learning in a relaxed environment. From learning how to properly taste wine to understanding the different elements that make up a wine's flavour profile, our experts will guide you through the process with enthusiasm.

Ever wondered what the heck acidity really means in a wine? Or what makes a wine "finish" strong or weak? We've got you covered! By the end of the experience, you'll be confidently swirling, sniffing, sipping, and describing wines like a pro.

So grab your friends, your partner, or even just yourself, and come join us for a wine-tasting adventure like no other. Cheers to learning and sipping your way to wine-tasting mastery!

B.2 How to Taste Wine Like a Pro

How to Taste Wine Like a Pro

Wine tasting can be an intimidating experience for those who are not familiar with the process. However, with a few basic guidelines and some practice, anyone can become a skilled wine taster.

The first step in wine tasting is to examine the wine's appearance. Hold the glass against a white background at a 30-45 degree angle and observe the colour of the wine. This can give you clues about the grape variety and age of the wine. Younger wines tend to be lighter in colour, while older wines are typically darker.

Next, it's time to assess the wine's nose. Swirl the wine in your glass to release its aromas, then take a few quick sniffs to get a sense of the wine's bouquet. Note the intensity of the aromas and any prominent scents you can distinguish, such as fruits, flowers, spices, or oaky notes. The nose can tell you a lot about the wine's complexity and quality, so take your time to explore all the scents present fully.

Finally, it's time to taste the wine. Take a small sip and let it linger on your palate for a few seconds before swallowing. Note the wine's intensity - is it light and delicate, or bold and full-bodied? What aromas can you taste? Are they similar to the once you smelled, or totally different? Also, pay attention to the wine's acidity, which can be sensed by how much saliva your mouth produces after swallowing the wine. Finally, consider the wine's finish. Does it linger on

your palate after it has left your mouth, or does it fade quickly? A longer finish often suggests a higher quality wine.

Overall, wine tasting is a multi-sensory experience that anyone with a curious palate can enjoy. By paying attention to the wine's appearance, nose, and palate, you can develop a deeper appreciation for the world of wine. So next time you pour yourself a glass of wine, take a moment to savour and enjoy all the flavours and aromas it has to offer. Cheers!

B.3 Personalised Review

Wine-Tasting the Classics
a review by *name participant*

1. Sauvignon Blanc - Mount Vernon

This sauvignon blanc pours a **lemon yellow** colour in the glass. On the nose, this wine is very green, with aromas of **grass** and **green bell pepper**. It also has some aromas of citrus fruits like **grapefruit** and **lemon** present, as well as slight hints of tropical fruits like **pineapple** and **passionfruit**. The intensity of the nose is **medium**. On the palate, similar refreshing flavours of **lemon**, **green apple**, and a touch of **grass** can be found. The intensity of the palate is **medium** and the acidity of this sauvignon blanc is **high**. The finish is **long** and zesty, leaving a lingering impression of citrus fruits. Overall, this sauvignon blanc is a great example of a fresh and lively wine that is perfect for warm weather enjoyment.

2. Chardonnay - Lanzerac

This South African chardonnay displays a **golden** hue in the glass. The aromas on the nose are of ripe green fruits like **apple** and **pear**, and some citrus notes of **lemon**, as well as subtle **vanilla** notes from oak ageing. The intensity of the nose

is **medium**. On the palate, flavours of **apple**, **lemon** , and a hint of **vanilla** from the oak can be tasted. The intensity of the palate is **high**. The acidity is **medium** and the finish is **long**, with a touch of toasted **oak** lingering on the palate. This chardonnay is a great choice for those who enjoy a rich and buttery white wine.

3. Merlot - Ironstone Vineyards

This merlot is a deep **ruby** colour in the glass. The aromas on the nose are of ripe black fruits like **plum** and **blackberry**, as well as hints of **vanilla** and **black pepper**. The intensity of the nose is **medium**. On the palate, flavours of **red cherry**, **black plum**, and a touch of **chocolate** can be found. The intensity of the palate is **medium**. The acidity **low**, smooth and balanced, complementing the fruit-forward flavours of the wine. The finish is **medium**, with soft tannins that give structure to the wine. Overall, this merlot is a great choice for those who enjoy a fruit-driven red wine with a smooth finish.

4. Cabernet Sauvignon - Catena

This cold climate cabernet sauvignon boasts a deep **purple** colour in the glass. The aromas on the nose are of black fruits like **blueberry** and **blackberry**, as well as hints of **coffee** and **vanilla**. The intensity of the nose is **high**. On the palate, additional flavours of ripe **plum**, and a touch of **cherry**. The intensity of the palate is **high**. The acidity is **medium**, making the wine bright and refreshing, balancing out the richness of the wine. The finish is **short,** with silky tannins that add depth to the wine. This cabernet sauvignon is a great choice for those who appreciate a bold and structured red wine.

B.4 What to Try Next

If You Liked... Try...

1. Sauvignon Blanc

For those who enjoy sauvignon blanc's crisp acidity and grassy notes, a natural next step would be to try a refreshing glass of Pinot Grigio or Vermentino. These Italian whites offer similar zesty flavours with a touch of minerality that will tantalise your taste buds.

2. Chardonnay

Fans of rich and buttery chardonnay might enjoy exploring Rhône Valley whites like Viognier or Marsanne. These wines often have luscious textures and aromas of apricot, honeysuckle, and spice that will satisfy your palate.

3. Merlot

For red wine lovers who appreciate the velvety smoothness of merlot, consider trying a bottle of Barbera or Sangiovese from Italy. These reds boast vibrant acidity and juicy red fruit flavours that will complement a wide range of dishes.

4. Cabernet Sauvignon

Lastly, fans of bold and powerful cabernet sauvignon may find themselves drawn to Argentine Malbec or Australian Shiraz. These wines offer robust tannins, dark fruit flavours, and a hint of spice that will leave you wanting more.
Overall, exploring different varietals and regions is a great way to expand your wine knowledge and find new favourites to enjoy. Cheers to your next wine adventure!

Appendix C

Fritzing Schematics

The Fritzing schematics in figure C.1 show how the load cells and CAP1188 breakout sensors need to be connected to the Arduino Nano to create the interactive board for the Interactive Wine-Tasting Experience.

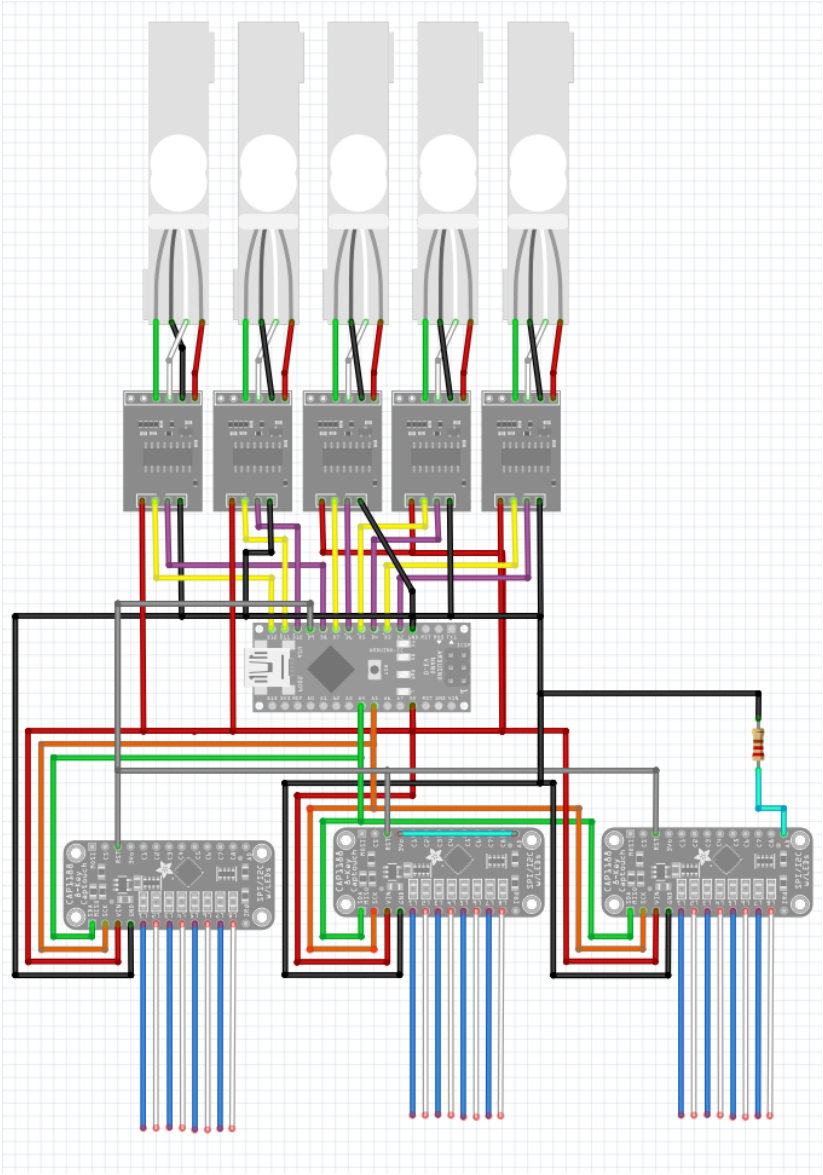

Figure C.1: Fritzing schematics of the connections of the interactive board.

Appendix D

Demographics Functional Evaluation

This appendix shows the demographics of the six participants that were included in the functional evaluation study.

How old are you?	What is the highest level of education you've completed?	Have you participated in a wine tasting before?	How would you judge your knowledge on the subject of wine?	Have you participated in another type of beverage tasting before? (e.g. Beer, Whisky)	How would you rate your technical abilities?	How would you rate your knowledge on technical installations?
26-35	HBO or WO master	3-5 tastings	3	More than 5 tastings	3	3
26-35	HBO or WO bachelor	3-5 tastings	3	3-5 tastings	5	4
36-45	HBO or WO master	1-2 tastings	2	3-5 tastings	2	2
26-35	HBO or WO bachelor	3-5 tastings	3	No	4	2
26-35	HBO or WO bachelor	1-2 tastings	2	No	2	2
56-65	Secondary school	1-2 tastings	2	1-2 tastings	1	1

Table D.1: Answers of the participants to the answers on their demographics.

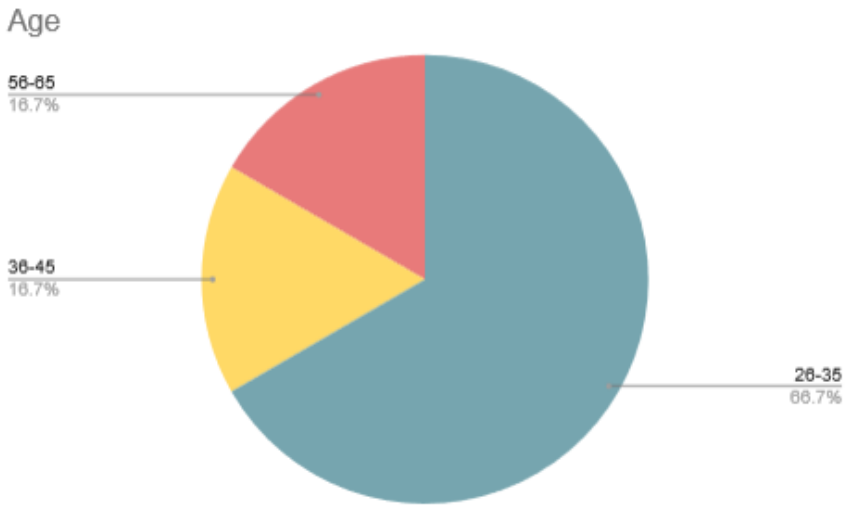

Figure D.1: Pie chart showing the division of age of the participants

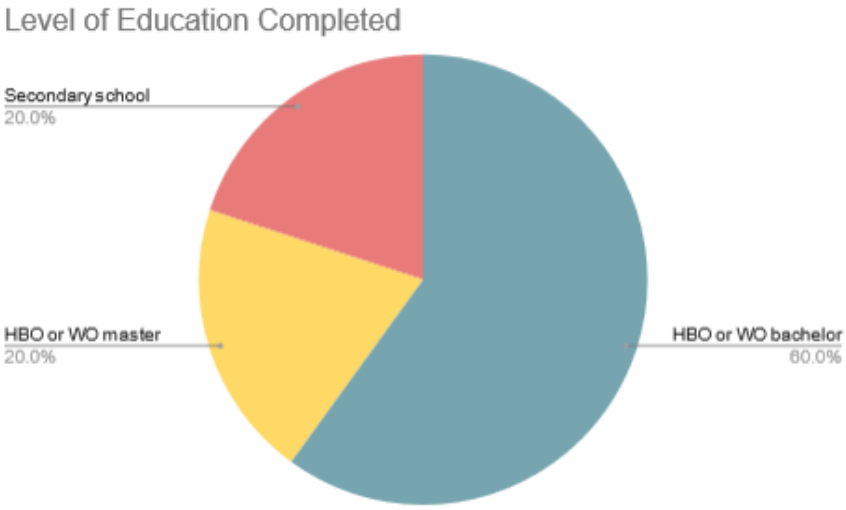

Figure D.2: Pie chart showing the division of level of education completed of the participants

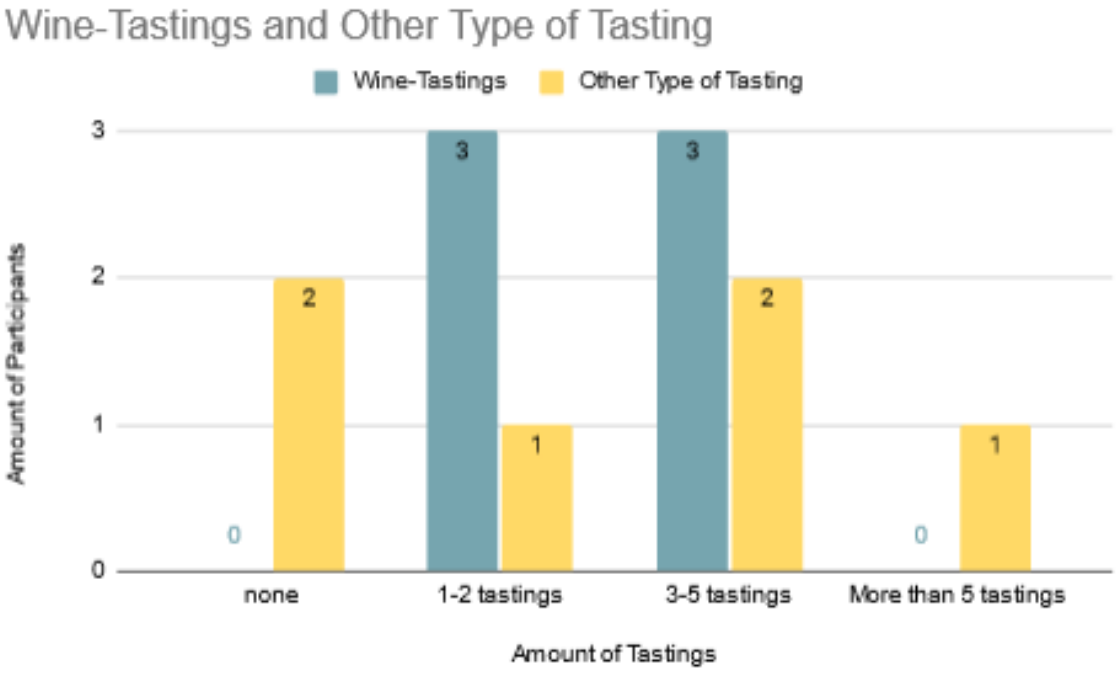

Figure D.3: Bar chart showing the number of tastings participants have visited

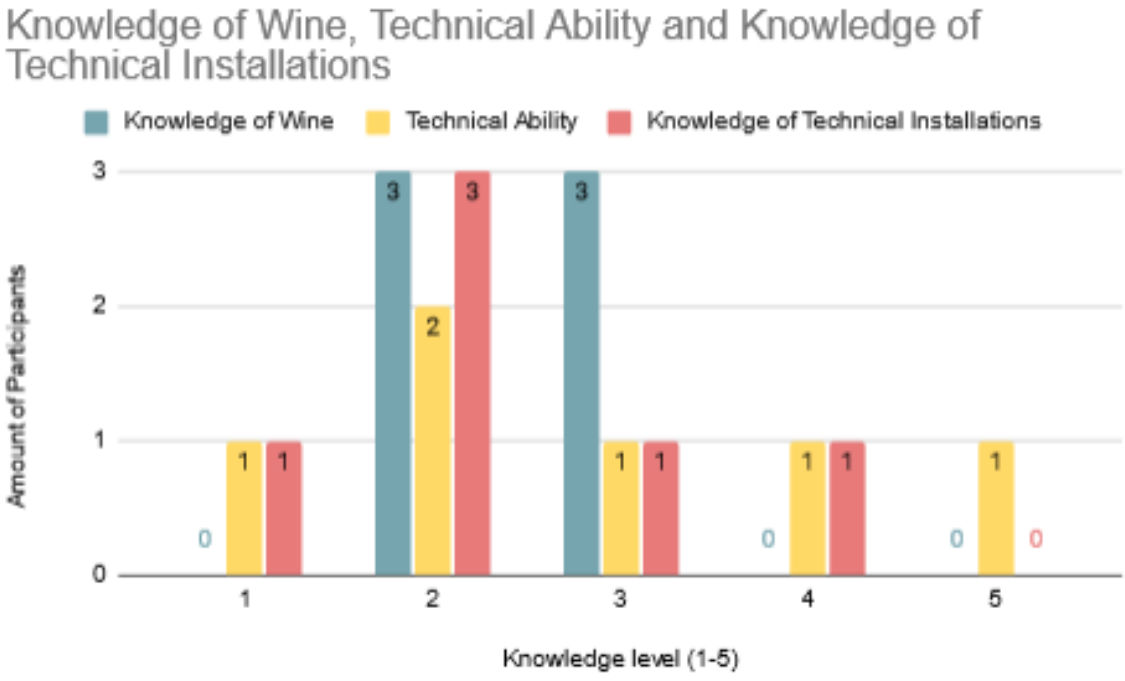

Figure D.4: Bar chart showing the amount of knowledge the participants judge they have of wine, their technical ability, and knowledge of technical installations

Appendix E

Detailed Results of the Initial Functionality Test

FR-1 Should educate on how to assess and describe the appearance of the wine, using the colour of a wine

How to assess and describe the appearance of the wine are included in the educational contents of the interactive technology wine-tasting experience.

FR-2 Should educate on how to assess and describe the nose of the wine, including intensity and type of aromas

How to assess and describe the nose of the wine are included in the educational contents of the interactive technology wine-tasting experience.

FR-3 Should educate on how to assess and describe the palate of the wine, including intensity, type of aroma, acidity and finish

How to assess and describe the palate of the wine are included in the educational contents of the interactive technology wine-tasting experience.

FR-4 Should educate on the differences between sauvignon blanc and chardonnay

During the interactive technology wine-tasting experience, a glass of sauvignon blanc and a glass of chardonnay are assessed and described using the installation. Additionally, the two glasses of wine are poured into different glasses to allow for comparison of the wines.

FR-5 Should educate on the differences between merlot and cabernet sauvignon

During the interactive technology wine-tasting experience, a glass of merlot and a glass of cabernet sauvignon are assessed and described using the installation. Additionally, the two glasses of wine are poured into different glasses to allow for comparison of the wines.

FR-6 Could educate on how to objectively judge the quality of the wine A summary with the description of the wine they have assessed shows what descriptors of the wine can be used to objectively judge the quality of the wine and how to do so.

FR-7 Could adjust the provided information to the knowledge level of the participants An expert in wine-tasting, with at least WSET level 2 knowledge [7], provides the information during the experience. This expert can adjust the level of information provided, depending on the knowledge of the participants.

FR-8 Must include correct equipment: wine glass, water glass, spittoon and carafe

Each participant has one wine glass, one water glass, and a spittoon on their section of the table. Additionally, there is a water carafe filled with water available for every four participants, placed in the corner of the board of the four participants.

FR-9 Must provide enough space for the equipment: wine glass, water glass, spittoon and carafe There is enough space for all the equipment to be placed on the participant's section of the table while completing the interactive activities.

FR-10Must be brightly lit during appearance step There needs to be enough light during the appearance step. This can either be done by keeping the room bright during all steps, or by lighting up the room during the appearance step. Here the latter is preferred. This can be done by changing the lighting in the room. In this setup, a Phillips Hue lamp above the table allows for quick adjustments during the appearance step. Even with the brightener lights, the projections are still properly visible.

FR-11 Must provide a white background for appearance step The background projected during the appearance step is white.

FR-12 Must have bathroom readily available There is a bathroom available at the location that the participants can use at any time.

FR-13 Should not add more than two additional items onto the table There are no items added to the table. Only the necessary equipment for a wine-tasting is provided: wine glass, water glass, spittoon and water carafe.

FR-14 Could be dimly lit during other steps When the experience is not busy with the appearance step, the room is dimly lit using the Hue light above the table.

FR-15 Should exclude complex wine terms The instructor can exclude all complex wine terms or explain the terms that are necessary for novice wine-tasters in an easy-to-undertand language.

FR-16 Should not add more than two additional items onto the table There are no items added to the table. Only the necessary equipment for a wine-tasting is provided: wine glass, water glass, spittoon and water carafe.

FR-17 Could provide the participant something to take home to remind them of the experience

At the end of the experience, the participants get a magazine handout with several articles about what they have done. Such as an advertisement of the experience, a article explaining

the wine-tasting steps and a review of the wines they have tasted.

FR-18 Could provide the participant something to take home to teach them more about wine and wine-tasting

At the end of the experience, the participants get a magazine handout with several articles containing additional information, such as what wines they should try next.

FR-19 Could include supporting visualisations to guide focus

FR-20 Could use the lighting of the room to guide focus Other than lighting up the room more brightly during the appearance step, this possibility has not been explored.

FR-21 Could music to guide focus While classical music was softly playing throughout the experience, the possibility of using music to guide the focus of the participants has not been explored.

FR-22 Should display visual representations of the tasting notes

Each of the tasting notes is visually represented with colours and illustration of the aromas.

FR-23 Should display the tasting note findings of the participants to allow for a quick comparison After every step, the participant is shown what they have chosen in the form of a summary page.

FR-24 Could guide towards certain talking points The instructor can guide the discussion when necessary.

FR-25 Could initialise the discussion

The instructor can initialise the discussion when necessary.

FR-26 Could use lightening to guide focus to the discussion with the rest of the group Other than lighting up the room more brightly during the appearance step, this possibility has not been explored.

FR-27 Should represent all learning styles: kinesthetic, auditory, visual, read/write, social and solitary

FR-28 Must detect wine glass on the five circle locations on the table With a white tablecloth over the board, placing a wine glass on any of the load cells makes the Arduino sketch return the message that the wine glass is placed on the specified load cell. Even if the wine glass is placed slightly off-centre, the wine glass is registered. Only if the wine glass is placed out of the circle for more than two centimetres does the system not recognise the glass placed on that circle. The system does not register the glass placed anywhere outside of the circles for more than two centimetres. Therefore, the system detects the wine glass only on the necessary of the table.

FR-29Must detect the finger of the user on 22 locations on the table Touching any of the

capacitive sensor touch pad endings through the tablecloth is registered by the Arduino sketch. Each touch sensor is uniquely labelled, allowing the system to understand which sensor has been touched.

FR-30 Must record the colour, nose intensity, nose aroma, palate intensity, palate aroma, acidity, and finish selection of the user The system records all of the selections of the user.

FR-31 Must display instructions on how to do a wine-tasting step on the table

The instructions on how to do a wine-tasting step are visualised on the table before each time the participant try the step out themselves.

FR-32Must display the summary of the wine based on the selections of the user on the table Based on the recording of the selection of the participant, the system is able to display the summary of the wine based on the participant's selection.

FR-33 Must be waterproof

The plastic wrapping around the board should make the system waterproof. However, the board is currently wrapped in a thin layer of plastic, leaving small possible openings or holes. Therefore, during the initial functionality test, whether the system is waterproof is only tested with water with a liquid volume that amounts to the amount of wine that will be held in the glasses, about 75 millilitres. In future iterations of the system, the board should have a uniform plastic layer around the elements to protect them. However, for this research, it is sufficient for the system to be waterproof enough to handle small spills.

FR-34 Must be controlled by the instructor

The system is built to be controlled by the instructor. By pressing a button, the instructor moves to the next projection. Allowing them to set the speed during the tastings.

FR-35 Should display feedback of the selection that has been made

After the glass has been placed on one of the circles to make a selection, this circle starts to pulse. Therefore, showing the user that they have made their selection. Additionally, if an aroma has been chosen, the aroma turns grey and a smaller version of the aroma is shown around the circle at the top of the page. Moreover, during the last wine tasting step, the timer shows the amount of time that it took before the user did not taste the wine anymore. Therefore, for all selections the user can make, there is visual feedback on what they have done. This selection is also recorded to create the summary in every next step, and to create the personalised article of the magazine.

FR-36 Should automatically fill in the personalised review with the selections of the user

Due to time constraints, this requirement was not met. Therefore, the magazine handout the participants received did not contain a personalised review, but rather the tasting notes of the wines as found by the researcher.

FR-37 Should print the magazine hand-out at the end of the experience

This requirement was not met. As the review in the hand-out was not personalised, there was no need to print the magazines at the end of the experience. Instead, they were printed beforehand.

FR-38 Should be visible during daylight

The projections have been tested during broad daylight, as well as, under a bright white light of a lamp above. In both cases, the projectors proved strong enough for the visualisations to be clearly visible. However, the projections are better visible when the room is dimmed down.

FR-39 Should feel flat and smooth, similar to a tabletop

With a tablecloth over the installation, the sensors and circle cutouts can still be somewhat felt. However, it does not seem to take away from the experience.

FR-40 Could be modular As the system uses one board for each participant, the amount of boards can be adjusted to the table size. This allows for the system to be modular. However, currently, the system still uses two projectors and two computers to run the experience for two individuals. Adding more participants in this way increases the amount of computers and projectors by one per individual. Therefore, a solution to run the sketch for multiple boards on one computer/projector should be created for the system to be fully modular. As this functional requirement was categorised as a requirement that 'could' be added, this does not pose a problem for this research. However, adding this functionality would be preferable for future iterations.

The boards can fit onto any square or rectangular table. However, as the boards are rectangular, it does not work for round or oval tables. The board itself is somewhat larger than half of the standard table width, which makes it hang 10 centimetres over the edge. As the boards create a new table surface this should not be a problem. However, this does mean that the boards that are being used should be attached to one another so that leaning on the edge does not tip the board. Furthermore, a thin rubber mat should be placed between the table and the board, creating friction, so that the board does not move around on the table.

Appendix F

Evaluation of the Functional Requirements: Data Collection

This Appendix holds the list of tasks the participants have to complete during the interactive wine-tasting experience of the functional evaluation study, and the list of questions asked after completing the experience, as further explained in chapter 11 Evaluation of the Functional Requirements.

F.1 List of Tasks for the Participant to Complete During the Interactive Wine Tasting Experience

- ☐ Select colour
- ☐ Deselect colour
- ☐ Select another colour
- ☐ Select nose intensity
- ☐ Deselect nose intensity
- ☐ Re-select nose Intensity
- ☐ Pick four aromas
- ☐ Deselect an aroma
- ☐ Re-select an aroma that was deselected
- ☐ Select palate intensity
- ☐ Deselect palate intensity
- ☐ Re-select palate Intensity
- ☐ Select acidity
- ☐ Select another acidity
- ☐ Time the length of the finish
- ☐ Time the length of the finish again

F.2 List of Questions Asked After Completing the Interactive wine-Tasting Experience

- How did you find the experience of using your wine glass to select the colour/intensity/acidity?
- How did you find the experience of using your finger to select an aroma?
- How did you find the experience of using your finger/hand to start and stop the timer?
- Did you experience any difficulties while using the system? If so, please explain them as thoroughly as possible
- Were you able to notice any wires or ridges under the tablecloth with your finger?
- If so, was this bothersome?
- Did you feel like you needed more space on the table for your wine glass, water glass, and spittoon?
- Were any of the items in the way of you doing the interaction?

Appendix G

Demographics Non-Functional Evaluation

This appendix shows the demographics of the twelve participants included in the non-functional evaluation study.

How old are you?	What is the highest level of education you've completed?	Have you participated in a wine tasting before?	How would you judge your knowledge on the subject of wine?	Have you participated in another type of beverage tasting before? (e.g. Beer, Whisky)	How would you rate your technical abilities?	How would you rate your knowledge on technical installations?
26-35	HBO or WO bachelor	3-5 tastings	1	No	1	4
26-35	HBO or WO master	3-5 tastings	2	More than 5 tastings	3	4
26-35	HBO or WO bachelor	1-2 tastings	1	No	3	2
56-65	Secondary school	1-2 tastings	2	1-2 tastings	1	1
26-35	HBO or WO master	3-5 tastings	3	1-2 tastings	2	1

26-35	HBO or WO bachelor	1-2 tastings	1	1-2 tastings	1	2
26-35	HBO or WO bachelor	More than 5 tastings	3	1-2 tastings	3	3
36-45	HBO or WO master	3-5 tastings	3	1-2 tastings	5	5
56-65	HBO or WO master	1-2 tastings	3	No	3	3
56-65	Secondary school	3-5 tastings	2	More than 5 tastings	5	4
26-35	HBO or WO bachelor	More than 5 tastings	3	More than 5 tastings	3	1
26-35	HBO or WO bachelor	More than 5 tastings	2	1-2 tastings	4	3

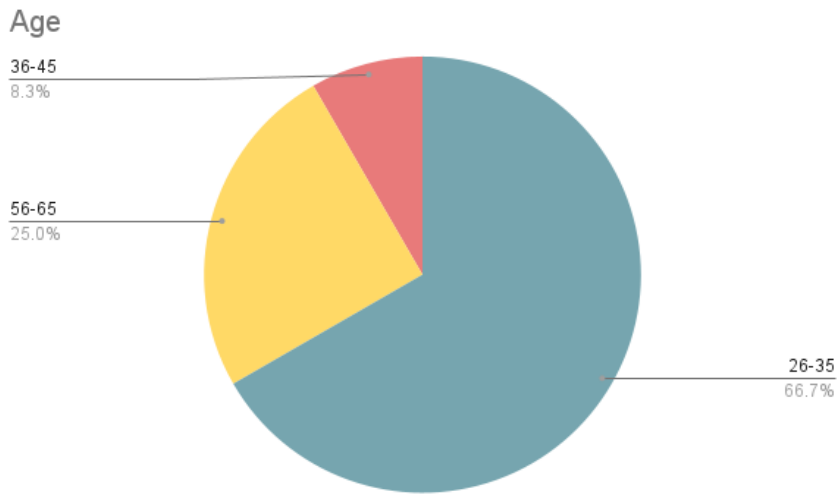

Figure G.1: Pie chart showing the division of age of the participants

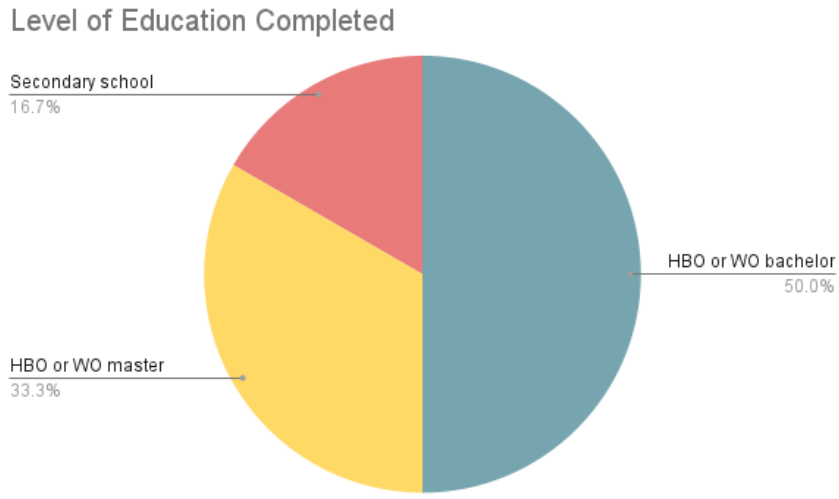

Figure G.2: Pie chart showing the division of level of education completed of the participants

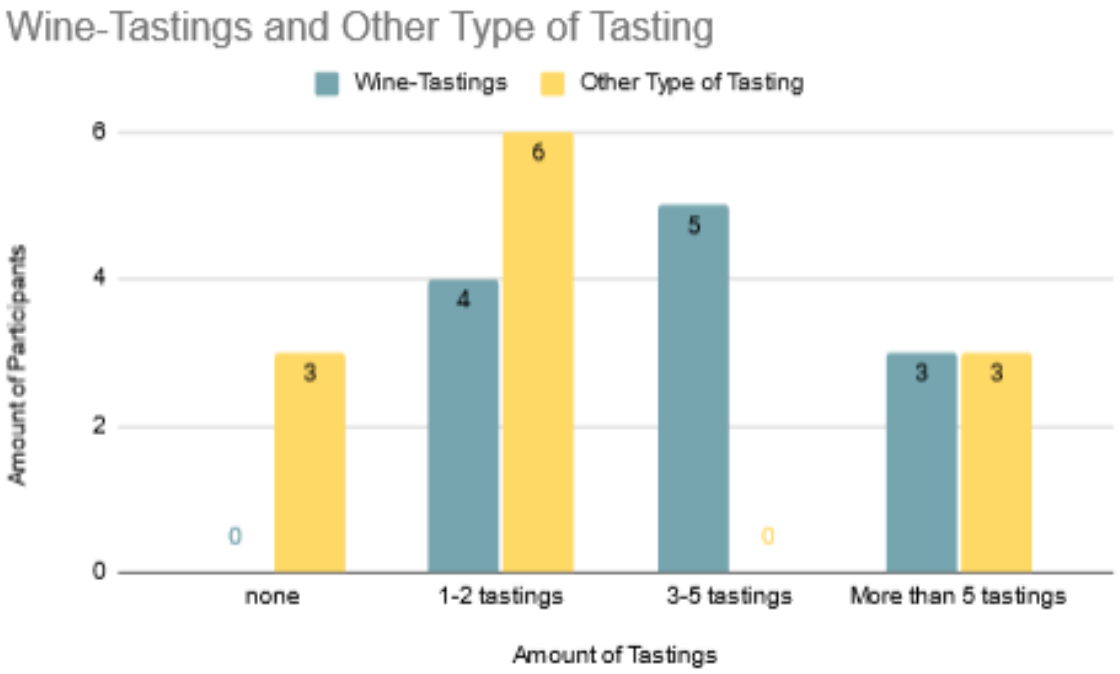

Figure G.3: Bar chart showing the number of tastings participants have visited

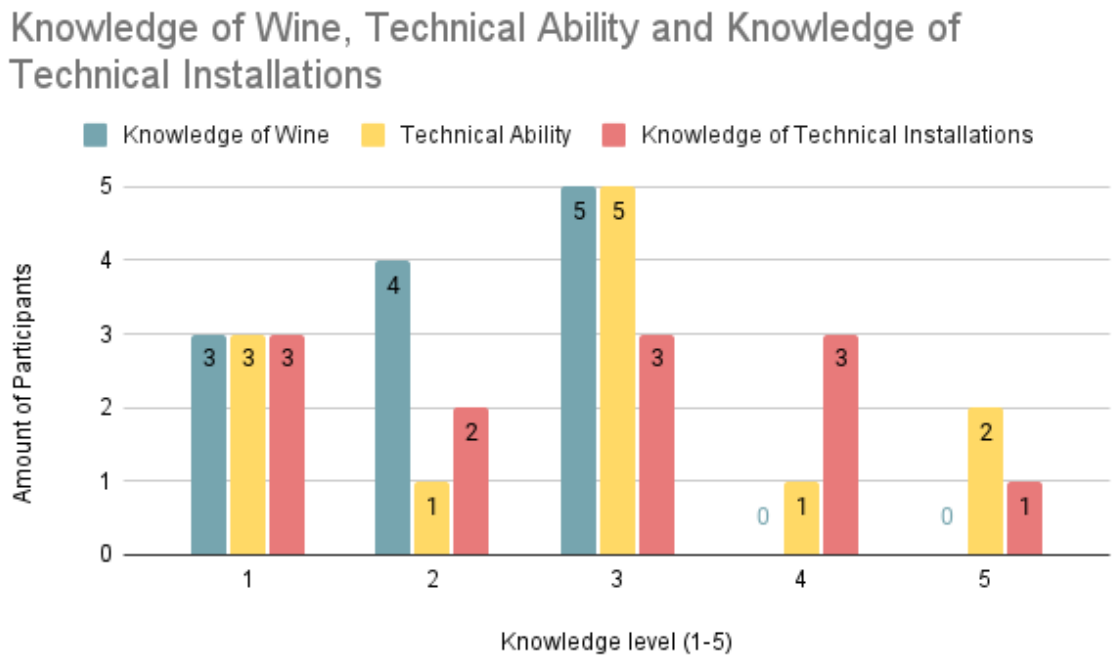

Figure G.4: Bar chart showing the amount of knowledge the participants judge they have of wine, their technical ability, and knowledge of technical installations

Appendix H

Evaluation of the Non-Functional Requirements: Data Collection

This Appendix contains the questions of the knowledge test, the questions of the SUS questionnaire, and the questions of the interview the participants have to complete during the non-functional evaluation study, as further explained in chapter 12 Evaluation of the Non-Functional Requirements.

H.1 Questions of the Knowledge Test

1. What three tasting steps are used to assess a wine?
2. How do you assess the appearance of the wine?
3. What aspect of a wine can you describe during the appearance step?
4. What three colours can a white wine be categorised as?
5. What three colours can a red wine be categorised as?
6. How do you assess the nose of a wine?
7. What aspect of a wine can you describe during the nose step?
8. How do you assess the intensity of the nose?
9. How is the intesity of the nose categorised?
10. A higher quality wine has more aromas present. [True/False]
11. The aromas smelled on the nose are objective. [True/False]
12. How do you assess the palate of a wine?
13. What aspect of a wine can you describe during the palate step?
14. How do you assess the intensity of the palate?
15. How is the intesity of the palate categorised?
16. The intensity of a wine says something about the quality of the wine?
17. The aromas that you smell on the nose are the same once you taste on the palate. [True/False]
18. How can you make the flavour of a wine be more pronounced in your mouth?
19. With what categories can you describe the acidity level?
20. How can you recognise if a wine has a high acidity?

21. What does 'the finish' of a wine mean?
22. How is the finish of a wine measured?
23. A higher quality wine has a shorter finish. [True/False]

H.2 Questions of the SUS Questionnaire

1. I think that I would like to use this system during every wine tasting
2. I found the system unnecessarily complex
3. I thought the system was easy to use
4. I think that I would need the support of a technical person to be able to use this system
5. I found the various functions in this system were well integrated
6. I thought there was too much inconsistency in this system
7. I would imagine that most people would learn to use this system very quickly
8. I found the system very cumbersome to use
9. felt very confident using the system
10. I needed to learn a lot of things before i could get going with this system

H.3 Interview Questions

1. **First impressions**

   (a) What was your overall impression of the experience?

   (b) What did you think of the layout of the content?

   (c) What did you think of the on-page explanations?

   (d) What was the best thing about the experience?

   (e) What was the worst thing about the experience?

   (f) How would you change the experience?

   (g) How did you find the experience of using the glass to complete the task?

   (h) How did you find the experience of using your finger to select an aroma?

   (i) How did you find the experience of using your finger/hand to start/stop the timer?

   (j) (if applicable) How would you compare the wine-tasting experience you just had to that of traditional wine-tasting?

   (k) What's your opinion on how the information is laid out? What did you think about how the language was used on this page?

   (l) What, if anything, surprised you about the experience?

2. **Educational level**

   (a) Do you feel you have more wine knowledge now?

   (b) What did you think of the educational content?

i. Was there any information you found difficult to understand?
ii. Was there any information that was too easy to understand?

(c) How would you rate your knowledge of wine and wine tastings after the interactive wine tasting?

3. **Tangibility**

(a) Did you feel the wine-tasting experience was organized in an appropriate space?

(b) Do you think there is enough light to properly see the colour of the wine?

(c) Did you feel like you could go to the bathroom at any moment in time?

(d) Was there enough space on the table?

4. **Approachable**

(a) Did you understand all of the information provided during the experience?

(b) Did the experience feel snobbish? Did you feel inexperienced during the experience?

(c) How would you rate the language used during the experience from 1-10? (1 hard to understand & 10 perfectly understandable)

(d) Did you need more in-depth information to be provided?

5. **Have room for discussion**

(a) Did you have enough time to use the system before moving on to the next step?

(b) Did the system help you formulate your findings during the discussion?

(c) Did you feel like there were wrong answers during the discussions?

(d) Did you feel uncomfortable during the discussions? How comfortable were you to speak up? (rate 1-10)

(e) What did you think of the visual aids during the discussion?

6. **Guide zooming in and out of the glass**

(a) Where was your focus during

i. The instructions?
ii. The wine-tasting step?
iii. The discussion?

(b) Could spotlight the user during individual tasks

(c) Could light up the room during discussion elements

(d) Could spotlight the instructor during the instruction elements

7. **Responsiveness**

(a) Did you have any questions during the experience?

   i. If yes: How quickly were they answered?

(b) Did you have enough time to formulate your own answers during the wine-tasting step activities?

(c) How would you rate the customer service from 1-10

(d) Did you feel like you could leave your concerns?

8. **Memorability**

(a) What did you think of the story that was told during the wine tasting?

   i. What about the magazine element?

   ii. What about the magazine handout?

(b) How repetitive would you rate the experience? (1-10) Was the level of repetitiveness frustrating for you?

(c) How novel would you rate this experience? (1-10)

(d) Do you feel you learned more about wine and wine-tasting techniques?

(e) How likely are you to recommend this experience to friends and family? (1-10)

9. **Good Value for Money)**

(a) Would you pay money for this experience?

(b) if so, how much?

10. **Final remarks**

(a) Is there anything we didn't ask you about this experience that we should have?

(b) What final comments do you want to make before ending this interview?

Appendix I

Answers to the Non-Functional Evaluation Study

I.1 Answers Participant 1 and Participant 2

	Participant 1	**Participant 2**
Initial Thoughts		
What was your overall impression of the experience?	Liked that it was a combination of interactive table and explanation. Also liked that you could see and discuss what others were thinking, but that you did have your own space. And I think it is cool when things move	I liked the surprising elemtent of "oh can you touch this". Or that the wine glass was detected on the table.
What did you think of the on-page explanations?	I thought they were clear	The system language was in English, so translating some words to Dutch was sometimes difficult
What was the best thing about the experience?	Building your confidence. Especially with the summary page it was nice to see that things were added every time, making you feel like you know what you are doing and being able to explain it. I also liked the interactive part a lot	You slowly feel like more of an expert during the experience. And at the end you are confident in explaining a wine yourself. The role of the instructor also had a large added value to the experience

What was the worst thing about the experience?	The projections were not as sharp on my board compared to the projections of participant 2.	My buttons were sometimes very slow, which made me frustrated
How would you change the experience?	Add the name of the step on the how-to slide.	At one point in the experience, where you had to place your glass previously is in the way of the explanation text. I would let the participants place their glass somewhere else
How did you find the experience of using the glass to complete the task?	Cool to see the interaction. Was clear what to do	Nice interaction. Had no problems with understanding what to do
How did you find the experience of using your finger to select an aroma?	It was not immediately clear that I could add the aromas by touching them.	Some of the buttons were very slow, which was frustrating
How did you find the experience of using your finger/hand to start/stop the timer?	Understood it	Asked if they could have also done it with their glass. However, did not think it was difficult
[if applicable] How would you compare the wine-tasting experience you just had to that of traditional wine-tasting?	This wine tasting felt less chaotic, because you are moving through the steps systemetically. You know what you have to do at any point, and even if you are not listening, you still know what to do. And I enjoyed that you could easily registrate what aromas you smelled and tasted. I find that it can be easy to start tasting and completely forgetting what you had smelled before that. So I liked that you could easily compare those. During the traditional wine tasting, we also learned how to read the label of a wine, which i found really interesting. So I kinda missed that here	NA

What's your opinion on how the information is laid out? What did you think about how the language was used on this page?	Visuals matched in every aspect, which was nice for consistency and understanding what was niext	Easy to understand elements and visuals. Understood the text on the screen
Did you understand that you could place your glass to select your choice yourself?	It was also written on the table. I did not feel like that would be a bottleneck	
What did you think about the fact that you can see what others are doing		
Educational level		
Do you feel you have more wine knowledge now?	Yes definitely. I now know how to assess if a wine is a good quality, which I didn't understand before	Yes, especially the categories of the aromas was something I never knew before
Was there any information you found difficult to understand?	No	No
Was there any information that was too easy to understand?	No	Yes, I felt like the explanations on how to do each step was repeated a too often
Do you feel like you are now able to describe a wine?		
Tangibility		
Did you feel the wine-tasting experience was organized in an appropriate space?	Yes	Yes
Do you think there is enough light to properly see the colour of the wine?	Yes	Yes

Was there enough space on the table?	More than enough	Yes definitely!
Approachable		
Did you understand all of the information provided during the experience?	Suggested to give an introduction of the interactivity of the system at the beginning. Not necessarily explaining what they can do, but saying something along the line of an interactive table that can registrate your glass placement and touch	
Did the experience feel snobbish?		No, because with the visualisations explanation you have concrete tools to talk about and describe the wine. But if I would do this at a restaurant I think I would feel snobbish
Did you feel inexperienced during the experience?	Yes, I had a hard time tasting the different aromas. All I could think was "I taste wine". But the visuals of the aromas helped, because otherwise I could not have found any aromas at all.	
How would you rate the language used during the experience from 1-10? (1 hard to understand & 10 perfectly understandable)	10	There were no words or terms that I did not understand
Did you need more in-depth information to be provided?	I would have maybe liked to learn something about the specific wines and wine labels	No
Have room for discussion		

Did you have enough time to formulate your own answers during the wine-tasting step activities?	Yes, I really enjoyed that you did not have to write anything down yourself, but that the system did that for you	Yes
Did you feel like there were wrong answers during the discussions?	I felt like as long as I was somewhat correct I was doing a good job. So with selecting the aromas for instance, the instructor explained that the first wine had a lot of green aromas. Which made me feel safe to choose any of the greener aromas. The guidance of the instructor was nice. I felt like there was no hard wrong	Sometimes the instructor nudged us in a different directions, but that does give a good frame of reference what is normal or not
Did you feel uncomfortable during the discussions?	I always find it a little scary, but that was gone after the first time because I realised I just have to say what I see in front of me	Liked that at the end you let the participants explain the steps. While using the system you slowly start feeling more confident in tasting wine
What did you think of the visual aids during the discussion?	They were very supportive. Especially during the aromas steps, they really helped me narrow down what aromas it could be that I tasted	It gave you the tools to figure out about what subject you could talk and what your own findings were
Guide zooming in and out of the glass		
Where was your focus during the experience? (during instructions, executing the, the summary?)	I focused on the instructor when they were talking, but looked at the screen sometimes in the meantime	My focus was on the screen, unless the instructor was talking. Especially if they were talking to me directly
Responsiveness		
Did you have any questions during the experience?	No	I think I asked a few
How quickly were they answered?		Immediately

How would you rate the customer service from 1-10	The instructor did a really good job.	The instructor has a huge added value
Memorability		
What did you think of the story that was told during the wine tasting?	It could have been more elaborate. And I don't really see the relevance of the story to the wine tasting itself, but I don't know how you can do that better or differently	
What about the magazine handout?		Maybe seeing back the same icons that were used during the summary of the experience to have a better link between the two
Was the level of reptititveness frustrating for you?	I am someone who always want to know if I am doing something correctly. So I liked that the how to pages were visible between every step. I also liked that you could see your progess during every summary page, but the instructor can just move a bit quicker through those. Starting from the second wine, maybe the summary page can be visible after the appearance step, all of the nose steps and all of the palate steps. So 3 times in stead of 7.	At some points I though "I already know this" and did not really look at the how to pages anymore because of this. So for me, some of those could be removed
How novel would you rate this experience? (1-10)	Very novel	8.5
How likely are you to recommend this experience to friends and family? (1-10)	Yes! Would definitely recommend	10/10
(good value for money)		
How much would you pay for the experience?		40 Euro

Final remarks		
Is there anything we didn't ask you about this experience that we should have?		
What final comments do you want to make before ending this interview?	No, I think it is a really cool project. Maybe only that I would have liked some snacks during the tasting	

Table I.1: Answers to the interview questions of the non-functional evaluation study, participant 1 and participant 2

	Participant 3	**Participant 4**
Initial Thoughts		
What was your overall impression of the experience?	I liked that it is interactive. I liked that you don't just sit and listen to someone, but that you can actually join in. And that things move and you can select or deselect things. And educational	Fun and interesting
What did you think of the on-page explanations?	Clear, maybe even clear enough to use it without an instructor present	
What was the best thing about the experience?	The interactive part, and that you see your progress.	My favourite part was the interactive part. You focus on the glass and then you can use that glass to select something
What was the worst thing about the experience?	My english is not the best, so that is something I sometimes found difficult	Can't think of someting
How would you change the experience?		
How did you find the experience of using the glass to complete the task?	A lot of fun. Clear that that was possible	Was clear what to do, especially because of the text above
How did you find the experience of using your finger to select an aroma?	Did need the instructor to say we could select the aromas, but that was not a problem	Clear after instructions of the instructor. After that super easy

How did you find the experience of using your finger/hand to start/stop the timer?	Clear	Was clear, especially because of the steps beforehand. You expect something interactive
[if applicable] How would you compare the wine-tasting experience you just had to that of traditional wine-tasting?	This is a lot more educational. Especially the comparison between wines. Now you have a better reference of what it means if someone says a 'light wine'. That is not something that was ever explained to me before. And that the visuals helped understand what these elements were. By seeing what a 'purple' or 'ruby' is on the screen gives a good reference what is in the glass, but also for future reference.	Other wine tastings are more about if you like a wine or not. Someone tells a story about the wine, and that is the extend of it. This was more educational
What's your opinion on how the information is laid out? What did you think about how the language was used on this page?		Clear what everything meant. Visualisations were easy to understand
Did you understand that you could place your glass to select your choice yourself?		
What did you think about the fact that you can see what others are doing		
Educational level		
Do you feel you have more wine knowledge now?	Yes, I like that i now know which elements make a wine better or worse	Yes, I liked the tools on how taste a wine properply. Especially how to taste the acidity is not something i knew.

Was there any information you found difficult to understand?	No, except for the english	It was still difficult for met to choose aromas. Maybe simplifying it more for beginners would be nice, so just choosing the aroma category in stead of the aroma itself, for example. Or first the aroma category and then choose something from that category
Was there any information that was too easy to understand?	No	No
Do you feel like you are now able to describe a wine?	Yes, especially with the smelling distances and what that means. Usually I smell a wine and all I can say is 'not bad', but how bad can it be? Now I have the tools, such as the acidity, that helps me assess if a wine is good and if I like the wine myself. And why that is.	
Tangibility		
Did you feel the wine-tasting experience was organized in an appropriate space?		
Do you think there is enough light to properly see the colour of the wine?		
Was there enough space on the table?	Yes, no problem	Yes
Approachable		
Did you understand all of the information provided during the experience?		
Did the experience feel snobbish?		

Did you feel inexperienced during the experience?	I did feel like a true beginner during the experience. I do not know much about wine. Great guidance from the instructor in helping people find their way	I did feel somewhat inexperienced. But suggestions of the instructor really helped. Especially not providing the answers, but steering us into the right direction
How would you rate the language used during the experience from 1-10? (1 hard to understand & 10 perfectly understandable)		
Did you need more in-depth information to be provided?		
Have room for discussion		
Did you have enough time to formulate your own answers during the wine-tasting step activities?	Yes	Yes
Did you feel like there were wrong answers during the discussions?	No, not like there were wrong answers, but the instructor did steer us in a certain direction at some points. With the colour for example, I needed to look again to find the right reference.	No
Did you feel uncomfortable during the discussions?		
What did you think of the visual aids during the discussion?	Yes. If the elements were not there, we should have gotten a different instruction at the beginning, because then you have to remember everything. Now you could just easily describe it based on the visualisations	It was very helpful
Guide zooming in and out of the glass		

Where was your focus during the experience? (during instructions, executing the, the summary?)		
Responsiveness		
Did you have any questions during the experience?		
How quickly were they answered?		
How would you rate the customer service from 1-10		
Memorability		
What did you think of the story that was told during the wine tasting?	The story helped me to get into it. It immediately felt like "we are going to do something now". However, in the beginning it was a bit confusing of what it meant. But it did make it lively	
What about the magazine handout?	It is nice to get, but Im not sure if I am going to do something with it.	I like that you receive something that you have helped with. I would maybe take this with me when trying new wines.
Was the level of reptititveness frustrating for you?	No, I want to try to use these steps myself in the future. So it is good that I have done these steps four times now. So i know i have to look, smell, taste. The repetitiveness just helps with remembering these steps. Also, because it is four different wines you are tasting, it did not feel repetetive at all	No, it was good to know what was coming next.
How novel would you rate this experience? (1-10)		
How likely are you to recommend this experience to friends and family? (1-10)	Yes definetly, 8	7, You do need feeling for one of the aspects: wine, or going out for dinner.

(good value for money)		
How much would you pay for the experience?		
Final remarks		
Is there anything we didn't ask you about this experience that we should have?		
What final comments do you want to make before ending this interview?	What I think that would be nice, is if you are at a restaurant and you could do this there to taste a wine. I have often ordered wine and then they ask 'do you want to taste it', and then I don't know how to taste the wine and don't know what to say. So having it part of the evening experience of the restaurant. I think it would be really interesting to have it part of the table where you are eating at	

Table I.2: Answers to the interview questions of the non-functional evaluation study, participant 3 and participant 4

	Participant 5	**Participant 6**
Initial Thoughts		

What was your overall impression of the experience?	I really enjoyed it. I would send other people to do this experience too if I found this somewhere and did it on my own. I think it would be nice with a larger group. I think there is a large population that does not know a lot about wine, but would like to get a little more insight. Which is something I miss during other wine-tastings, even though they know you also do not have a lot of knowledge there. So yeah, fun! I liked the visual aspects on each of the pages. Especially how the aromas were displayed	It was a fun experience. I really liked that you could visually see what you were doing and what all the elements were. Everything is a lot better to understand when things are in front of you, in stead of you having to imaging everything yourself. I liked how everything was presented on the screen
What did you think of the on-page explanations?		Especially the first round the explanations of the how-to really helped to explain and visualise what you had to do. But you do look at the explanations less throughout de rounds
What was the best thing about the experience?	The best part for me is that your input matters. You are choosing the elements yourself, but you are still in contact with each other. Making it interactive in two ways. Usually at a tasting you might say you taste something, but others are saying things as well, so things get lost. Now you have your own summary at the end.	My favourite aspect is that you have visual support of what is being told.
What was the worst thing about the experience?	The most irritating part, but it is something small, is when you put your glass down at the summary, it is in the way of the how-to text on the next page. That was just a shame	
How would you change the experience?	Move the glass to another location	

How did you find the experience of using the glass to complete the task?	Yes, but it could have been clearer. Like a large arrow with "put glass here". Or visualisations of a glass on the circles. And if it is the same visualisation, it also helps to quickly see what to do during the experience.	It was clear that that was what I had to do.
How did you find the experience of using your finger to select an aroma?	When the instructor explained what to do it was clear after the first time.	Yes, after instructions. Not clear text on the page.
How did you find the experience of using your finger/hand to start/stop the timer?	It was clear	No problems
[if applicable] How would you compare the wine-tasting experience you just had to that of traditional wine-tasting?	It was a lot more about how to taste wine, in stead of, what wines do you like. Which is honestly not something I like with traditonal tastings i had. I think you need both aspects. Now I feel like I want to try five more wines in this manner, because this was fun. If a traditional tasting was more like this I would also be more likely to come back.	A lot more in depth. More about how to taste a wine and what aspects a wine has. Most wine tastings I have done just quickly explain a wine and let people figure it out themselves. Here you get to the bottom of it
What's your opinion on how the information is laid out? What did you think about how the language was used on this page?		
Did you understand that you could place your glass to select your choice yourself?	yes	Yes
What did you think about the fact that you can see what others are doing		

Educational level		
Do you feel you have more wine knowledge now?	Yes, I like that i have a roadmap on how to taste wine.	Yes, especially getting to the bottom of what aspects a wine has.
Was there any information you found difficult to understand?	No	No
Was there any information that was too easy to understand?	No	No, you start with a good base. You might always have people with different levels of wine knowledge. And you go to a wine tasting to learn something. And for me it does not matter that there are some things you already know.
Do you feel like you are now able to describe a wine?		
Tangibility		
Did you feel the wine-tasting experience was organized in an appropriate space?		
Do you think there is enough light to properly see the colour of the wine?		
Was there enough space on the table?	Yes	Yes
Approachable		
Did you understand all of the information provided during the experience?	For me it was fine, but I can understand that it might be difficult for some people. However, the visualisations might also help in that case	In the beginning I did not know many of the terms, but they were explained properly.
Did the experience feel snobbish?		

Did you feel inexperienced during the experience?	No, at the beginning I would not have been so confident in describing a wine. But at the end I fully felt like i had enough knowledge to explain the wine.	No, you slowly get more confident througout the experience
How would you rate the language used during the experience from 1-10? (1 hard to understand & 10 perfectly understandable)		
Did you need more in-depth information to be provided?		
Have room for discussion		
Did you have enough time to formulate your own answers during the wine-tasting step activities?	yes	yes
Did you feel like there were wrong answers during the discussions?		
Did you feel uncomfortable during the discussions?		
What did you think of the visual aids during the discussion?	I sometimes feel dumb if I forgot what I said a minitue ago. Therefore, it really helped that it registrated what I found in the wine.	The visual definitely helps. It allows you to just move trough the summary from start to end when explaining the wine
Guide zooming in and out of the glass		
Where was your focus during the experience? (during instructions, executing the, the summary?)		
Responsiveness		

Did you have any questions during the experience?		
How quickly were they answered?		
How would you rate the customer service from 1-10	It would not have worked without the instructor	The support was really helpful throughout the tasting
Memorability		
What did you think of the story that was told during the wine tasting?	I was excited when i found out that my input had an impact on the magazine. I would sell the story more	I liked the story
What about the magazine handout?	Exciting that you get a magazine. Would make it a better quality. Would not necessarily add more, cause I don't think I would read more. I like the starting 'advertisement' text. And Very nice that you get receommendations on what to try next	I like the articles.
Was the level of reptititveness frustrating for you?	Repetition is key. It was nice that we sometimes moved a bit quicker through the steps. However, for bigger groups you don't even have to move slower through the steps. Then it might be good to have everyone see the steps again. Otherwise you might feel like the dumb person that has forgotten how to do a step when you are busy with the fourth wine. By seeing the steps again, I think you remember them better when you leave. Very repetitive, but very good repetitive.	I did not find the repetitiveniss frustrating at all. I could have continued with more wines. You do the same steps, but you perceive something different every time.
How novel would you rate this experience? (1-10)		

How likely are you to recommend this experience to friends and family? (1-10)	Yes, a good 8. For groups of friends or a team outing/activity with collegues. Also by yourself, but definitely for a group	Yes, I would recommend it to friends
(good value for money)		
How much would you pay for the experience?	20 euros more than a traditional wine tasting. But depending on the wines etc.	40 euros
Final remarks		
Is there anything we didn't ask you about this experience that we should have?		
What final comments do you want to make before ending this interview?	I would add more aroma options. I was missing some, like tabacco. And maybe add scents during the aroma step	

Table I.3: Answers to the interview questions of the non-functional evaluation study, participant 5 and participant 6

	Participant 7	**Participant 8**
Initial Thoughts		
What was your overall impression of the experience?	I found it very professional and fun. I think we are definitely the right audience for something like this.	I think the projections onto the table are super well done. And also the interactive elements, and that someone walks you through it is great. I am very positive about the experience
What did you think of the on-page explanations?		I think you could even do this yourself. The icons and explanations are clear on their own. Maybe with a little more explanation it would work perfectly. You just have to let the user move to the next step on their own

What was the best thing about the experience?	The top for me is that the aromas are well visualised. That you can see what you taste and that it corresponds to each other. And i think that if you do not have a lot of experience with wine, it can be very hard to name aromas. I also liked that you could see that we both chose different aromas and that this is something that is subjective. We were both kind of in the same categories, but chose different aromas. And that it was easily visualised as well. When discussing aromas you do not always notice these differences.	I liked that you are guided through the steps. You learn how to properly think about a wine. I think the interactivity was well done. And I liked the selections of wines that showed the differences between the elements. All wines are so different in descriptions.
What was the worst thing about the experience?	I accidentally bumbed against the table too hard, which moved the sensors to a different location. So it had to be moved back exactly again.	The aroma categories were not visualised during the summary, so it was a little harder to compare those with the other person. Especially in bigger groups that would make it easier to see what similarities there are in categories.
How would you change the experience?	Makle it more stable	Give the aromas a background colour in the summary
How did you find the experience of using the glass to complete the task?	Yes, it was very intuitive	Yes, it was clear that you could place them on the circles, also because they have a similar size to the glass.
How did you find the experience of using your finger to select an aroma?	Yes, also because you already know the system is interactive at this point. Maybe also because it was said by the instructor.	Yes, but because you know it is interactive and the table kind of looks like a touch screen
How did you find the experience of using your finger/hand to start/stop the timer?	Clear	Was intuitive again

[if applicable] How would you compare the wine-tasting experience you just had to that of traditional wine-tasting?	During the wine tastings we had, it was not this informative. They explain a wine and might say what you can taste, but do not explain all elements. During this tasting are forced to think about something and are less likely to be influenced by other people in the tasting.	Traditional wine tastings are a lot of verbal explanation. This experience forces you to take your time and think about the wine. Also, during traditional tastings you are very dependend on the instructor, what they explain and how fast they go, now you could explore more yourself.
What's your opinion on how the information is laid out? What did you think about how the language was used on this page?		
Did you understand that you could place your glass to select your choice yourself?		
What did you think about the fact that you can see what others are doing	I like that you could compare your answers. It did not influence me what the other did. I dont think it is a negative thing if you can see what the other does, it might also help someone gain confidence in their choices	I am always a bit scared to get influenced by others, because i want to do it myself. So I tried hard not to look. But I liked that afterwards you had an interactive moment where you could see what the other chose. Especially having the 'aha' moment of seeing something you could not quite get.
Educational level		

Do you feel you have more wine knowledge now?	Yes, definitely. I thought I knew a lot about tasting wines, but then when you have to name those elements you have to really think about what they were. Now with the system, you are very conscience of what these elements are. And in the future I can think back about how we walked through these steps together. So it has an educational advantage of doing these elements step by step.	Yes. I already have quite a bit of wine knowledge. But I think for the 'enthousiastic amateur' it is exactly enough information.
Was there any information you found difficult to understand?	no	no
Was there any information that was too easy to understand?	No, there are some things you already think you know, but I found that I did not know the exact aspects. Normally I do it on just on feeling, and now I know exactly what steps to take.	I think the how to pages that explain how to do a step might get a little repetitive for some.
Do you feel like you are now able to describe a wine?	I felt more confident in explaining a wine. In the past I felt like I am okay in smelling and tasting a wine, but I have not followed a wine course or something like that, so i always feel like people might think 'oh she also wants to know something'. So this gave me a lot of confidence that I know what I am talking about, in stead of just saying something. A lot of people pretend they know something about wine, but this gave me confidence that I knwo	
Tangibility		

Did you feel the wine-tasting experience was organized in an appropriate space?		
Do you think there is enough light to properly see the colour of the wine?		
Was there enough space on the table?	Yes, enough space for yourself, but also not too big so you can still look at your neighbours	Yes
Approachable		
Did you understand all of the information provided during the experience?		
Did the experience feel snobbish?	No, but we are also to snobbish ourselves.	No, it did not feel pretentious. I think more aromas could even be added
Did you feel inexperienced during the experience?	No, but sometimes it was hard to determine the differences between light, medium, pronounced. But I think that is just that you need more experience. I do think it was wel explained. Especially if you do this for the first time i can imagine that it is nice that you get that context fron the instructor.	No, very accessible
How would you rate the language used during the experience from 1-10? (1 hard to understand & 10 perfectly understandable)	10, but I do speak English fluently. So I can also imagine it might be tough for others	10, easy to understand
Did you need more in-depth information to be provided?		

Have room for discussion		
Did you have enough time to formulate your own answers during the wine-tasting step activities?	Yes	Yes, plenty
Did you feel like there were wrong answers during the discussions?	No, I did not. But i can understand that something might feel wrong if you are totally at the other end of the spectrum. But the guidance of the instructor really helps with setting people on the right track and comforting people that there is no wrong answer.	No, it did not feel like I had wrong answers. Also guided by the instructor that helped with seeing what end of the spectrum you should be on.
Did you feel uncomfortable during the discussions?		
What did you think of the visual aids during the discussion?	It dit help me. It helps you not skip a step. And it reminds you of what you smelled and tasted. It would not have been so easy if I had to do it by heart. Especially the first steps I would have found hard to remember. Also liked that you could see your progress of a wine with every step	Identifying aromas is a lot easier if you have options before you. Some of the aroma icons were so small that is was sometimes hard to remember what the icon was. Vanilla and white blossoms, for instance, look quite similar when small.
Guide zooming in and out of the glass		
Where was your focus during the experience? (during instructions, executing the, the summary?)		
Responsiveness		
Did you have any questions during the experience?		Yes, they were quickly answered.
How quickly were they answered?		

How would you rate the customer service from 1-10		
Memorability		
What did you think of the story that was told during the wine tasting?	I thought it was funny to see what you were doing it for. I think that if people were to pay for this expeirence, it is very nice to receive a magazine to take home	I did not really understand it or why the story was necessary.
What about the magazine handout?	It would be fun to compare it with your friends afterwards. You can also help people further with what wines to try next, if they really liked one wine. I think that is also an added value. I really like that it is personalised	I think the content of the magazine is strong, but the story around it I do not understand. Personally would like to see it more to the point, thus explaining what we are giong to do. Could even add a discount code to buy these wines.
Was the level of reptititveness frustrating for you?	No, I think it would still be fun with six wines. But it is nice that after doing it two times you think "oh i understand this now"	Yes, but only the black how to do it pages inbetween. Even for more professional wine drinkers, this could be an added value to give them a systematic approach
How novel would you rate this experience? (1-10)		
How likely are you to recommend this experience to friends and family? (1-10)	9, I think it would be a great couples activity. Or a fun friend activity. You learn a lot, have interaction with the instructor, but also have time inbetween to interact with each other.	9, it is such a fun interactive experience, where you learn how to taste wine better.
(good value for money)		

How much would you pay for the experience?	I think you should not underestimate how much people, especially my user group, are willing to spend on such an experience, as long as it is a full experience. I think with everything 80 euros per person, with good wines. If you go out for drinks with friends, you also quickly spend that much money.	50 euros for really good wines. For more basic tastings, around 30 euros.
Final remarks		
Is there anything we didn't ask you about this experience that we should have?		
What final comments do you want to make before ending this interview?	I think it also has potential for people that want to get better at tasting wine to have this be something they can do at home	Also very helpful that you explain each step yourself during the last wine

Table I.4: Answers to the interview questions of the non-functional evaluation study, participant 7 and participant 8

	Participant 9	**Participant 10**
Initial Thoughts		
What was your overall impression of the experience?	I thought it was a lot of fun. Very refreshing, a totally different way. And it is nice that you can see what choices you make	I liked the visual part. It helps your nose and tongue as well.
What did you think of the on-page explanations?		
What was the best thing about the experience?	I liked the repition with the visual aspect. That is why you remember it in the future	The presentation was my number one. I also thought the technique behind it is very cool, I don't understand how it works. And I liked the background music
What was the worst thing about the experience?		It is not entirely stable on the table.

How would you change the experience?		
How did you find the experience of using the glass to complete the task?	I understood it completely	Yes, but maybe after I saw my partner do it
How did you find the experience of using your finger to select an aroma?	was clear	was clear
How did you find the experience of using your finger/hand to start/stop the timer?	was clear	clear
[if applicable] How would you compare the wine-tasting experience you just had to that of traditional wine-tasting?	You are more focussed on what you are smelling and tasting yourself. You are a lot more aware of what you need to focus on. I liked that a lot. Traditionally you have to think about flavours yourself, but then I didn't get that far.	I liked this much better than a traditional tasting i did recently.
What's your opinion on how the information is laid out? What did you think about how the language was used on this page?		
Did you understand that you could place your glass to select your choice yourself?		
What did you think about the fact that you can see what others are doing		I dont know if i like that I could see what my partner was doings. Now my answers were sometimes influenced by what she was filling in. I would have rather decided what I though myself, before looking at her anwers.
Educational level		

Do you feel you have more wine knowledge now?		
Was there any information you found difficult to understand?	No, in the beginning you learn a lot of new things, but throughout the experience everything is clear	No, I would now say I am almost an expert. I didnt dare say that in the beginning
Was there any information that was too easy to understand?	No, i think the level of information was correct	No, I don't know anything at all about wine, and I had no trouble understanding anything
Do you feel like you are now able to describe a wine?		
Tangibility		
Did you feel the wine-tasting experience was organized in an appropriate space?		
Do you think there is enough light to properly see the colour of the wine?		
Was there enough space on the table?	Space enough	I put my glass next to the board, because it did not feel entirely stable, but I think it is enough space
Approachable		
Did you understand all of the information provided during the experience?		
Did the experience feel snobbish?	No not at all	Nothing snobbish about it. It was very down to earth
Did you feel inexperienced during the experience?		No, it was a good level for someone who knows nothing, like me

How would you rate the language used during the experience from 1-10? (1 hard to understand & 10 perfectly understandable)	Fully understood	My english is not the best, but I could still follow it well
Did you need more in-depth information to be provided?		
Have room for discussion		
Did you have enough time to formulate your own answers during the wine-tasting step activities?	Yes	Yes
Did you feel like there were wrong answers during the discussions?		
Did you feel uncomfortable during the discussions?		Yes, and it also gives a lot of confidence that there is an instructor present that cna help you confirm your findings or steer you in the right direction
What did you think of the visual aids during the discussion?	The examples really helped with explaining a wine	Yes, that is what I liked the most.
Guide zooming in and out of the glass		
Where was your focus during the experience? (during instructions, executing the, the summary?)	Moments when the instructor was talking. I was listening to what was happening, but could also read it on the sceen	It was very logical where my focus had to be during the experience
Responsiveness		
Did you have any questions during the experience?		
How quickly were they answered?		

How would you rate the customer service from 1-10		
Memorability		
What did you think of the story that was told during the wine tasting?	I did not find it that interesting. I like it better if things are just what they are. I don't really get into that role. I am more of a realist	It went past me a little.
What about the magazine handout?	I do really like the magazine. I enjoy that you can read what you have tasted afterwards. But that stands alone from the story around it for me	
Was the level of reptititveness frustrating for you?	I liked the repetitiveness, because then it sticks. I cant wait to try this method at home too. I am a little older, so maybe even extra good for me	I think it would maybe get repetitive if you do it more than 10 times. But this was totally fine.
How novel would you rate this experience? (1-10)		
How likely are you to recommend this experience to friends and family? (1-10)	8, very likely to recommend	8/10
(good value for money)		
How much would you pay for the experience?	For a tasting of about two hours with basic wines, between 40-50 wines. With very good wines I might even pay 70. But than I would like some snacks too	I don't know
Final remarks		
Is there anything we didn't ask you about this experience that we should have?		

What final comments do you want to make before ending this interview?		

Table I.5: Answers to the interview questions of the non-functional evaluation study, participant 9 and participant 10

	Participant 11	**Participant 12**
Initial Thoughts		
What was your overall impression of the experience?	It was very fun. We had wine tastings before, but it was never interactive like this. It is a lot of fun to look at to.	I really enjoyed the experience
What did you think of the on-page explanations?		
What was the best thing about the experience?	Visualising the steps. It is more than just hearing someone talk. So the interactivity	The most effective, especially if you have not tasted wine before, is the structure. Also that you are doing it for yourself first, so you really have to think about it. because you have to select things
What was the worst thing about the experience?		Sometimes I wish there were more options. So sometimes i wanted to place it between low & medium. So another option or two would help with that. For instance two medium steps would already have to make you choose more, otherwise I would just choose medium a lot
How would you change the experience?	Maybe for people that really want to learn a lot, adding a piece of paper they can wirte on. I would like to rate how much i liked the wines for example	Maybe already turing the summary into a small story. But maybe it was also nice that you had to do it yourself. I think the way you do it now you would learn more. And anything that is more interaction is nice, I think people always like if there is something they can do

How did you find the experience of using the glass to complete the task?	Clear	Yes, but I sometimes did forget it. So maybe the system could get your attention after a while. So the circles flashing or something.
How did you find the experience of using your finger to select an aroma?	Took a moment, but was clear after the first time. And I don't mind that it is something that the instructor says someting	Maybe an icon or something would help
How did you find the experience of using your finger/hand to start/stop the timer?	Yes the most clear one	Clear
[if applicable] How would you compare the wine-tasting experience you just had to that of traditional wine-tasting?	More reasoning why you are doing the steps. More interactive. Traditionally, with a larger group there are maybe one or two things that you can add to the conversation, but here you are constantly challenged to select things, even if you do not say them aloud. I think you learn more fromt his	I feel like with traditional wine tastings it is the people that feel more comfortable with wine will speak up, maybe even a character aspect. So with this you do it for yourself more. I think more people will be inclined to participate with this.
What's your opinion on how the information is laid out? What did you think about how the language was used on this page?	Dutch/English is something I had to translate at points	No problem
Did you understand that you could place your glass to select your choice yourself?		
What did you think about the fact that you can see what others are doing	I only looked at what my partner was doing during the first wine, after that I did not feel the need to look at their choices until the summary. And I was interested in what they chose, but wanted to focus on my own selection first.	I think it does influence you. Maybe in a subconscience way. But if you are with a larger group, i think it would matter less. I also did not experience this as negative, cause it is also nice to see what others are doing
Educational level		

Do you feel you have more wine knowledge now?		
Was there any information you found difficult to understand?		
Was there any information that was too easy to understand?	No, i thought is was a great balancce between things that were easy and a little bit more in depth. And the simple things were not overly explained	No, some things you already know of course, but you don't usually taste wine in this manner, so it was just a good way to see how to taste wine. And it was not negative that I already knew some elements
Do you feel like you are now able to describe a wine?		
Tangibility		
Did you feel the wine-tasting experience was organized in an appropriate space?		
Do you think there is enough light to properly see the colour of the wine?		
Was there enough space on the table?	Enough space	Space enough
Approachable		
Did you understand all of the information provided during the experience?		
Did the experience feel snobbish?	No not for me	No
Did you feel inexperienced during the experience?		

How would you rate the language used during the experience from 1-10? (1 hard to understand & 10 perfectly understandable)		
Did you need more in-depth information to be provided?		
Have room for discussion		
Did you have enough time to formulate your own answers during the wine-tasting step activities?	Yes, i think it was good pacing	yes
Did you feel like there were wrong answers during the discussions?		
Did you feel uncomfortable during the discussions?	Yes, especially because you could see the wine terms in front of you. I am sometimes afraid that I use them in the wrong way, so it was helpful that they were there	
What did you think of the visual aids during the discussion?	Yes, each element was super clear	Yes, the visualisations really helped with quickly seeing what an element was. The water for the saliva, for instance, is a quick reminder of what you had to note
Guide zooming in and out of the glass		
Where was your focus during the experience? (during instructions, executing the, the summary?)		
Responsiveness		

Did you have any questions during the experience?		
How quickly were they answered?		
How would you rate the customer service from 1-10	It really helps that there is someone that can talk well about the wine	
Memorability		
What did you think of the story that was told during the wine tasting?		I would present it differently. In stead of saying they are helping with the magazine, maybe just explaining that they are geteting a magazine with their personalised notes at the end.
What about the magazine handout?	It was a nice surprise at the end. But maybe if people didnt know beforehand they would feel like they would not remember it after the experience. If they know before, they can trust that their selections are recorded. But i like that you get something at the end. It is a summary, but can also help you to investigate further	I did like the handout
Was the level of reptititveness frustrating for you?	No not at all, I think the repetitiveness is helpful in learning the steps	I think it helps to get used to what you have to do. First you follow what the instructor is doing, but by the end you are doing it yourself. I think it helps you better memorize the steps
How novel would you rate this experience? (1-10)		
How likely are you to recommend this experience to friends and family? (1-10)	I would definitely recommend it. Especiallly to people that want to learn something about wine. 7.5	8/10
(good value for money)		

How much would you pay for the experience?	It is between learning, fun and selling wine. If it is for the learning effect I would pay, but still maybe not that much. As it is now, I would pay 15 euros per person	If it is part of a larger experience, with food or something. On its own, I don't know if I would pay for it. Especially if you are likely to buy the wines afterwards. With a group outing and snacks and drinks around 40 euro
Final remarks		
Is there anything we didn't ask you about this experience that we should have?		
What final comments do you want to make before ending this interview?	I like that you can even try this with other types of wines. And I would add something like crackers between the wines as a neutraliser (and a little snack). It works because there is an instructor present, and that was done really well	I liked that you do it yourself the last step. It shows that if you know something you can do it yourself

Table I.6: Answers to the interview questions of the non-functional evaluation study, participant 11 and participant 12

Appendix J

Answers of the Knowledge Tests Before and After the Interactive Wine-Tasting Experience

J.1 Answers of the Knowledge Test Before the Interactive Wine-Tasting Experience

No	Question	Answer P1	Answer P2	Answer P3	Answer P4	Answer P5	Answer P6	Answer P7	Answer P8	Answer P9	Answer P10	Answer P11	Answer P12
1	What three tasting steps are used to assess a wine?	color analysis, smell, taste	Smell, taste, color	Kijken, Ruiken, proeven	smell taste colour	Looking, smelling, tasting	Look, nose, mouth,	Aroma, color, acid	colour, smell, taste	Look, smell, taste	dry run, smell & taste	Colour, smell, taste	See, smell, taste
2	How do you assess the appearance of the wine?	Still the glass above a white surface and look through to shallow part of the wine from the top	In het licht kijken	Door te kijken		color	Looking at the wine in the glass and turning your glass	By color	look at glass bottom upwards (diagonally) with light behind glass	Bekijk de kleur, kijk of hij aan het glas blijft hangen	color , behavior in the glas	By judging what stands out (e.g. cloudy, type of colour)	Looking trough the wine glass, looking at the colour
3	What aspect of a wine can you describe during the appearance step?	Color of the bubbles, viscosity, color of the wine (deep or transparant).	Kleur, licht doorlatendheid, stroperigheid,		colour	color, see throug or not see through	Color		colour, vibrancy	Red or white, dark or light	stroperigheid	Age,production method,	Colour, cloudiness
4	What three colours can a white wine be categorised as?	Golden, wheat, pearl	Wit, geel, goud	Wit, rood, rose		yellow, orange, white	No idea	White, yellow, gold	white, red, orange	Red white ros&®	light white, more yellow & rose	Green, yellow, gold	White, orange,...
5	What three colours can a red wine be categorised as?	Purple, bright red, burgendy	Ruby, amber, red	Licht, middel, donker		dark red, velvet, burgundy	No idea	Pink, red, purple	ruby, red, ?	Schaflaken rood gelooft ik verder niet bekend	from rose, light red & deep red	Ruby, Red, Purple	Red, orange,...
6	How do you assess the nose of a wine?	Swirl the wine and sniff	zuurstof toe te voegen en neus in het glas steken om te ruiken	Door te ruiken	smell	by describing what you smell	Smelling the wine		hold nose in/just above wine glass, smell	Ruiken nadat je de wijn in het glas hebt laten walsen	with my nose	By taking the smell apart based on other familiar smells like fruits, herbs etc.	Swirling the glass, letting air in, then full nose in the glass
7	What aspects of a wine can you describe during the	The smell, tanginess, sweetness, hints of elements	De fruitr andere geuren die men in de wijn kan herkennen.	De geur		what type of smells you recognise	Smelling the wine and turning the glass		aromas	Samenstelling, zoals fruitig, hout geriipt, oud of jong	less or more alcohol	Age, production method,	Smell and therefore the start of taste
8	the intensity of the nose?		De afstand waar je de wijn kan ruiken	smell	I dont konw	No idea			by smelling	geur in je neus hangen	with pleasure	countryfregion, faults different smells you can distinguish	...
9	How is the intesity of the nose		Schaal van 1-5?		i dont know	No idea				Weet ikniet	?		...
10	A higher quality wine has more aromas present.	False	True	True	True	True	True	True	True	False	False	True	True
11	The aromas smelled on the nose are objective.	True	True	False	True	False	True	False	False	False	False	True	False

Figure J.1: Answers of the Knowledge Test Before the Interactive Wine-Tasting Experience Part 1/2

No	Question	Answer P1	Answer P2	Answer P3	Answer P4	Answer P5	Answer P6	Answer P7	Answer P8	Answer P9	Answer P10	Answer P11	Answer P12
12	How do you assess the palate of a wine? What aspect of a wine can you describe during the palate step?	Taking a sip and churne	Het aantal smaken wat je kan herkennen, een hoger aantal heeft hogere complexiteit = een betere wijn De smaak van de wijn aan de hand van fruit soorten/ chocolaf noten	Door te proeven	taste	i dont know	Tasting it		Bij tasting	Gorgelen waardoor er lucht bij komt Zik er veel tannine in, van welke druif gemaakt, hoe is de	taste the wine in the mouth with air	By describing the acidity, tannins, mouthfeel	Taking a small sip, letting some air in, taste with whole mouth
13	How do you assess the intensity of the palate step?	Taste	De wijn door de mond heen laten walsen	Hoe sterk de wijn is	taste	what the taste is like (red fruid, vanille enz), tannines, finish	Sipping the wine		aroma, acidity, tannines, alcohol	wijn gerijpt	Mixed flavours	Age, faults, region, production method, quality, price	Taste, aftertaste, tannins
14	How is the intesity of the palate	See how long the taste lingers	Proeven			i dont know	No idea		by tasting, washing the wine in your mouth		with the eyes closed	By the length/intensity of the different flavours	Feeling the mouthfeel/tannins
15	categorised? The intensity of a wine says something about the quality of	Lingering time	Schaal 1-5?			i dont know	No idea			Geen idee	young, medium or an old wine		âij
16	the wine? The aromas that you smell on the nose are the same once	False	True	True	True	False	False	False	True	True	True	False	True
17	you taste on the How can you make the flavour of a wine	False	False	False	False	False	False	True	False	False	False	False	False
18	be more pronounced in your mouth? With what categories	Churning	Zuurstof toevoegen, een ronde mond	Door het langer in je mond te houden		by mixing it with air	No idea	By aitating	washing it in your mouth	Laat er lucht bij komen	by slurping	By adding air	Letting air in
19	can you describe the acidity level?		Schaal 1-5? Een droog mond gevoel en de aanmaak van speeksel			i dont know	No idea	Sour, base	low to high, 4 steps		good, drinkeble, bad		âij
20	How can you recognise if a wine has a high acidity?	When it makes your mouth dry	De afdronk is wat je mond gevoel is na dat de wijn als is doorgeslikt of uit gespuugd	Of het naar tanine proeft		i don't know	No idea		your mouth starts watering	Zurige smaak	bleu or red tonge or teeth	By the mouthfeel	If your cheeks pull in
21	What does 'the finish' of a wine mean?	The after taste		De nasmaak in je mond		how the aftertaste is	The last tast of wine in your mouth		lingering taste of a wine	De afdronk, hoe is de smaak nadat je de wijn hebt doorgeslikt.	wether the flavours are consistant	The taste after swallowing the wine	The last taste
22	How is the finish of a wine measured?		Schaal 1-5?			i dont know	No idea				?	in seconds	Taste
23	A higher quality wine has a shorter finish.	False	False	False	False	False	False	False	False	False	False	False	False

Figure J.2: Answers of the Knowledge Test Before the Interactive Wine-Tasting Experience Part 2/2

J.2 Answers of the Knowledge Test Before the Interactive Wine-Tasting Experience

No	Question	Answer P1	Answer P2	Answer P3	Answer P4	Answer P5	Answer P6	Answer P7	Answer P8	Answer P9	Answer P10	Answer P11	Answer P12
1	What three tasting steps are used to assess a wine?	color analysis, smell, taste	Kleur, geur en smaak	Kijken, ruiken, proeven	Kijken, ruiken, proeven	Looking, smelling, tasting	See, smell, taste	Looking, smelling, tasting	colour, smell, taste	Uiterlijk, geur, smaak	Kleur geur tong	Colour, nose, palate	Looking smelling tasting
2	How do you assess the appearance of the wine?	Still the glass above a white surface and look through to shallow part of the wine from the top	Hou de wijn in het licht, tegen een witte achtergrond. Beklijk de kleur	Door het glas schuin te houden en te kijken naar de kleur	De kleur bekijken	By the colour of the wine	by taking the glass in your hand and turning it around	By the colour	look at glass bottom upwards (diagonally) with light behind glass	Kleur, helderheid en daarna de kleur die bij wit of rood hoort beoordelen	Visueel, mate van vloeibaarheid, viscositeit. Stroperigheid	Tilt the glass and look at the colour with a white background	Tilt the glass 45degrees and look at the upper layer of the wine
3	What aspect of a wine can you describe during the appearance step?	Color of the bubbles, viscosity, color of the wine (deep or transparant).	de kleur	Kleur	Hoe vol of licht de wijn is	The colour	the color, the darkness	Colour	colour, vibrancy	De kleur, egy iets over de druif en over de leeftijd. Ook kan je zien of er droesem in zit	Kleur	The intensity of the smell and complexity	Color
4	What three colours can a white wine be categorised as?	Golden, wheat, pearl	amber, gold, lemon	Goud, licht of donker	Goud, lemon, geel	Yellow, gold, amber	Gold, lemon, white	Citroengeel, goudgeel, amber	white, red, orange	Geel, oker, bruin-geel	Helder, meer naar geel, donkerder	Yellow, gold, amber	Gold, yellow, green
5	What three colours can a red wine be categorised as?	Purple, bright red, burgendy	Ruby, red, Tawny Houd het glas onder je neus op verschillende afstanden en test wanneer je de geur	Ruby, purple, dark	Ruby, red, dark	Ruby, tawny, red	red, dark red, darker red	Bright red, Ruby, purple	ruby, red, ?	Paars, robijn, rood	Rood, robijn, amber	Purple, Ruby, tawny	Purple, ruby, light
6	How do you assess the nose of a wine?	Swirl the wine and sniff	Door in te ademen door de neus met de neus in het glas	Door met je neus in het glas te ruiken	By the intensity, the different tupes of smells	By taking the glass en smell the odor strength of the wine	Intensiteit, aroms	hold nose in/just above wine glass, smell	Je wak st het glas en ruikt welke geuren vrij komen	Mild, medium, intense	By describing the different aromas that you smell	Small swirl with the glass, then put your nose in the glass
7	What aspects of a wine can you describe during the	The smell, tanginess, sweetness, hints of elements	Hoe ver je de wijn vanaf de neus ruikt	Hoe diep de geur is	The intensity, different tupes of smells	the flavors and spices in the wine	Aroma en intensiteit	aromas	De intensiteit de aroma's	Fruit, hout, rood fruit enz	Intensity, complexity	Aroma's and strength of the smell
8	the intensity of the nose?	de geur intensiteit afstand waarvan de wijn al te ruiken is.	Hoe ver je het van het glas nog ruikt	Hoe ver van het glas je de wijn nog ruikt	gou have to put your nose to smell the	to your nose, the further the glass the	Hoe ver je de wijn nog ruikt	by smelling	afstand tussen glas en neus. Daarna	glas de geur waarneembaar	of the wine you smell from what distance	you smell the wine; keep your nose a bit
9	How is the intesity of the nose	in drie stappen, licht, medium, intens	Dichtbij of ver weg	Dichtbij, middel, ver	Light, medium, intense	from normal smell to strong smell				Mild, matig, intens	Mild, matig en intens	Low, medium, high	High medium low
10	A higher quality wine has more aromas present.	False	TRUE	TRUE	TRUE	TRUE	FALSE	TRUE	True	FALSE	FALSE	TRUE	TRUE
11	The aromas smelled on the nose are objective.	True	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	False	FALSE	FALSE	TRUE	TRUE

Figure J.3: Answers of the Knowledge Test After the Interactive Wine-Tasting Experience Part 1/2

No	Question	Answer P1	Answer P2	Answer P3	Answer P4	Answer P5	Answer P6	Answer P7	Answer P8	Answer P9	Answer P10	Answer P11	Answer P12
12	How do you assess the palate of a wine?	neem een slok van de wijn en voeg zuurstof toe door te zuigen.	By tasting	Door te proeven		By smelling and deciding which smells you recognize	by taking a sip of wine at some air en then roll it around your mouth	Puik en en proeven	By tasting the wine	Je neemt een slok in je mond en gorgelt een beetje	Met Neus en tong	Take a sip, ad some air and taste	a sip, let some air in and taste the wine through your whole mouth
13	What aspect of a wine can you describe during the palate step?	De verschillende smaken die in de wijn te zijn herkennen	The different aromas of taste	Zuurgraad		What type of smells you recognize like red fruit, dark fruits, vanille enz	the flavours in the wine	The tastes / flavours of a wine	You take a sip, and assess how pronounced the flavours are	Klopt de smaak met de verwachting van de geur, welke smaken, fruit, vanille etc. Je proeft of de wijn hout geïlpt is	De aroma's	Intensity, palate,	Aroma's, acidity and intensity (afdronk)
14	How do you assess the intensity of the palate?	Je telt het aantal smaken dat je kan herkennen in de wijn. Dit kan aan de hand van verschillende categorieën zoals; hout, bloemen en citrusvruchten	By timing how long the taste lingers	De hoeveelheid speeksel	Door de wijn door de mond te laten	How long the taste stays in the mouth	by taking the glass spin it, taking a sip	Hoelang de smaak blijft hangen	Slurpen / sipping air whilst the wine is in your mouth	Je voegt lucht toe aan de slok wijn	Slurpen en rondje tong	With air, by slurping	By timing how long the main taste of the wine is in your mouth
15	How is the intesity of the palate categorised?	In drie stappen, weinig, medium of veel smaak	Weak, medium, intense			Short, medium, long	normal, middle, strong	Light, medium, Long	Low, Medium high	Mild matig intens	Wit fruit, rood fruit, vanille en chocola (hout)	Low, medium, high	Short, medium, long
16	The intensity of a wine says something about the quality of the wine?	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
17	The aromas that you smell on the nose are the same once you taste on the	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
18	How can you make the flavour of a wine be more pronounced in your mouth?	Tuit je lippen en voeg meer zuurstof toe in de mond	By geting more oxigen in there (slurpen) I don't remember the word.	Swaddle	Lucht erbij laten	By adding air	by taking some air with the sip	Door het door je mond te laten gaan	Slurpen / sipping air whilst the wine is in your mouth	Je voegt lucht toe aan de slok wijn	Droog zoet of zuur	Low, medium, high	Low, medium, high
19	With what categories can you describe the acidity level?	2 levels, high or low	By taking a sip and take notice off the amount of selliva in your mouth	Hoeveelheid speeksel	Hoog of laag	How much salavia is produced in the mouth	normal, middle strong	Ligt, medium, hoog	Low medium high acidity	Laag medium hoog	De mate van speeksel vorming	By adding air	Low, medium, high
20	How can you recognise if a wine has a high acidity?	Door speeksel aanmaak in je mond na dat je de wijn hebt doorgeslikt	Maakt veel speeksel aan	Maakt mond meer speeksel aan	More salavia	by producing a lot of saliva	Je maakt veel speeksel aan	Door het door je mond te laten gaan	By assessing the amount saliva in your mouth after taking a sip	Veel speeksel in je mond	How long the taste sticks in your mouth after swallowing	The end taste after having swallowed the wine	Mouth feel and making more saliva (speeksel)
21	What does 'the finish' of a wine mean?	de smaak die achterblijft in je mond nadat je de wijn hebt doorgeslikt	Hoe long the taste lingers	Hoe lang je het nog proeft in de mond na doorslikken	How long the taste stays in your mouth	how long it takes for the flavours to leave your mouth	Hoe lang die blijft hangen	How long the taste lingers	By counting the seconds you can taste the wine	Timen hoe lang je hem proeft na een slok	Milde medium strong	In seconds	How long you can taste the main taste of the wine (afdronk)
22	How is the finish of a wine measured?	hoelang de wijn in de mond aanwezig is naar het doorslikken van de wijn	By timing how long the taste lingers	Hoe lang je het nog proeft	Hoe lang je het blijft proeven	by taking a sip and measure the time of when the flavours are gone	Met tijd	FALSE	By counting the seconds you can taste the wine	FALSE	FALSE	FALSE	By timing how long the main taste is still in your mouth after a sip
23	A higher quality wine has a shorter finish.	False	False	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE

Figure J.4: Answers of the Knowledge Test After the Interactive Wine-Tasting Experience Part 2/2

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	
Points before	9.50	11.95	8.25	6.60	9.90	7.80	6.40	12.80	10.85	7.25	8.85	12.20	**Average**
Score before	4.72	5.68	4.23	3.58	4.87	4.05	3.50	6.01	5.25	3.84	4.46	5.77	4.66
Points after	18.15	19.25	15.25	15.20	15.45	14.85	17.35	19.30	18.10	12.15	17.80	17.80	16.72
Score after	8.10	8.53	6.97	6.95	7.05	6.81	7.79	8.55	8.08	5.75	7.97	7.97	7.54
difference points	8.65	7.30	7.00	8.60	5.55	7.05	10.95	6.50	7.25	4.90	8.95	5.60	7.36

Table J.1: Total scores of the knowledge test of the participants before and after the interactive wine-tasting experience

Appendix K

Answers of the SUS Questionnaire After the Interactive Wine-Tasting Experience

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
I think that I would like to use this system during every wine tasting	5	2	4	5	4	3	4	5	5	4	4	3
I found the system unnecessarily complex	1	1	1	1	2	2	1	1	1	1	1	2
I thought the system was easy to use	5	4	5	5	1	4	4	5	5	5	4	4
I think that I would need the support of a technical person to be able to use this system	1	3	1	2	2	4	4	2	2	1	2	2
I found the various functions in this sytem were well integrated	4	4	5	4	3	3	5	4	4	5	5	4
I thought there was too much inconsistency in this system	1	1	1	1	2	4	3	2	1	1	1	1
I would imagine that most people would learn to use this system very quickly	4	5	4	5	4	4	5	5	5	5	5	5
I found the system very cumbersome to use	1	1	1	1	2	3	1	2	2	1	2	1
I felt very confident using the system	5	4	4	5	3	5	5	5	4	5	5	4
I needed to learn a lot of things before i could get going with this sytem	1	1	2	2	2	2	1	2	1	4	1	4

Table K.1: Answers of SUS questionnaire

Annex

Annex No	Annex Title	File/Folder Title
1	Research Topics Report	Annex1$_{R}esearchTopicsReport$
2	Arduino Sketch	Annex2$_{A}rduinoSketch$
3	Processing Sketch	Annex3$_{P}rocessingSketch$
4	Ethics Request	Annex4$_{E}thicsRequest$