SHARED DECISION MAKING: A SERIOUS GAME BASED ON OSCE FOR CLINICIANS

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

Shared Decision Making: A Serious Game Based on OSCE for Clinicians
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Shared decision making(SDM) is an essential process to improve outcomes and reflect patient views in medical consultation. In SDM, the treatment that patient will take is a decision reached by the participation of both the clinician and the patient. To achieve SDM, clinicians should explain possible treatment options with their pros and cons and encourage patients to join in the process, and patients should state their ideas about the options and preferences about the outcomes. This process follows three steps in the three-talk model of SDM. In the first step, clinicians describe the decision-making process to patients. In the second step, clinicians describe treatment options and possible outcomes. In the final step, the clinician and the patient together reach a decision considering the patient's preferences. However, while the current health systems put some barriers to this process, such as limited and short time spared for consultation, there are other barriers too, such as patients seeing the clinician as the final decision authority in the medical domain or clinicians not knowing or being unwillingly about how to reach patients. Serious games, as being games that not only entertain, are mediums widely used in the medical domain and education. It provides an environment for the players where they can exercise, practice, and learn. This thesis aims to design a dialogue-based serious game for physiotherapists to improve their SDM actualization skills and create an environment where clinicians can practice the SDM process. For this aim, the objective structured clinical examination (OSCE) method, which is commonly used in medical education and provides a pseudo or virtual patient for students, will be used to design the game.

Keywords: shared decision making, decision making, serious games, OSCE, healthcare

ÖZ

Ortak Karar Verme: Hekimler için OYKS Tabanlı Bir Ciddi Oyun
Sülün, Ahmet
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Ortak karar verme (OKV) medikal konsültasyon sürecini iyileştirmek ve hasta görüşünü tedavi kararlarına yansıtmak için önemli süreçtir. Bir konsültasyon sürecinde, hastanın alacağı tedavinin kararının, hasta ve hekim tarafından ikisinin de katılımı ile verilmesi gerekmektedir. Bu süreçte hekimin hastaya tedavi seçeneklerini artı ve eksi yanlarıyla açıklaması gerekirken hastanın da tedavi sürecine yönelik tercihlerini ve seçenekler hakkındaki fikirlerini ortaya koyması gerekir. Üç konuşma modelinde, bu süreç için üç basamaktan oluşan bir yöntem önerilmiştir. Modelin ilk basamağında hekim hastaya OKV süreci hakkında bilgi verir. İkinci basamakta hastaya tedavi seçeneklerini ve bunların olası sonuçlarını açıklarken, son basamakta ise hasta ve hekim beraber bir tedavi üzerinde karara varırlar. Ancak var olan sağlık sistemleri bu sürecin gerçekleşmesine engel olabilecek, hastalara ayrılan kısıtlı ve kısa danışma süreleri gibi, bariyerler ortaya koymaktadır. Bunun dışında da hastaların hekimleri son karar mercii otoritesi olarak görmeleri ya da hekimlerin hastalarla nasıl iletişime geçileceğini konusunda bilgisiz veya isteksiz olması gibi bariyerlerde bulunmaktadır. Ciddi oyunlar, sadece eğlendirmeyen oyunlar olarak, medikal alanda ve eğitimde sıklıkla kullanılan araçlardır. Bu oyunlar oyuncular için pratik yapabilecekleri ve öğrenebilecekleri ortamlar sağlamaktadır. Bu bilgiler dahilinde, bu tez, fizyoterapistler için bir diyalog oyunu tasarlamayı amaçlamaktadır. Oyunda hekimlerin OKV gerçekleştirme becerileri puanlanacak ve hekimlerin OKV üstüne pratik yapabilecekleri bir ortam sağlanacaktır. Bu amaç doğrultusunda, oyunu tasarlamak için ise medikal alanda sıklıkla kullanılan ve öğrencilere sahte ya da sanal bir hasta sunan, objektif yapılandırılmış klinik sınavı (OYKS) metodu kullanılacaktır.

Anahtar Sözcükler: ortak karar verme, karar verme, ciddi oyunlar, OYKS, sağlık hizmeti

To My Family and İlayda

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LIST OF ABBREVIATIONS

ADMP	Assisting Decision Makin Process
TMCHO	Transformation Model of Communication and Health Outcomes
BR	Building Rapport
CC	Closing Consultation
EHR	Electronic Health Records
GTO	Giving The Options
IS	Initiating Session
IRfC	Identifying Reasons for Consultation
OSCE	Objective Structured Clinical Examination
PfSDM	Preparing for Shared Decision Making
SDM	Shared Decision Making
SG	Serious Games
SUS	System Usability Scale
TAM	Technology Acceptance Model

CHAPTER 1

INTRODUCTION

Consultation is a process that includes social interaction between two parties to examine a problem and produce a solution (Sheridan et al., 1996). In healthcare, during a medical consultation, these parties consist of patients as counselees and clinicians as consultants. During this process and on the patient side, they can state their problem, expectations, and concerns about the issue, expect to be advised a treatment, and react to this advice. On the other side, clinicians can ask problem-relevant questions, expect patients to clarify the situation and state their expectations, share their medical opinions, and advise on treatments and care routines (Tarrant et al., 2004). Coming to an agreement on the solution in the given time ends the consultation process. In medical consultation, this requires a prescription of a treatment or a care routine. However, there is not always one solution to a medical problem to easily come to an agreement as many diseases do not have a single best treatment option that can be recommended to all patients. For example, in musculoskeletal pain management, the treatment options include self-management, anti-inflammatory medication, physiotherapy, or their combination. The best treatment combination depends on the patient's personal situation and preferences. For example, a patient who needs to go back to work urgently may prioritize the options with low waiting times and higher potential for rapid recovery.

When there is more than one solution for a problem, this entire process of sharing information and agreeing on a solution requires decision-making with the involvement of the two parties. However, in medical consultation, this may not be a straightforward process. As not being with medical background, patients may expect to receive a treatment decided by the clinician for their problem. As experts in the domain, clinicians may expect to give the treatment with the best outcome for the relevant problem. Besides these, the circumstances, such as the designated time for the consultation, may not allow an appropriate discussion of the problem and the solutions to actualize a proper decision-making process.

In healthcare, the term *shared decision-making* (SDM) was proposed to address decision-making during consultations. SDM refers to the joint contribution of the parties to the treatment decision by providing evidence-based information about treatments to patients while considering their preferences (Elwyn et al., 2000). Therefore, it is crucial that the patient participates in the decision-making process.

Lenert et al. (2014) stated that clinicians' inferred preferences could be misleading and significantly affect the outcome. Alsulamy et al. (2020) also argued that having multiple options at hand requires considering patients' preferences, and SDM can be a helpful process to provide the most appropriate option. However, Jacklin et al. (2018) argued that this involvement does not have to be equal all the time. The patient should be encouraged to state their concerns and preferences that may affect the treatment outcome and should be listened to as an equal member of the discussion. Hence, for a successful medical consultation, patient involvement is vital in the process, even if the final treatment decision is left to the clinician as an informed decision of the patient.

There were models developed to practice a successful but also structured and equal process across patients. Bomhof-Roordink et al. (2019) Among these, Elwyn et. al.' (2017) three talk model is one of the latest ones as built on other models and revised after the previous model proposed by Elwyn et. al. (2012). Three talk model proposed a three step process in which clinicians build a relationship and get information from patients; then inform them of treatment options, and finally, decide on one of them together. It was named "talk" to emphasize the communicative side of the SDM process (Elwyn et. al., n.d., 2012, 2017).

While SDM is important for medical consultations and studies developed numerous models, it is not always easy to implement it. Limited time, lack of communication, power asymmetry between parties or characteristics of them are some of the barriers hindering the SDM process (Alsulamy et al., 2020; Elwyn et al., 2010; Legare et al., 2008; Hack et al., 2006).

As one of the medical branches, physiotherapy is also an area that values the SDM process. However, it has gained popularity in practice, Pacheco-Brousseau et al. (2022) reported that the current practices are insufficient and need more research on the topic. Therefore, an open area exists to examine this process within the physiotherapy domain.

Games can be a novel and practical tool to examine the SDM process in medical consultation. The play activity itself is very fundamental to human life. Huizinga (1955) argued that play is older than human culture and an essential activity in life. Piaget associated it with human development and learning in the early childhood period (as cited by Pellegrini et al., 2007). Dörner et al. (2016) reported that games have been in human life across all cultures. The technology in our age gave rise to digital or video games, which have audiences of all ages and social groups (Dörner et al., 2016). While many people play video games for their entertainment quality, a branch of games has been developed that can be used in many research areas.

Serious games (SG) are games that have not only entertaining value. Dörner et al. (2016) define the term as "A *serious game* is a digital game created with the intention to entertain and to achieve at least one additional goal (e.g., learning or health).These additional goals are named *characterizing goals"* (p. 3). They also add that for some researchers, a serious game does not have to be digital but can include all types of games. For the use of them in healthcare, Gentry et al. (2019) stated that serious games can provide a space for healthcare providers to acquire various skills such as communication, critical thinking, decision-making, or multitasking. Since they can be played repetitively, learners may acquire these skills more quickly.

Physiotherapy is also a field where serious games are widely used. Ling et al. (2017) argued that these games could increase patients' motivation and adherence to therapy programs and help to distract patients' attention from painful physical activities. These games for physiotherapy generally use commercial technologies, which are developed for more engaging experiences when playing games such as Nintendo Wii Fit or Microsoft Kinect sensors (Fraiwan et al., 2013; 2014; Idriss et al., 2017; Ling et al., 2017).

In SDM, it can be challenging for clinicians to practice this process without getting into an actual consultation. However, consultations with poor SDM can subject patients to unsatisfactory outcomes. Therefore, serious games can provide an environment for clinicians to practice and examine the SDM process without causing a negative outcome for the patient. It can also be a cost-effective tool, less time-consuming, and easy to reach compared to other methods, such as providing a pseudo patient for clinicians. Overall, serious games can be a valuable tool for studying SDM when designed with a structured method, while there is no such example in literature.

In medical education, objective structured clinical examination (OSCE) is an examination tool for students to show their proficiency in various practice areas. During an OSCE, examiners assess students with pseudo or virtual patients, who are provided with sufficient information to actualize the examination under various conditions such as a real life situation, consultation, or diagnosis (Watson et al., 2002). Harden et al. (1975) designed the first OSCE, and the tool was found to be more beneficial compared to traditional assessment methods in being more objective, having the ability to assess various skills, providing motivation for learning, and with good levels of reliability and validity (Rushforth, 2007; Bartfay et al., 2004; Watson et al., 2002; Roberts & Brown, 1990; McKnight et al., 1987).

During an OSCE, guides are provided to examiners to assess students on the same criteria. An SDM guide for OSCE is also provided (Wamboldt & Loughran, 2017). This guide covers essential steps in an SDM process, with each step consisting of several points to provide a good consultation. This guide can serve as a structured design method for a serious game about SDM.

Serious games can be an efficient medium to address the issues regarding the SDM process and increase awareness of it. Making SDM a well-known practice needs understanding the steps to be taken, what information should be given, how to approach the other party, and what hinders and facilitates the process. Both patient and clinician sides of the process need these steps. A serious game can reflect this process easily and efficiently for both parties. However, no study in the literature aims this or incorporates any concepts regarding SDM and SGs. This thesis focuses on this lack in the literature from the clinicians' side while also integrating OSCE into the topic.

1.1. The Aims of The Thesis

Considering and with the motivation of information given in the previous section, this thesis aims to develop a serious game as an SDM practice tool for clinicians in the field of physiotherapy. The game aims to familiarize clinicians with the process and create a virtual environment to practice SDM safely. Since SDM is a communication process, the final product is in the form of a dialogue-based simulation game. For preparing the game setup and dialogues, the three talk model by Elwyn et. al. (2017) and the OSCE guide for SDM (Wamboldt & Loughran, 2017) is used.

This study also aims to conduct interviews with experts from the physiotherapy and SDM fields during the development process to improve its content and user experience. The interviewees are provided with the game's prototype during these interviews.

Finally, the developed game is evaluated with various participants from different backgrounds for the game's usability as the pilot study.

1.2. Thesis Outline

This thesis consists of six chapters. Chapter 2 presents the state-of-the-art in SDM and SG literature. Specifically, research on SDM, SGs, and OSCE is examined. Each concept is described with its roots and the literature's current approach towards them. Also, each concept's section presents the research intersecting the current and previous concepts.

Chapter 3 describes the methodology used in this thesis. The game development process is explained while the developed game is described in detail. Then, a qualitative evaluation study during the development of the game and the usability study are presented with the characteristics of the study.

Chapter 4 reports the results of the qualitative evaluation study conducted during the game's development process. The topics uncovered during the interviews regarding the possible improvements for the prototype are presented here. The adjustments are also displayed, demonstrating the game's final version.

Chapter 5 presents the results of the usability study.

Chapter 6 discusses the results of the whole process. The scores got in the usability study are also evaluated based on the literature findings.

Finally, Chapter 7 presents the conclusion of the study. Together with that, the contribution of this thesis to literature and its limitations will be discussed. In the final part, considering the collected information during this thesis process, suggestions are made for future studies.

CHAPTER 2

LITERATURE REVIEW

This chapter covers the state of the art of literature on the content of the study conducted by this thesis. Since the study aims to develop a serious game for clinicians to practice shared decision-making based on the structure of an OSCE, these three topics are examined in detail. First, the SDM process is explained and examined. Then, information on SGs is provided, including research related to SGs and SDM, at the end of the section. Finally, research on OSCE is given, considering studies combining the SDM and SGs with OSCE.

2.1. Shared Decision Making

This section of the thesis examines shared decision-making as a concept and process, the models proposed for SDM, outcomes of practicing SDM, and factors affecting it. The current state of the literature on these topics is provided.

SDM as a concept in literature first appeared in 1997 (Stiggelbout et al., 2015). However, before that, "sharing of decision making" idea was proposed by Veatch (1972) in his paper for examining patient and clinician roles in a relationship. In those years when Veatch (1972) published his paper, there was a revolution in the medical domain which healthcare had started to become available for all humans. This environment led to the discussion of ethics in medical consultations (Stiggelbout et al., 2015). Therefore, Veatch (1972) proposed that clinicians should share with patients the authority and freedom to make decisions about important choices while not obligating the patient to involve in every medical decision. This shared responsibility in decision-making can lead to ethical discussions during consultations where both parties can maintain their moral concerns (Veatch, 1972). So, the ethical concerns in the developing medical domain presented a shared decision-making requirement.

Stiggelbout et al. (2015) argued a second call where SDM is a required element in medical consultations. In the 1970s, there were differences in patient care practice based on geographic location. These differences imply that clinicians' preferences can affect the decisions made for a patient. Hence, the given patient care services were more supply-based than evidence-based. On the other hand, SDM proposes an evidence-based approach to medical consultations that can prevent the variations but also can help to lower the cost of patient care, such as lowering the number of elective surgeries made (Stiggelbout et al., 2015). Thus, the SDM process was suggested as a required element of medical consultations.

Charles et al. (1997) were the first to mention the shared decision-making term and describe the characteristics of the concept. Overall, they suggested four essential points for the SDM. These were the involvement of at least two parties, involvement of both parties in the treatment decision process, information sharing, and a treatment decision with the agreement of both parties. As they argued in their paper, SDM is an intermediate approach to a consultation process where other approaches can go extremist for either patient or the clinician. Therefore, SDM provides some autonomy and responsibility to patients while providing more than an informing agent and being less than the sole authority of treatment decisions to clinicians (Charles et al., 1997).

To the current years after 1997, the awareness and the popularity of SDM have increased. Alsulamy et al. (2020) conducted an umbrella review considering articles published between 1997 and 2018 and focusing on SDM. Passing the inclusion criteria of authors, seven review articles in the study revealed that over %50 of them were written after 2013. In addition to reviews, the examined articles and studies in those reviews increased in numbers. For example, Topp et al. (2018) stated that their study was the first to examine physiotherapists' knowledge, perception, and use of SDM. While they found that physiotherapists knew little about the topic, SDM was perceived positively by the clinicians. However, those studies mainly came from high-income western countries; these results point out that the SDM process is taking more attention to study and be improved (Alsulamy et al., 2020).

2.1.1. Models of SDM

One of the areas of research on SDM is building models of the process to provide a consistent way of practicing and studying SDM. Many models have been proposed, but as Makoul and Clayman (2006) stated in their review for conceptualizing SDM, a unified model could not be developed. However, based on the reviewed articles, they proposed an integrated model with a list of elements, which an SDM process can include. The list was consisted of 13 items but separated into groups as essential and ideal. While nine items essential list covered elements required to have an SDM process, such as defining the problem or presenting options, the four items ideal list covered elements that may improve an SDM process, such as unbiased information or mutual agreement (Makoul & Clayman, 2006). Stiggelbout et al. (2015) claimed that many models used a simplified version of the nine essential elements of Makoul and Chapman (2006).

Starting with Makoul & Clayman's (2006) elements but adding more in the process, Bomhof-Roordink et al. (2019) identified critical components in SDM models proposed to date by conducting a review. They reviewed a total of 40 articles for the analysis. They found that %65 of the models proposed were developed without any support from empirical data. Among these models, four of them both benefitted from and influenced other models. Thus, Bomhof-Roordink et al. (2019) stated that those researchers, who are Charles et al. (1997), Towle and Godolphin (1999), Elwyn et al. (2012), and Makoul and Clayman (2006), influenced the conceptualization of the SDM process. Although these authors have older models among 40 models, Elwyn and colleagues have the newest model among the four authors Bomhof-Roordink et al. (2019) stated and informed their model by the other three authors.

Elwyn et al. (2012) proposed a three step model for the SDM process (Fig. 1). In this model, the SDM process consists of three steps: choice *talk, options talk,* and *decision talk*. Choice talk covers where patients are informed that there are treatment choices, and a decision on these choices will be made together with the clinician. So, this step informs the patients about the general process of SDM. The second step, options talk is where patients are given and explained treatment options. This step ensures that the patient can have an informed decision. The final step is decision talk, in which an informed decision is made with the agreement of both patients and clinicians and considering the patient's preferences. Another term used in the model is *deliberation* which describes the period when patients become aware of their choices, have some information about them, and consider what is more important for them. They also emphasized using decision supports; tools prepared to aid the process

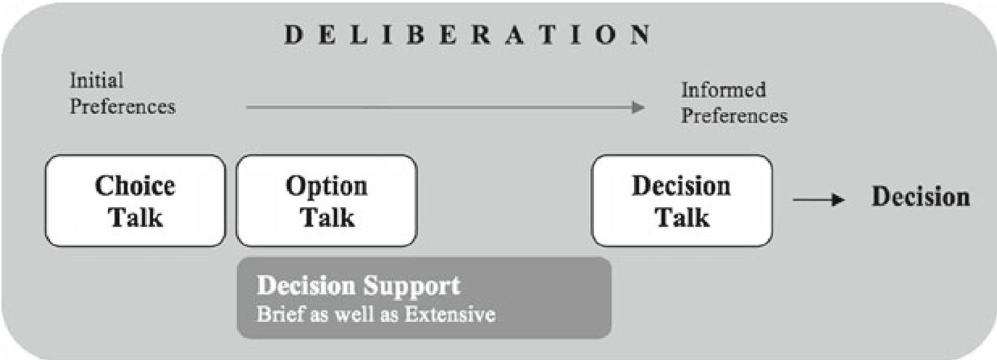

Figure 1. *The three-talk model for SDM by Elwyn et al. (2012)*

by summarizing evidence-based information on the relevant topic, treatment, or in finding out the patient preferences (Elwyn et al. 2012).

Elwyn and colleagues revised their three talk model in 2017. They designed a three step study before proposing the new revised model. First, they conducted an interview with a sample of researchers and health care providers as a commentary session. Here, the old model, the first revision of the old model, and a draft survey were presented to 30 participants, and a discussion was held on these. In the second step, they collected data from a broader sample (*n* = 153) with different backgrounds via the survey from the first step. In the last step, 316 clinicians from six specialties examined the new model with a survey. Revising the model with data from step one to step three, they have proposed the revised model in Fig. 2 (Elwyn et al., 2017).

The choice talk stage was renamed "team talk" in the revised model. Elwyn et al. (2017) reported that the suggestions on the name generally clustered around the term "team" indicating a supporting relationship between the parties in the process. During the model reviews, "active listening" was added as an additional term to emphasize the skill's importance in the SDM process. They stated that the model still supports decision aids, and they can fit naturally into the option talk stage. The final adjustment was the flow of the model. While the previous model depicted a more linear approach, the revised model emphasizes the fluidity between stages. However, the collected data from participants showed diverse opinions on fluidity. While half of the participants preferred the fluid representation, over 35% preferred the linear approach. To address the diversity, they numbered the stages but depicted a two-way connection between all stages (Elwyn et al., 2017).

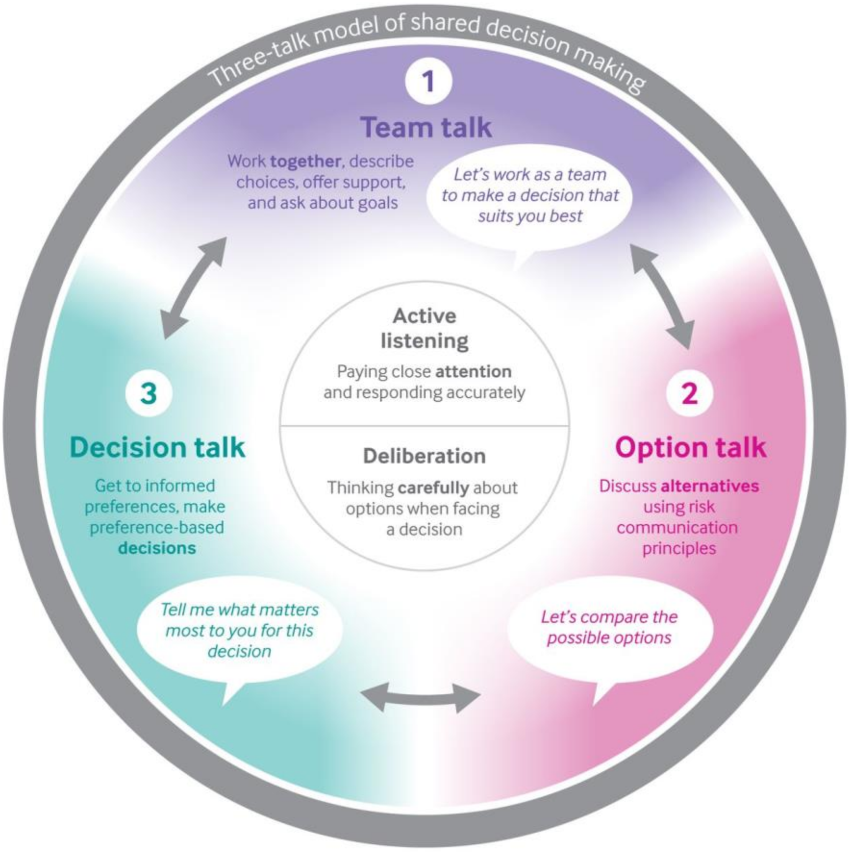

Figure 2. *The revised three-talk model for SDM by Elwyn et.al. (2017)*

Among the 316 participants in the final step of the study, the revised model was found to be understandable (67%) and helpful in practice (59%). On the other hand, the study was limited to the cultural diversity of the sample (US and UK), few patient participants, and the risk of oversimplifying the process (Elwyn et. al., 2017). The limitations in this study, the diversity of models, and how they developed indicate that SDM is still an investigation topic. There are dozens of models to practice the process; however, as Bomhof-Roordink et al. (2019) reported, some have taken more attention and informed the literature more with studies and revisions of current models. Although there is not a unified model for the process yet, as mentioned before, with the increased popularity of the topic, SDM continues to improve.

2.1.2. Outcomes of SDM Process

While models of SDM are still in development to ease the practice and get better results out of it, the current studies suggest that the practice of SDM already provides better outcomes (Hack et al., 2006; Kashaf et al., 2017; Shay & Lafata, 2015;

Stiggelbouta et al., 2015). There are different aspects in which the outcomes are examined, but results suggest that, especially in affective-cognitive outcomes, the SDM process provides improved health care services (Shay & Lafata, 2015).

Kreps et al. (1994) proposed a model to guide outcome research in the medical domain. Transformation Model of Communication and Health Outcomes(TMCHO) focuses on communication during a health care process and its outcomes from different aspects. These aspects include cognitive, behavioral, and physiological outcomes. The authors suggested that the model is applicable for interpersonal contexts and personal assessment of collecting information to decide on a health problem (Kreps et al., 1994).

Shay and Lafata (2015) used Kreps et al.'s (1994) transformation model in their review article to examine the SDM process and patient outcomes. They examined the patient outcomes with the three aspects suggested in TMCHO but changed physiological outcomes to health outcomes to cover a wider area. Affective-cognitive aspect refers to effects on the patient's possessed information, manner, and emotional state. The behavioral aspect covers the changes in health behaviors and commitment to treatments. Finally, the physiological or health aspect includes assessments of biological data, patient reports of wellness, and quality of life. In this context, the review overall included 39 studies (Shay & Lafata, 2015).

Among the three outcome aspects, the most examined was the affective-cognitive outcome (Shay & Lafata, 2015). This aspect also reported better results than the other two aspects. The review's authors stated that these results might be associated with and referenced the ethical reasons for the SDM process.

On the other hand, the fewest studies examined the health aspect of SDM, and the measurements used in those were not validated (Shay & Lafata, 2015). While physiological assessments were not included but mostly self-reports, no significant relationship was found between SDM and health outcomes. In another review study for SDM process' outcomes and type 2 diabetes, Kashaf et al. (2017) reported better results on the criteria such as patient knowledge that can intersect with affective-cognitive outcomes, while little evidence on the criteria such as glycemic control that can intersect with health outcomes. However, Shay and Lafata (2015) argued that despite the health outcomes, SDM is still essential to ensure the trust between parties during a medical consultation, provide an ethical context, and inform patients about treatments and their effects.

Studies focusing on breast cancer and SDM also provided positive outcomes for the SDM process. Hack et al. (2006) conducted a longitudinal study with 205 women with breast cancer to examine the results when women participated in the decision-making process. Their results showed that women who take part in an active role in their treatment process have a better quality of life level even after three years of treatment. Mendelblatt et al. (2006) also examined SDM and breast cancer with 715 older women. Their study revealed that women with breast cancer have higher short-term satisfaction when SDM is applied in the medical care process. However, they also found that when the medical care process incorporates SDM, women tend to report a higher influence of breast cancer in their life. Mendelblatt et al. (2006) explained this as women taking a more active part in their treatment decisions may have worried more about their health and disease. Since the SDM process aims to provide evidence-based information for patients and increase their knowledge for informed decision-making, such results may occur with the process.

Huges et al. (2018) also examined the SDM process and patient-perceived outcomes. Their results were in line with the fact that patient satisfaction was higher with greater SDM involved in the process, increasing the quality of health care and patient outcomes. However, they also found that patient characteristics impact the outcome. Such as this, many other factors are reported to hinder or facilitate the SDM process in literature to consider and work on providing better SDM (Alsulamy et al., 2020; Elwyn et al., 2010; Kuo et al., 2018; Legare et al., 2010; Oerlemans et al., 2021; Whitney, 2003).

2.1.3. Factors Affecting SDM

Elwyn et al. (2010) stated that for SDM to be a common method of application, three conditions are needed, which are 1) having evidence-based information, 2) processing pros and cons of options, and 3) assistive clinical environments. However, providing these can depend on the factors related to these conditions and parties in the consultation process. Therefore, some barriers and facilitators exist for the SDM process to actualize (Elwyn et al., 2010).

Among the barriers to the SDM process, however, Legare et al. (2008) indicated the lack of scientific evidence for that; the conducted reviews showed that the time barrier is the most commonly reported one (Alsulamy et al., 2020; Legare et al., 2008). The SDM process is hard to incorporate into the medical consultation due to limited time and different institutional practices. Clinicians may have time pressure since they generally have predetermined time intervals for each patient and tasks they must complete during these intervals, such as filling out official documents. This constraint also hinders active listening and providing adequate information (Elwyn et al., 2010).

Lack of applicability is another commonly reported barrier to the SDM process (Legare et al. (2008). This inadequacy may depend on both the patients' characteristics and the circumstances. If there is the use of decision aids, those materials may not be understandable by patients or may not apply to clinicians' workflow. It is important that the information provided to patients should be accurate and evidence-based so that patients can understand it while clinicians use it confidently (Elwyn et al., 2010). Grenfell and Soundy (2022) also emphasized that conveying information in an understandable and accessible way aids patients in making decisions for themselves.

As also cited by more recent studies, power asymmetry in the patient and clinician relationship also hinders the SDM process (Alsulamy et al., 2020; Oerlemans et al., 2021). Whitney (2003) argued that the SDM process provides an environment where patients can have their concerns listened to by the health care providers. While patients are the authority figure for their bodies, clinicians can become more powerful figures in clinical practice as consultants and providers of care. Under these circumstances, it is possible that patient does not believe in their active part in the decision-making process. Any lack of curiosity or interest in the information provided by patients can intensify the existence of this barrier (Oerlemans et al., 2021). In the same way, Grenfell and Soundy (2022) argue that in the context of physiotherapy, breaking this power asymmetry is one of the fundamental factors in increasing the confidence and involvement of patients during a consultation.

Some beliefs and characteristics from the patient's perspective may hinder the SDM process, too. Among these factors, Alsulamy et al. (2020) stated that "clinician knows the best" is the most common. Patients may believe that as experts, clinicians can only make decisions related to their health. In their review of the use of SDM in physiotherapy, Grenfell and Soundy (2022) observed that "clinician knows best" phenomenon may result from the one-way trust from patient to doctor. Therefore, building a two-way trust between parties in medical consultation is essential. Patients may also believe that involving too much may result in being perceived as problematic patients, or they may directly have difficulties communicating with the clinician. It is also possible that patients may not be aware of their preferences to participate enough in the process (Alsulamy et al., 2020; Kuo et al., 2018).

As there are barriers from patients' perspectives, there are also barriers reported from clinicians' perspectives. Alsulamy et al. (2020) reported in their umbrella review, 24 studies from two review articles identified the barrier of clinicians' lack of active listening to patients. There may be a false belief among clinicians that patients do not want to participate in decision-making; as Grenfell and Soundy (2022) argue, clinicians may overall abandon the practice of SDM. It is also reported that clinicians show little interest in patients' ideas or may have low levels of social skills to properly connect with the patients (Alsulamy et al., 2020).

As there are barriers to the SDM process, there are also factors that facilitate it. Oerlemans et al. (2021) suggested that the training of clinicians is one of the most critical factors in improving the SDM process. Topp et al.'s (2018) study is found that while young physiotherapists have more information about the SDM process, older physiotherapists reported more use of SDM in consultations which may indicate the need for training about the topic. Therefore, it is needed to inform the clinicians about the SDM process adequately and motivate them that SDM will provide better results for patients and medical consultations. Using a language that patients can understand while informing, revealing patients' preferences, and active listening are important facilitators from clinicians' perspectives (Alsulamy et al., 2020).

From the patient perspective of facilitating factors of SDM, it is needed to convince patients that they can participate in the process. For this, Alsulamy et al. (2020) suggested that patients need to acknowledge that they can ask questions confidently, understand that they are one of the experts in the consultation process, and finally, perceive themselves as responsible for involving in the final decision.

There are also some environmental factors suggested as facilitators for the SDM process. The first of them is time adjustments, as the most reported barrier. A consultation process must have enough time to fulfill the requirements of SDM.

Another factor can be providing relevant decision aids that may ease the communication or information sharing problems between parties. It is also stated that incorporating SDM into NHSs and providing relevant decision aids in EHRs can facilitate SDM (Alsulamy et al., 2020; Elwyn et al., 2010).

Overall, the current literature suggests that the practice of SDM can provide an ethical base and improve health care services. However, there are barriers to applying SDM to health care in the status quo; there are also facilitator factors. For a structured and uniform SDM process, various models have been developed and are in development. However, as Elwyn et al. (2017) reported in their article on revising the three talk model of SDM, training may require practicing the process properly. Similarly, while SDM is gaining popularity and increasing in awareness, as Topp et al. (2018) reported for physiotherapists, a certain level of experience may be needed to practice it together with training.

2.2. Serious Games

This section provides state of the art in serious games. The development of the field, the implications of its use, specifically the use of serious games in the health domain, and as related to the topic of this thesis, decision-making studies with SGs are provided.

Serious games, as a term, was first introduced by Abt (1970). He proposed the term and the type of games that the name suggests, targeting the educational domains. Abt (1970) argued that serious games could address the inadequacies in the education system in America in the 70s as well as increase the motivation for learning. Therefore, unlike the modern and broader definition given by Dörner et al. (2016), he defined the term as games with educational goals and not played only for entertainment. In his view, serious games were cost-effective that they were not expensive and could provide harmless environments to test and experience certain goals (Abt, 1970).

After Abt (1970), in 1972, the company Magnavox released *Odyssey*, the first game console usable at home (Dörner et al., 2016; Laamarti et al., 2014). This console and the games playable on it are considered one of the earliest serious games as the company marketed it for both entertainment and educational purposes. In 1974, the game *Oregon Trail* was released, again with educational purposes, to teach colonialism in America. This game is still used on various platforms and is considered another keystone for serious games (Dörner et al., 2016; Laamarti et al., 2014).

Outside of educational domains, in 1981, Atari company developed the game *Bradley Trainer* to train newcomers in the army for the USA government (Laamarti et al., 2014; Wilkinson, 2016). In the continuing years of the 80s, several games were also developed, and some are also considered to have advertising and exercising goals (Dörner et al., 2016; Laamarti et al., 2014).

In 2002, the USA army itself developed a game called *America's Army* (Laamarti et al., 2014; Wilkinson, 2016). This game aimed to be used as a hiring method and advertising the army. Laamarti et al. (2014) and Wilkinson (2016) reported that *America's Army* was considered the first well-structured SG widely used by the public domain. After this point, serious games started growing rapidly both in academic and industrial domains. Especially in academia, the growth was exponential. (Laamarti et al., 2014).

Dörner et al. (2016) explain this interest in SG with six factors. According to them, SG can 1) provide a fun experience with 2) increasing the users' motivation for a certain goal which can 3) induce active engagement. Thus, 4) the expected goal achievement can be greater with SGs than other tools used for the same goal. 5) As flexible and adaptable tools with the opportunity for immediate feedback, 6) SGs can also provide an alternative where a tool to reach a certain goal is unavailable (Dörner et al., 2016).

These factors and SGs increasing popularity gave rise to the usage of SGs in different fields and with various goals. As mentioned in the previous chapter, Dörner et al. (2016) stated that those goals are named characterizing goals. For example, advertisement is a characterizing goal for an SG if it is developed with this aim. As among the main fields SGs used, health care has also benefitted them (Dörner et al., 2016). Laamarti et al. (2014) reported that the first SGs in healthcare were used to distract patients from their pains for rehabilitative purposes. Other earliest examples included psychotherapeutic usage, such as controlling a certain behavior. In 2002, these led to the emergence of the first conference on the usage of SGs in the health care domain, which is called Games for Health (Laamarti et al., 2014).

2.2.1. Serious Games in Health Care

In the years following the first examples of SGs in health care, the number of studies and the variety of goals SGs used increased (Wattanasoontorn et al., 2013). In the review made to see state of the art in this context, Wattanasoontorn et al. (2013) examined 108 articles published between 2004 and 2012. The results showed that most of the studies focused on training professionals (24.07%) together with health and wellness (23.15%). Other than those two, training of non-professional agents (14.81%), rehabilitation (13.89%), and treatment (12.04%) were other topics studied substantially (Wattanasoontorn et al., 2013).

A more recent review by Warsinsky et al. (2021) showed a different and shifting focus on the topic. In this review, 206 papers were reviewed to see the state of the art in health care regarding SGs used, but they also included studies using gamified systems. In those studies, about half of the (48.1%) games are found to be on individual lifestyle habits. Disease management and rehabilitation contexts followed lifestyle habits with 38.3% of the reviewed papers. Finally, they reported that 23.3% of the studies dealt with the education and training of health professionals (Warsinsky et al., 2021).

Looking from the player perspective of the games, SGs designed for patients focus on health monitoring, detection of symptoms and diseases, rehabilitation, mental health, education on health problems and social challenges (Sharifzadeh et al., 2020; Wattanasoontorn et al., 2013). For example, physiotherapy is one of the health care domains SGs developed for the use of patients. The characterizing goal in those games generally consists of exercising. SGs are helpful in that context since, as Fraiwan et al. (2017) explain, patients may not always be able to cover the cost of the treatment, or repetitive involvement can lead to a decrease in motivation to attend. Also, depending on the culture, female patients may not want the involvement of male specialists in the process, or if the exercises can be executed at home, the accuracy of the exercises may decrease (Fraiwan et al., 2013). In that sense, Ling et al. (2017) argued that these games can increase patients' motivation and adherence to therapy programs and help distract patients’ attention from painful physical activities.

From the health care provider perspective, games focus on clinical proficiency, decision-making abilities, and knowledge assessment, mainly emphasizing providers' education and training (Gentry et al., 2019; Sharifzadeh et al., 2020; Wattanasoontorn et al., 2013). In line with Dörner et al.’s (2016) six factors, SGs can provide a safe environment to train health providers in risky situations and increases patient safety (Ricardi & De Paolis, 2014; Sharifzadeh et al., 2020). Games' intrinsic motivation and entertainment value increase the quality of learning (Ricardi & De Paolis, 2014; Vugts et al., 2018). Serious games also give a learner-oriented approach in which players can control the learning process and become more active, which may not be found in traditional teaching methods (Ricardi & De Paolis, 2014). As games have reduced costs and open-source options compared to other learning tools, they can help low-income countries in increasing educational standards (Ricardi & De Paolis, 2014; Sharifzadeh et al., 2020).

Supporting the concept of educating and training health care providers with SGs, Sharifzadeh et al. (2020) reported that students and medical specialists take serious games as a significant and beneficial learning tool. Learners using SGs feel responsible for their actions in games and benefit from the immediate feedback games can provide (Kaczmarczyk et al., 2015). However, Gentry et al. (2019) drew attention to the fact that serious games may lead to fewer experiences with patients, questions asked during the learning period, and discussions. Therefore, it is better to be used with supervision or the support of a lecturer.

The abovementioned reasons led to many developed SGs for health care providers to train, educate or provide a space for practicing various skills. For example, Olgers et al. (2021) conducted a literature review to examine the validation of games developed to train health care providers in technical skills like surgical skills. They found 2006 articles but included only 17 of them. The exclusion criteria of 121 articles were to be focused on non-technical skills like knowledge, attitudes, communication, or cognitive skills. Sharidzadeh et al. (2020) also conducted a review to see the state of the art of using SGs in health care but targeting all types of users. Among the included studies, 42 targeted health care providers. Sharidzadeh et al.’s (2020) review also showed that while knowledge assessment and clinical competency following it are the most studied with SGs, decision-making and social skills were among the least studied topics.

2.2.2. Serious Games on Health Related Decisions

As Sharidzadeh et al.’s (2020) study showed, very few studies focused on decision-making in health care, especially with health care providers. The review of

Sharidzadeh et al. (2020) revealed three games with a decision-making focus for health care providers, while there were none on the patient side included in the review. On the other hand, the literature review revealed one game as being related to decision-making on the patient side. While there are three games with a decision-making focus found on the provider side, one of the games was not available for full-text options and could not be evaluated.

On the patient side, Reichlin et al. (2011) developed *Time After Time*, a serious game to aid patients with localized prostate cancers in selecting the best treatment choice in line with their preferences. The game concept was derived from a qualitative study with prostate cancer survivors, where they explained how their decision-making process occurred. In the game, players experienced the short and long-term effects of four different treatment options reflected on health-related quality of life. The game resembled a card game where players were given different combinations of cards for each treatment option and time period (Fig. 3). Side effects of treatment options in the relevant time period were written on the cards, and players had to rate them on a 5 points scale based on his/her preferences. Players were also introduced to a spinner that hands out the side effect cards from 5 different domains for the treatment option and time period and reflects the probabilities of side effects to occur (Reichlin et al., 2011).

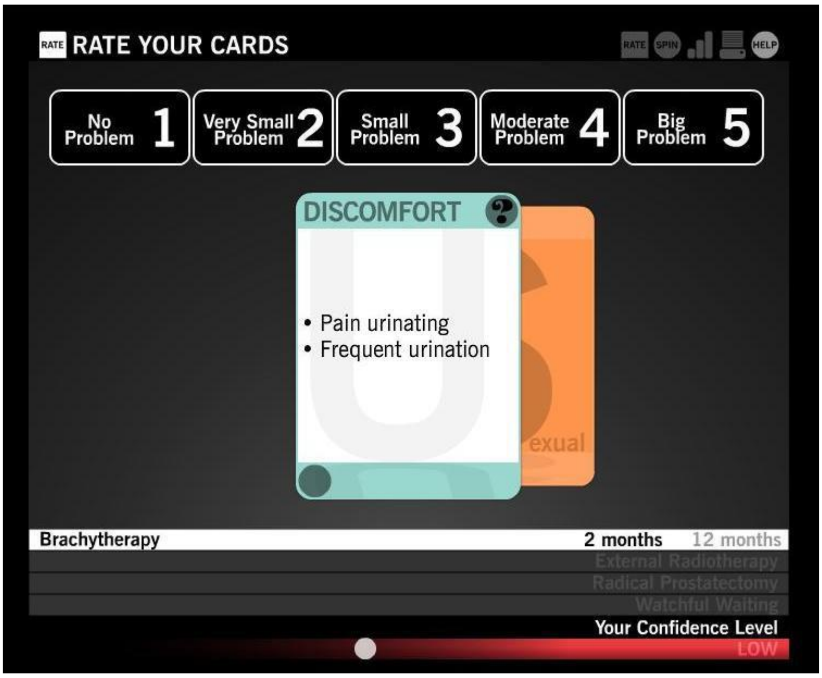

Figure 3. *Gameplay of Time After Time game developed for prostate cancer patients (Reichlin et al., 2011)*

When players finished rating cards in all treatment options and time periods, round 1 of the game ended. Reichlin et al. (2011) stated that although players do not have to play consecutive rounds, playing them helps to see different side effects that can occur. At the end of each round, players were given a summary of their choices in a ranked list. It is also possible to save a card during the gameplay or raise a question in a list to discuss with health care providers later on. The assessment of the game was made through interviews. The study results showed that most participants perceived the game as a useful aiding tool in the decision-making process. However, participants in the study also reported that the game needs more detailed explanations for the side effects and the game's goal, together with the ability to personalize the game with user input (Reichlin et al., 2011).

On the health care provider side, among the three games founded, Kaczmarczyk et al. (2016) developed an SG for decision-making in the acute management of tachyarrhythmias which is a situation related to abnormal heart rhythms. The game used videos filmed during the development process as the graphical representation. Players, as the junior doctors in the game, presented a video accompanied by multiple-choice options (Fig. 4). Each choice represented a medical action, and players' decisions on those choices led to another video. The scoring system, which was visible throughout the game, provided feedback for the players. Additional feedback was also provided at the end of the game. Experts such as senior doctors and nurses prepared the information conveyed in the game. The game was assessed by questionnaires and focus group interviews. The results of the study showed that participants found the game motivating. They reported that the game created a sense of competition; thus, they wanted to play it until they could reach the highest score. However, as the authors developed the game for improving decision-making skills, they reported as a limitation that the study did not include an assessment in that sense (Kaczmarczyk et al., 2016).

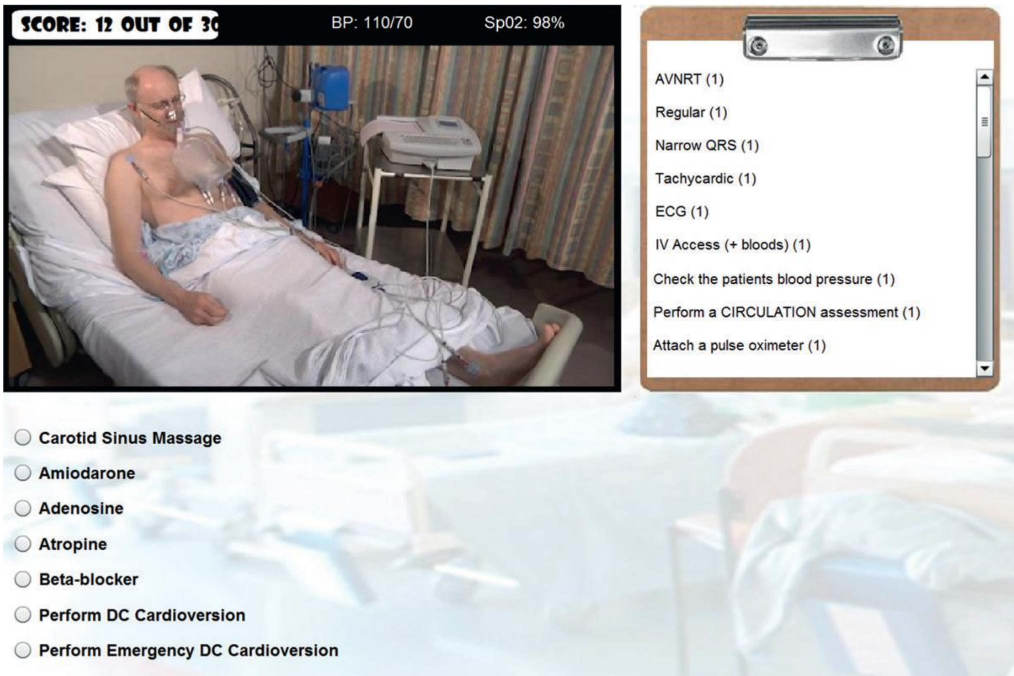

Figure 4. *Gameplay of developed decision making game by Kaczmarczyk et al. (2016)*

The final study was by Johnsen et al. (2016) to teach nursing students clinical reasoning and decision-making. The study focused on home care of chronic obstructive pulmonary disease patients. As with the study by Kaczmarczyk et al. (2016), the authors developed the game using videos filmed for this study specifically.

Videos included a nurse and the patient in care. The game setting was also similar to Kaczmarczyk et al. (2016), as players watched videos and decided on choices related to the content of the videos. However, the type of questions varied, like multiple choice or drag-and-drop questions. The game was planned to be linear, where players could not move further without answering a question. Feedback was provided by the nurse in videos in the game based on the given answers to questions. Players were provided a score based on their answers at the end of the game. The assessment process of the game included Post-Study System Usability Questionnaire, cognitive walkthrough, and semi-structured interviews. The results showed that participants found the game helpful to use before a real-life scenario similar to the one in the game. However, they also reported that some of the tasks were complex and videos were long, while feedback could be more (Johnsen et al., 2016).

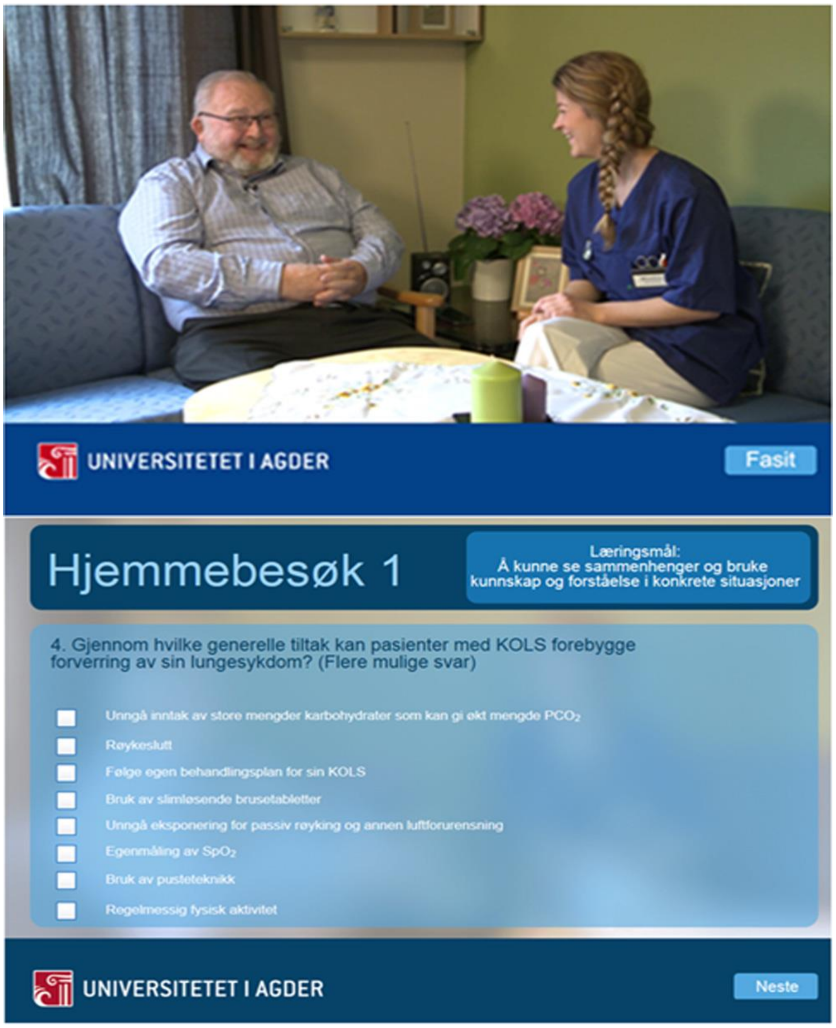

Figure 5. *Gameplay of developed serious game for nursing students (Johnsen et al., 2016)*

The examples show that literature on SGs and health care does not include many decision-making studies. On the other hand, those mentioned games focus on decisions made by only one of the parties in a health care service. However, the literature suggests that decisions in health care involve two experts where patients and healthcare providers should communicate, which the SDM process describes (Alsulamy et al., 2020). While the Time After Time game may include elements of SDM, like informing a patient about treatment's side effects to help them choose the proper treatment, the authors do not mention SDM in their article. This may also be because SDM is not a rooted practice in the medical domain known by all health care providers despite its increasing popularity (Topp et al., 2018). The literature review showed that there is no study designed for combining SDM and SGs, while SGs can provide a safe space for clinicians as in the abovementioned decision-related studies and may increase the awareness of the process.

2.3. Objective Structured Clinical Examination

This section of the literature review examines the research on OSCE. The information on what is an objective structured clinical examination, its emergence in literature and application, what an OSCE does and assesses, its benefits and disadvantages, considerations for reliability and validity of an OSCE, and finally, its use with SDM and SGs are provided.

Health care providers need to improve themselves in various skills as professionals in practice (Epstein & Hundert, 2002). These include clinically relevant skills, communication skills, and skills related to the assessment of patients. Though, as Ribeiro et al. (2019) suggested, candidate providers may not be able to identify their inadequacies in those skills when uncertain about expected competencies or until they come to face with a patient. OSCE is a tool that can help medical agents to identify these inadequacies while assessing their performance.

Khan et al. (2013) suggested a definition for OSCE by integrating various other description as the following:

> An assessment tool based on the principles of objectivity and standardisation, in which the candidates move through a series of time-limited stations in a circuit for the purposes of assessment of professional performance in a simulated environment. At each station candidates are assessed and marked against standardised scoring rubrics by trained assessors. (p. e1440)

As stated in the description, OSCE consists of different stations where each station tests a different competency, such as physical examination. Therefore, it gives an opportunity to assess medical agents for various skills and domains (Khan et al., 2013).

The first OSCE was developed by Harden et al. (1975). Before the OSCE method, there were two methodologies in use. The first was a short case examination in which candidate health care providers clinically assessed a couple of patients. The second was a long case examination in which a patient underwent a complete examination by candidate health care providers. However, in those two types of examinations, the scoring was problematic since there was no structured marking scheme. In addition, patients and assessors were changing between sessions, creating variations in the examination between candidates (Khan et al, 2013).

Those deficiencies and limitations were questioning, and Harden et al. developed the first OSCE in 1975 to decrease the amount of confounding variables and present a standardized methodology in clinical examination. Apart from clinical skills and knowledge, it is aimed to assess candidates for approaching clinical problems, their behavior, and effective communication.

By the time OSCE proposed, it perceived as a tool to evaluate various competencies of candidates (Khan et al., 2012). However, more recent literature went through a differentiation between competency and performance in OSCE research. Khan and Ramachandran (2012) suggested that OSCE is used for performance rather than competency assessment. While latter is a degree of achievement or success in a skill, OSCE assesses the performance on competencies and as emphasized by Khan et al. (2013), it does that in specifically under simulated circumstances.

The simulated part was emphasized because Khan and Ramachandran (2012) proposed that OSCE performance does not necessarily predict performance in real-life practices. Here, Miller's (1990) model for assessment can clarify this context (Fig. 6) (Khan et al., 2013; Rushforth, 2007). The model's first two steps represent the assessments made by traditional examination methods. The last step, "does" represent the performance in real-life practices. On the other hand, the third step "show how" is assessed by tools like OSCE, which are simulated environments where the setting of the assessment is adjusted to replicate the real-life circumstances as much as possible but still structured and standardized for the assessment tool (Khan et al., 2013; Rushforth, 2007).

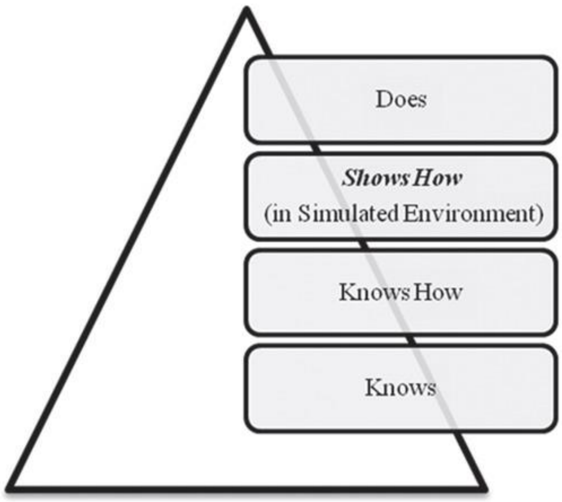

Figure 6. *Miller's (1990) model for assessment.*

As such tool, today, OSCE is a decent methodology for assessment in the health domain (Ribeiro et al., 2019). Patricio et al. (2013) reported that its use and research increasing continuously since 1975, and the increase has accelerated since 2005. It is considered a multicultural tool in more than 50 countries. The number of health domains implemented is over 25 (Patricio et al., 2013).

As one of the health domains OSCE is utilized, Ribeiro et al. (2019) conducted a literature review on OSCE usage in physiotherapy. They included a total of seven articles in their review. As the result of their review, they reported that further studies were needed since quality research on OSCE and physiotherapy was scarce in the literature because OSCE has some drawbacks, such as time, cost, or requirement of proper training of patients. However, they also concluded that it is a suitable tool for assessment or providing feedback in learning (Ribeiro et al., 2019).

On the other hand, John and Deshkar (2014) conducted a study to see the physiotherapy student's perspective on having an OSCE for an osteoarthritis knee condition. They developed an OSCE with 14 stations and applied it to third-year students while taking master students as observers for the examination. As a result of the study, most students and observers perceived the examination as fair and a tool decreasing the possibility of failing. About half of the students found the exam well-structured. John and Deshkar (2014) argued that OSCE is also a good learning tool where students can identify the points of improvement in them and work on these.

While most of the research on OSCE focused on assessing candidate health care providers in undergraduate degrees, it actually has a wide range of usage (Khan et al., 2013; Patricio et al., 2013). For the target audience, OSCE is used for postgraduate students and professionals together with undergraduate students. For the implementation aim, it is used as feedback, licensure, and foreign registration tool (John & Deshkar, 2014; Khan et al., 2013; Patricio et al., 2013). This quality makes OSCE a flexible tool as one of the benefits of using it (Patricio et al., 2013).

2.3.1. Advantages and Disadvantages of Using An OSCE

As Patricio et al. (2013) stated, OSCE gained popularity years after its emergence. In this trend, the advantages it provides are compelling. The first of these advantages, and one of the reasons OSCE emerged in the first place, was the standardization and, in line with that, the objective quality it provided (Rushforth, 2007; Watson et al., 2002). This advantage is also related to other advantages the OSCE tool brings. These are decreasing the chances of different assessors evaluating examinees and examinees having the same experience due to adjusted examination circumstances (McKnight et al., 1987; Rushforth, 2007).

Another advantage is that examinees perceive the method as favorable (John & Deshkar, 2014; Roberts & Brown, 1990; Rushforth et al., 2007). This may also enhance the learning quality of OSCE, which is another advantage proposed (Bartfay et al., 2004; Khan et al., 2013; Rushforth et al., 2007). Khan et al. (2014) related this learning advantage to the OSCE's nature as a real-life simulation. Since examinees are provided feedback after the examination, if the simulated circumstances can reflect the real-life circumstances well, it is possible to take valuable lessons from the process regardless of the examination outcome (Khan et al., 2014).

Patricio et al.'s (2013) review also revealed that OSCE is a feasible tool for various domains in health, showing its flexibility and versatility for implementation. It is also reported that OSCE has high levels of reliability and validity (Bartfay et al., 2004;

Rushforth, 2007). However, Rushforth (2007) had various suggestions on the context of reliability and validity of OSCEs.

The review made by Rushforth (2007) argued that to avoid issues with inter-rater reliability, it is better to use more than one assessor during an OSCE. While considering internal consistency between stations, evaluating the number of stations and what these stations are essential. For test-retest reliability, using actors for simulated patients rather than trained patients or volunteers brings better outcomes. Finally, in general, it is required to assess the reliability and validity of each OSCE since each developed OSCE focuses on a different health domain with different medical conditions and changes the number of stations (Rushforth, 2007).

While having the abovementioned advantages, there are various reported disadvantages for OSCE. The main disadvantage reported in the literature was the stress on examinees imposed by the examination (Bartfay et al., 2004; McKnight et al., 1997; Ribeiro et al., 2019; Rushforth, 2007). However, Rushforth (2007) also stated in his review that stress is also considered as a factor enhancing the OSCE's reflection of real-life practices.

It is also concerning that OSCE applied in various stations causes a deficiency in the evaluation of examinees holistically (Rushforth, 2007). Therefore, it is crucial to design the process; so that different stations do not entirely consist of different elements. Khan et al. (2013) also emphasized considering this issue and avoiding isolated evaluations between sessions as much as possible.

Another main disadvantage is the complexity of the implementation of the process (Bartfay et al., 2004; Patricio et al., 2013; Ribeiro et al., 2019; Rushforth, 2007). Implementing an OSCE requires finding assessors, simulated patients, substantial time, and financing to provide those people. Rushforth (2007) suggested using actors for patients instead of volunteers for at least a standard quality. While it may not be possible for all institutions to provide these, the complexity of the process requires examinees to take the exam in different groups, making it hard to control the confidentiality of the exam. However, in their review, Ribeiro et al. (2007) reported a study by Snodgrass et al. (2014) and argued that it could address some of these issues.

Snodgrass et al. (2014) designed an online OSCE that is adjustable for different health domains. The study was conducted with students from physiotherapy and occupational therapy. The process management was still in the hands of the examiners, and students completed the process as in traditional methods. However, an online system on iPad was used to mark and provide feedback for students. The system sent feedback to student e-mails. At the end of the process, examiners' views were collected. The results showed that although there were limitations and improvements to be done, examiners found the online OSCE easy and would choose over traditional methods (Snodgrass et al., 2014). Ribeiro et al. (2019) suggested that this type of technology may address issues with financing OSCEs, required time, and other costs.

2.3.2. OSCE, Shared Decision Making and Serious Games

Communication skills are one of the core components of health care services. Therefore, OSCE was also used to assess the performance of health care providers in that context (Cömert et al., 2016). On the other hand, SDM is a suggested process to practice in health care services and requires good communication skills (Alsulamy et al., 2020). However, while communication skills and OSCE are studied, there are not many studies with SDM and OSCE in the literature (Edmonds et al., 2019). Some studies use OSCE to assess SDM knowledge (Hsiao et al., 2202; Kupke et al., 2012), but these studies use OSCEs designed for communication skills rather than OSCEs designed for SDM.

There are two studies in the literature that designed an OSCE to assess the practice of SDM (Tucker Edmonds et al., 2019; Tucker Edmonds et al., 2020). However, both studies reported no reliability and validity assessment of the designed OSCEs. Instead, these studies reported how the participants performed in those examinations and what parts they failed in SDM related to the medical condition in the OSCE. Though this may provide valuable information in terms of the practice of SDM in the relevant medical condition, both fail to provide sufficient information on the OSCE and its design process.

The first of these studies devised an OSCE to assess fourth-year students in medical school in the context of periviable obstetrical care. The medical condition depicts issues related to premature birth, where the probability of living for newborns is very low (Tucker Edmonds et al., 2019). The number of OSCE stations was not specified, but the required time for each station was 15-20 minutes. For assessing the participants, a coding scheme with 10 elements was created. Three assessors took place during the examination and inter-rater reliability changed between 46.1% to 96.1% for different elements in the scheme. Later discussion of assessors increased the IRR to 100% (Tucker Edmonds et al., 2019).

In the second study, an OSCE was designed to assess SDM in the trial of labor after cesarean counseling (Tucker Edmonds et al., 2020). The article specifies neither the number of stations nor the time given. A 10-item coding scheme was prepared for the OSCE. The study took place over three years. Each year, different cases were developed for the simulation, and participants were from higher grades. The number of assessors and IRR are not reported. However, the preparation of patients in the simulations and backgrounds of the stories are depicted in detail (Tucker Edmonds et al., 2020).

While these two studies were the only ones found to develop an OSCE for SDM, they only focused on reporting participants' performance on the examination. On the other hand, Wamboldt and Loughran (2017) published a book to guide the examinees for OSCE in communication-related skills. The book includes a section for the SDM and provides information on how to manage the SDM process in an OSCE through a generic scheme. Although this may have less scientific value since the scheme is not specific to a health domain or a medical condition and, therefore, has no reliability and validity assessment, it may be used to guide an SDM process along with using the SDM models proposed.

On the other hand, as Ribeiro et al. (2019) suggested with Snodgrass et al.'s (2014) study, new technologies could be used to design an OSCE. In that sense, serious games can serve as a medium to implement OSCEs (Roman et al., 2022). While there are studies that used serious games as an intervention method and then assessed participants with OSCEs (Akbari et al., 2022; Alyami et al., 2019; Aksoy & Sayali, 2019; Aster et al., 2022; Meyer et al., 2011), serious games designed as an OSCE were few in the literature. A total of three games exist for the latter purpose (Faria et al., 2021; German et al., 2020; Roman et al., 2022). While these studies, which designed an SG for OSCE, evaluated their results with usability scales, interviews, and other scores, how the OSCEs were used in these games was not detailed.

In the study of Germa et al. (2020), an SG called *OSCEGame* was developed. For the OSCE in the game, one applied previously in the researchers' faculty was taken as the base, and six stations in it were adjusted. Fourth and fifth-year dental students played the game. Data collection methods included an ad-hoc usability scale and a Visual Analogic Scale to measure anxiety. As a result of the study, *OSCEGame* was found to be a good tool for applying an OSCE with reduced anxiety and working on time management. However, mostly the fourth-year students, who were unfamiliar with the OSCE, gave these favorable responses. In a question asked, while the most preferred method was a mock examination, the SG came after that. The evaluation of the game with an ad-hoc questionnaire revealed that the game was long and more feedback was required (Germa et al., 2020).

The next study is by Faria et al. (2021). They developed a game called *OSCE 3D*, a virtual reality game. The OSCE used in the game was prepared for third-year medical students, and further information on the structure of the OSCE was not provided. System Usability Scale (SUS) was used to assess the game. The study reported a good usability score for the game, with an average of 75.4.

The final game is by Roman et al. (2022). The game was prepared for nursing students as the setting represents an Intensive Care Unit. The OSCE in the game is designed for decision-making for various conditions. However, the structure of the OSCE was not specified. Focus groups and semi-structured interviews were the data collection methodology in the study to evaluate students' perceptions of using a game for OSCE as an online assessment. The results showed that the game as an online assessment was useful and objective. However, this study focused on the online assessment context rather than testing the SG as an implementation of OSCE (Roman et al., 2022).

Those three studies used SGs to implement an OSCE for different purposes. The assessments made by studies differed in each, but none focused on the used OSCEs' validity. Rushforth (2007) argued that each OSCE should be evaluated for its reliability and validity. Roman et al. (2022) also did not evaluate the SG used in their study and focused on the online assessment in which the SG is the medium. While further research using SGs to implement OSCE should be more explicit on the OSCEs used in studies and evaluate both the OSCE and SG with more structured methodologies, the reported results show that participants in favor of using SGs as a medium to implement an OSCE (Faria et al., 2021; German et al., 2020; Roman et al., 2022).

The literature review on shared decision-making, serious games, and objective structured clinical examination showed that all of the concepts are topics of interest and perceived as valid tools or processes to utilize in relevant domains (Alsulamy et al., 2020; Laamarti et al., 2014; Patricio et al., 2013). While there are studies that utilized some of them together for research, no study in the literature aimed to use those three together.

CHAPTER 3

METHOD

This chapter is dedicated to the methodology used in this thesis. Specifically, information on the study's design, the game development process, the data collection process for game design and usability study, and materials used in these steps are provided.

This research aims to develop a serious game for physiotherapists to practice a shared decision-making process and test the usability of this game as a pilot study. For this, a mixed method design was adopted in which the development procedure included qualitative data, and the usability testing quantitative data. As mentioned in the first chapter, a guide on SDM for OSCE was used to design the game along with the three talk model of SDM proposed by Elwyn et al. (2017).

To actualize this aim, the process shown in Figure 7 was followed. First, a literature review was conducted to create a conceptual framework for informing the game. Then, when a concept emerged, the development process of a dialogue-based, linear simulation game started. This process was iterative, in which the game changed continuously. When the prototype was ready, a semi-structured interview was held with two participants, who are experts in shared decision-making or physiotherapy, to gather feedback about the game before using it in the usability study. That feedback provided some directions for the adjustments of the prototype, and the final game was named *PhysioInformed*. 20 participants played the game *PhysioInformed* online and filled out the System Usability Scale and a part of Intrinsic Motivation Inventory (IMI) to assess usability. As the final step in the study, collected data was analyzed, which the next chapter presents.

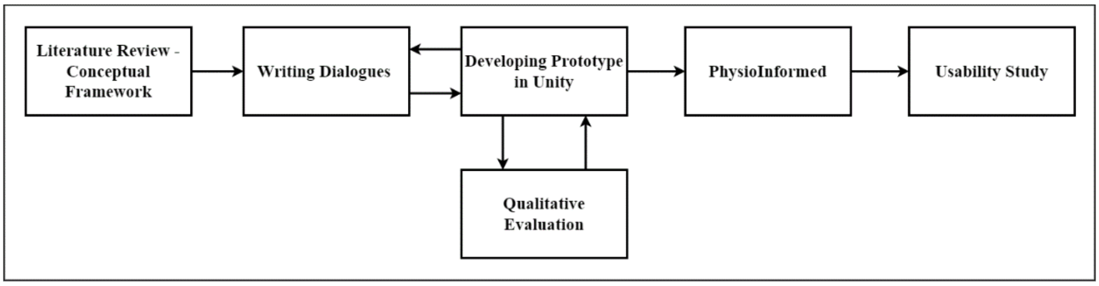

Figure 7. *The flowchart showing the process of developing the game, PhysioInformed.*

3.1. Conceptual Framework

PhysioInformed requires implementing an SDM process during a physiotherapy consultation into the game, and therefore, a theoretical base was needed to inform the game. This base was provided in three steps. Firstly, an SDM model was used to create a general framework. Second, an OSCE guide was used to inform the game about the SDM process. Finally, since the game needs to represent a medical consultation process in the physiotherapy domain, a sample medical condition and information on that condition were needed.

The game adopted the three talk model for SDM by Elwyn et al. (2017) for the general framework. As mentioned in the second chapter, Elwyn et al. are among the authors who informed the literature on SDM substantially, and they developed the model by benefitting from previous methods. The model was also a revision of the previous model (Elwyn et al., 2012) and adjusted based on experts' feedback in the medical domain.

For the OSCE implementation, the game benefitted from the guide provided by Wamboldt and Loughran (2017). This guide provides a sample and generic coding scheme for an OSCE and information on how to interact with a patient in each station. Since it is generic, a reliability and validity study of the guide is not available, but as reported in the second chapter, while few studies in the literature present an OSCE for SDM, the existing ones also did not have reliability and validity, and those did were specific to other health domains with different medical conditions. Therefore, Wamboldt and Loughran's (2017) guide was more suitable for the scope of this study.

Finally, the medical information related to physiotherapy was collected through a previous study by the supervisor's research group. They designed a tool to help clinicians during a medical consultation ("Shared Decision Making App", n.d.) In this tool, physiotherapists can choose and rank several preferences from a list with patients' guidance. Then, a multi-criteria decision-making model ranks available treatments according to the chosen preferences. Physiotherapists provided the information on the treatments as relevant to patients' preferences for that study. The current study benefitted from that information while providing the medical information used in dialogues, showing preferences to guide players in the relevant option talk step of the game, and creating in-game patient's background.

3.2. Game Development Process

3.2.1. Game Concept Generation

In the game's development process, the first step was generating a general game concept with the information gathered in the previous section. Since one of the main factors that SDM is dependent on is communication (Alsulamy et al., 2020), the game in this study is a dialogue-based game in which it tries to show basic types of questions, the ways of approaching patients, and fundamental steps. The conceptual framework provided two directions while designing the game. First, Elwyn et al.'s (2017) model for SDM making anticipates three steps in the process: team talk, option talk, and decision talk. Based on this outline, the game follows three main sections where players gather information on the consultation reason and frame the SDM process for a patient. Then, they explain available treatments, followed by negotiating options as the patient gets informed about them.

Second, the OSCE guide (Wamboldt & Loughran, 2017) depicts a nine stations process that fits Elwyn et al.'s (2017) model when clustered (Appendix A). Among these nine stations, *initiating session* (IS), *identifying reasons for consultation* (IRfC), *building rapport* (BR), *preparing for SDM* (PfSDM), *giving the options* (GTO), *assisting decision-making process* (ADMP), *and closing consultation* (CC) were taken as the main seven steps of the game. In the game, the first four stations (IS, IRfC, BR, PfSDM) correspond to the team talk step in three talk model. GTO station represents the option talk, while ADMP and CC are under the decision talk. Two additional stations, *structuring the consultation* and *process*, depict the process's overall organization and provide a clear and caring attitude. Therefore, the premises of these stations were incorporated into other steps where applicable and relevant. Each station in the OSCE guide also has several main points to structure the consultation (e.g., taking a focus history and asking open questions in IRfC station). Those are the main actions to be chosen among the given choices to players.

As shown in the given examples of decision-making games in the health domain (Section 2.2.2.), a choice base interaction was used to design the games. This study also adopts that approach and represents the ways of communication and decisions as multiple choices. However, some choices were planned to be given recursively to be able to break down some steps into several smaller steps (e.g., the points of consulting the patient, exploring the pros and cons of treatments, and sharing professional views about the treatments in ADMP station as recursive choices until they are chosen or players proceed the next part in the game).

The main idea was represented firstly in a basic form, as shown in Figure 8. The below section of the figure represents the panel where players choose from given options, and shows their parts of dialogues. The boxes on the left indicate the treatment options to select when the treatment explanation part comes, whereas the boxes on the right indicate the possible preferences taken from the SDM multi-criteria decision-making tool ("Shared Decision Making App, n.d.). As there is a time barrier discussed in the literature and consultations are made in a limited time (Alsulamy et. al., 2020), a time countdown was placed in the left upper corner while the patient vignette in the right upper corner is available to give basic information on the patient.

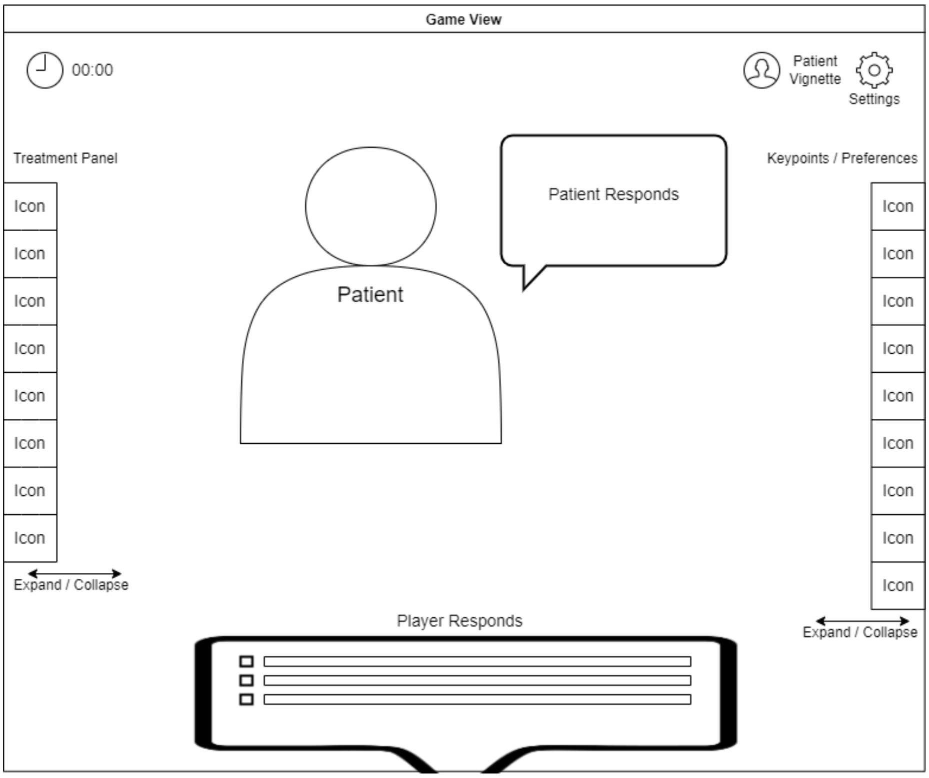

Figure 8. *Initial representation of the game concept.*

So, in the game, players take the role of a physiotherapist who tries to actualize a consultation process with a non-player character (NPC) as the patient. The choices give the player the chance to follow the SDM process according to the three talk model (Elwyn et al., 2017) and OSCE guide (Wamboldt & Loughran, 2017). The treatment and key point panels were planned to help players with navigation and to show what they have to talk about. The game aimed to represent an actual consultation process as much as possible.

After framing the main concept, different parts of the game were designed. As the three talk model suggests, the first part is the team talk step, where clinicians get to know patients, gather information about the medical situation, and inform patients about the SDM process. As outlined in Section 3.1., OSCE presents four stations here IS, IRfC, BR, and PfSDM. These four sections overall foresee a basic style of conversation between the clinicians and patients in the topics described by the team talk step. Here, while it may be possible to provide in-game interactions for diagnostic tests used, the game aims to show and create a space to practice SDM in a limited time rather than testing the diagnostic skills of a clinician. Therefore, patient NPC is introduced in the game as diagnosed with a particular condition.

For the abovementioned reason, the team talk part of the game is represented in dialogues where players direct the progress. The generic outline of this step is shown in Figure 9. Before starting the game and this step, we planned to introduce the patient with a patient history card where players can understand the medical condition they will deal with in the game and get some background information about the patient.

Following the patient history card, the time countdown starts for the game, and here, IS station of OSCE was put in which players can welcome and meet with the patient. Then, IRfC part follows to gather more information about the patient NPC's condition. In BR station, players, as clinicians, need to show their interest or respect for the patient while trying to establish his/her expectations and concerns. In the final station PfSDM, players inform the patient about the SDM process and get questions if the patient NPC has any. While this outlines this step in the game, progress is provided by given choices. Some choices can direct players to other stations, skipping the stations in between, which shows the player's performance in SDM. After completing the final station in this step, the game presents the available treatment options to players. The study with the SDM tool ("Shared Decision Making App", n.d.) included eight treatments. Here, the aim is to eliminate some treatments that are not applicable or harmful to the patient in medical terms. However, since this is a practice game and to not make it too long for players, which is reported as a downside in other studies (Germa et. al., 2020; Johnsen et al., 2016), players are asked to choose two or three treatments for the patient. With this interaction, the team talk step ends.

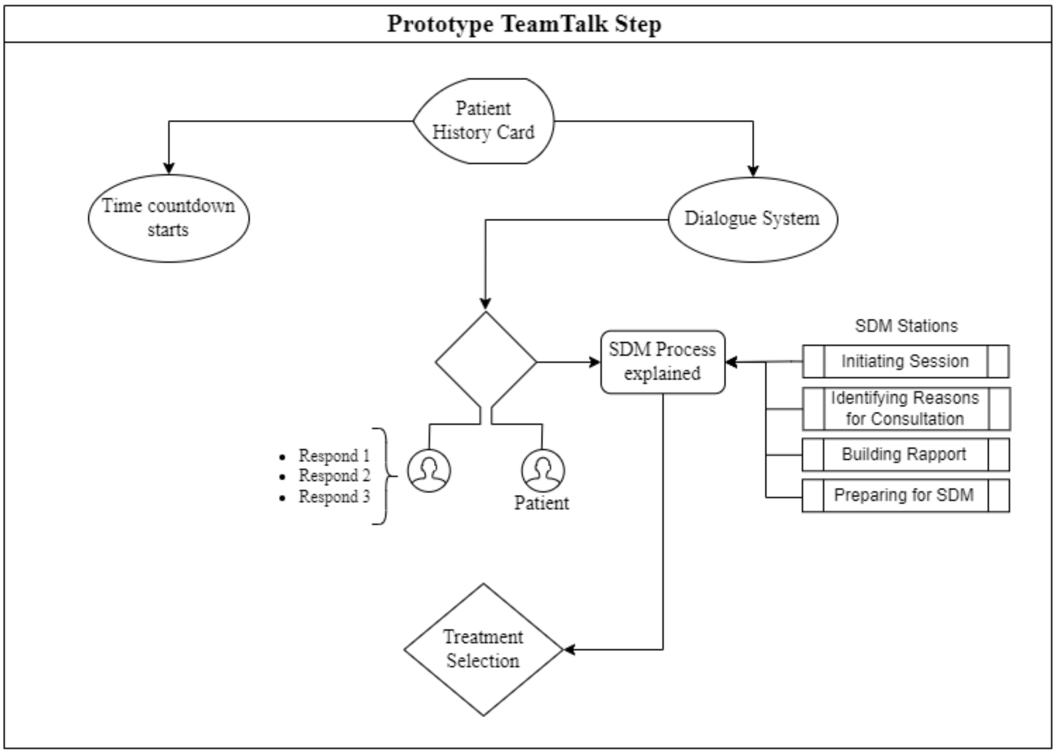

Figure 9. *The general flow of the team talk step in the game.*

Option talk, the second step of the three talk model (Elwyn et. al., 2017), is represented in the game with the GTO station of OSCE. Here, the model and the station aim to inform the patient about the treatment options and their pros and cons. Therefore, this part of the game requires navigating between treatments, and the treatments panel shown in Figure 7 is placed here. SDM also requires eliciting patients' preferences to help them in treatment decisions (Bomhof-Roordink et al., 2019). We thought explaining treatments was a suitable place to initiate conversations about preferences. The study with the SDM tool ("Shared Decision Making App", n.d.) includes nine preferences in their tool in which we eliminated *the cost* and *psychosocial improvement* due to limited information available on them and as the cost may not be relevant with different health systems and socio-economic status of patients. The seven preferences left were *pain resolved, improvement in functional abilities, side effects, discomfort caused by the treatment, treatment waiting time, time spent for treatment,* and *recovery time.* Integrating these into the dialogue, preferences were taken as the key points in this part of the game. Here, players can choose among preferences/key points while explaining treatments to inform patients about and observe their reactions to understand their preferences. However, not to tire players with seven key points for each treatment, we clustered them into three key points; 1) *possible improvement after treatment* including *pain resolved* and *improvement in functional abilities,* 2) *possible effects during treatment* including *side effects* and *discomfort caused by the treatment* and finally, 3) *time required for treatment* as including the left three preferences regarding time. These three key points provided a detailed explanation of the treatment and a way to understand the patient's perception of the treatment.

Figure 10 shows the general flow in the option talk part of the game. Upon entering this level, the treatments panel is shown to players as excluding treatment options eliminated in the team talk. As players choose a treatment, the explanation starts. After the initial talk on a selected treatment, key points panel, in which players talk more about the options, is given. Here again, players progress through the given choices for each treatment and key points. As the final interaction in this step, a ranking section appears at the end. This section aims to understand how well dialogues represented the preferences and how players could understand them. So, players are asked to rank the three key points based on importance for the patient as they understood from the from the dialogues. This interaction ends the option talk step.

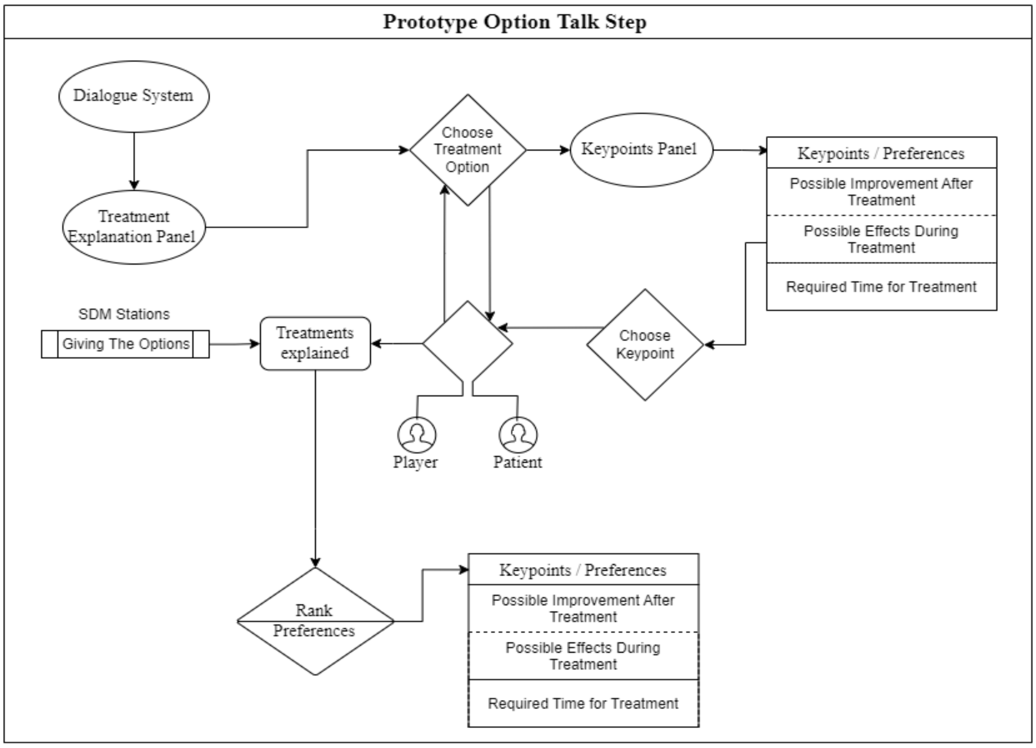

Figure 10. *The general flow of the option talk step in game.*

The final step in the three talk model and the game is decision talk (Fig.11). ADMP and CC are the relevant OSCE stations used in this step. In this part of the game, the clinician needs to discuss the treatment options with patients as they have been informed about the options in the previous step. In the ADMP station, the OSCE guide emphasizes consulting patients, sharing professional views about a treatment, and exploring the pros and cons of treatments. Therefore, the ADMP part progresses around these points. Upon choosing a treatment to prescribe, the game moves to the CC part, where the final words on the treatment are said, and the consultation ends.

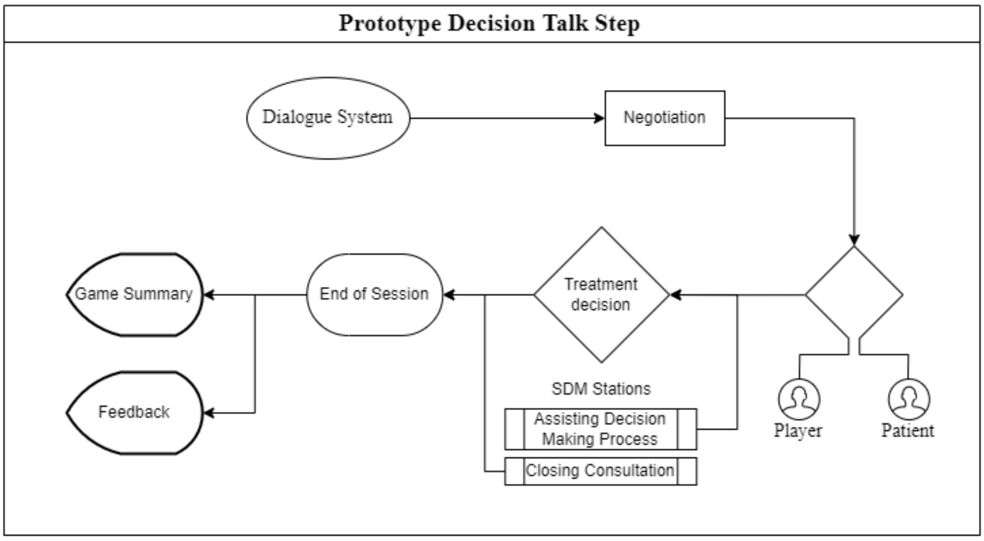

Figure 11. *The general flow of the decision talk step of the game.*

A game summary screen was planned to show players some information on the game played and provide feedback on the process followed by players. As many games include achievement sections, it was thought that feedback could be given as achievements. After examining the game summary and achievements gained, the game ends. The final step in the three talk model and the game is decision talk (Fig.11). ADMP and CC are the relevant OSCE stations used in this step. In this part of the game, the clinician needs to discuss the treatment options with patients as they have been informed about the options in the previous step. In the ADMP station, the OSCE guide emphasizes consulting patients, sharing professional views about a treatment, and exploring the pros and cons of treatments. Therefore, the ADMP part progresses around these points. Upon choosing a treatment to prescribe, the game moves to the CC part, where the final words on the treatment are said, and the consultation ends.

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The next step was prototyping the game after generating the main concept and concepts for each section. As the game developed, additional details for the game concept were added during this process. The complete flowchart of the game is in Appendix B.

3.2.2. PhysioInformed - Prototype

There were two main steps in the development of the game's prototype. These were writing the dialogues for the game and developing the game. While making these, various software and websites were used. The dialogues were first prepared in the open source desktop app of diagram.net (version 19.0.3) which has tools to create flowcharts easily. Unity (Unity Technologies, version LTS 2021.3.1f1) was used as the game engine for developing the game. It is a software that allows creating games both in 2D and 3D for various platforms. It also provides assets developed by other game developers to ease the development process. In that sense, we used several assets from other developers. Ink Unity Integration (inkle, version 1.0) was used as the dialogue system. It is an asset where you can create stories and dialogues that runs during the game. Animations was prepared with DOTween (Demigiant, version 1.2.632) animation engine along with Unity's own animation system. Hospital Medical Office Modular (Brick Project Studio, version 3.1) was benefitted for the 3D models provided for the hospital setting. Along with these, Artstation (https://www.artstation.com) and Adobe Mixamo (https://www.mixamo.com/) websites for 3D humanoid models and animations and Flaticon (https://www.flaticon.com) website for 2D sprites was used. Adobe Photoshop 2020 (version 21.1.1) was utilized to create and adjust 2D sprites.

As the first step in developing the prototype, dialogues were created (Appendix D). Since the game offers choices based on previous choice decisions, the dialogues were written in flowcharts to show each choice and its direction to other choices. The dialogues and the choices were prepared based on the points given in each station of OSCE. For example, IS station includes points as welcoming patients, introducing yourself, and getting the context of consultation. These were turned into choices that demonstrate relevant dialogues in the game. Later while building the game in Unity, these dialogues carried into Ink.

After the dialogues were ready, the game was built in Unity. The game was created for the WebGL platform, which enables one to play the game in internet browsers irrespective of the operating system. This was thought to be easier to share the game with participants without needing any setup. The finished game was uploaded to Unity's own website (https://play.unity.com/) to host games made with their engine. The prototype development progressed step by step, starting from the team talk step and IS station. First, the dialogue system with Ink was built and adjusted in the development process with each new talk step. After each step and station was ready, a menu scene was added to the game to welcome the players at the start. An in-game tutorial was also added to instruct the players through the game.

The game opens with the menu scene (Fig. 12). Here, an overview screen informs and instructs players. The name of the game was not decided during this prototype phase. The "Play" button on the screen directs the player to a patient list to choose a consultee, which in this pilot study for usability only includes one. Upon selecting the patient, the game directs to a new scene in the clinician's room.

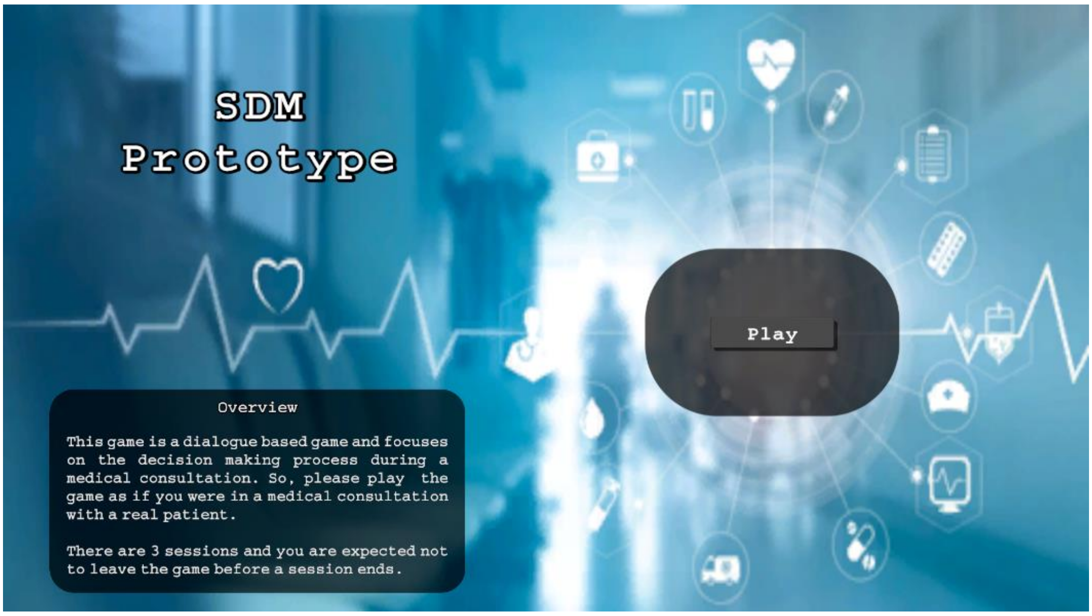

Figure 12. *The menu scene at the beginning.*

The clinician's room is the main setting to play the game (Fig. 13). It is a typical doctor's room with relative equipment and objects. The clinician sits in his/her seat behind his/her table, facing the patient and a part of the room. The rest of the game progresses in this environment. A message displayed on the upper side of the screen welcomes the player. The tutorial starts immediately by introducing the UI elements in the game. As in the initial representation of the game in Figure 7., there is a time countdown in the upper left corner, which starts after the patient history card is displayed. A study examining consultation lengths in practice and collected data from six European countries revealed that the average consultation length is 10.7 minutes (Deveguele et. al., 2002). Therefore, we gave a total time of 10 minutes to players. However, this is a dialogue-based game and includes lots of reading in which players can easily exceed the given time. Hence, another five minutes were given if 10 minutes were not enough. To emphasize the extra time, the time countdown turns red when extra time is in usage, and the countdown continues from -00:01 seconds to -05:00 minutes.

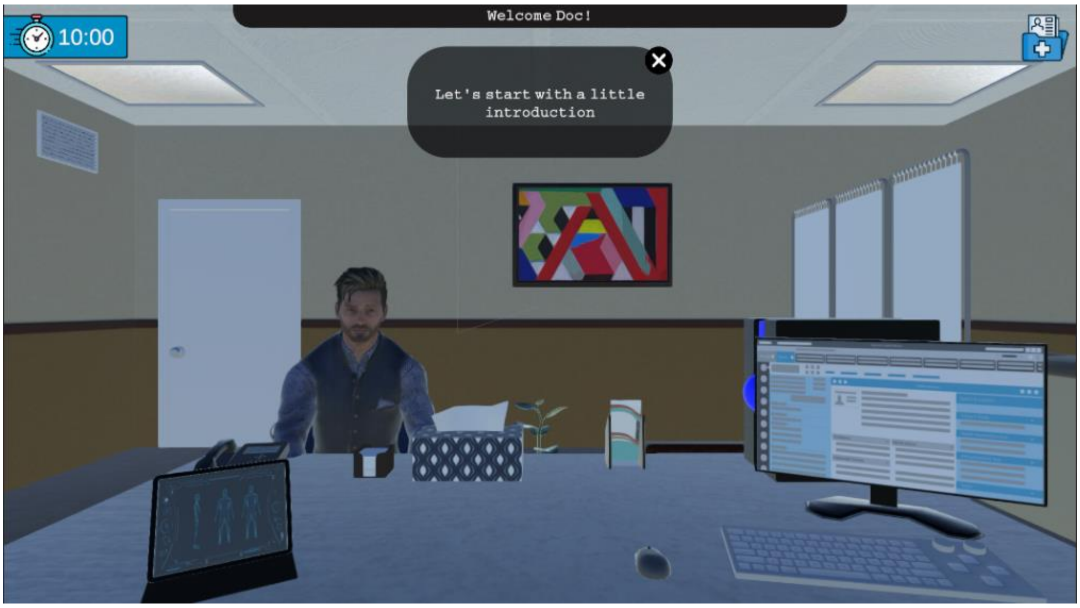

Figure 13. *The initial screen as tutorial started.*

Where the welcome message is displayed is an information panel that gives some aiding instructions to players during gameplay. The icon in the upper right corner is a button to open the patient history card whenever players want to check. The initial tutorial informs players about these and opens the patient history card (Fig. 14). Here, when the “OK” button is pressed, the time countdown starts, and the dialogue system opens as the game begins.

Figure 14. *The patient history card.*

The game begins with the IS station in the team talk model. Figure 15 shows the choices given to players in this station. The panel at the bottom of the screen presents the clinician's dialogues and choices. The choices are represented as the part of dialogues they are tied to since it is a dialogue-based game and commercial games commonly represent dialogue choices in this way. The final two choices represent the IS station points in the OSCE guide. The second choice in Figure 14 enables players to prescribe a treatment immediately. Although this is not an expected action, this choice is scattered in the team talk multiple times to allow for ending the game early. It is also possible that in real consultations, clinicians can give a treatment with little information, even if it is not a good practice. Selecting this choice opens a list of treatments available at the beginning (Fig. 16), and choosing one prescribes the treatment as ending the session. On the other hand, the first choice in Figure 15 directs the game immediately to the treatment elimination part at the end of the team talk step to skip to the decision talk step without going through the stations in between. This choice is also scattered in the team talk step to see if players are aware of the SDM process and get information from patients before going into treatment options.

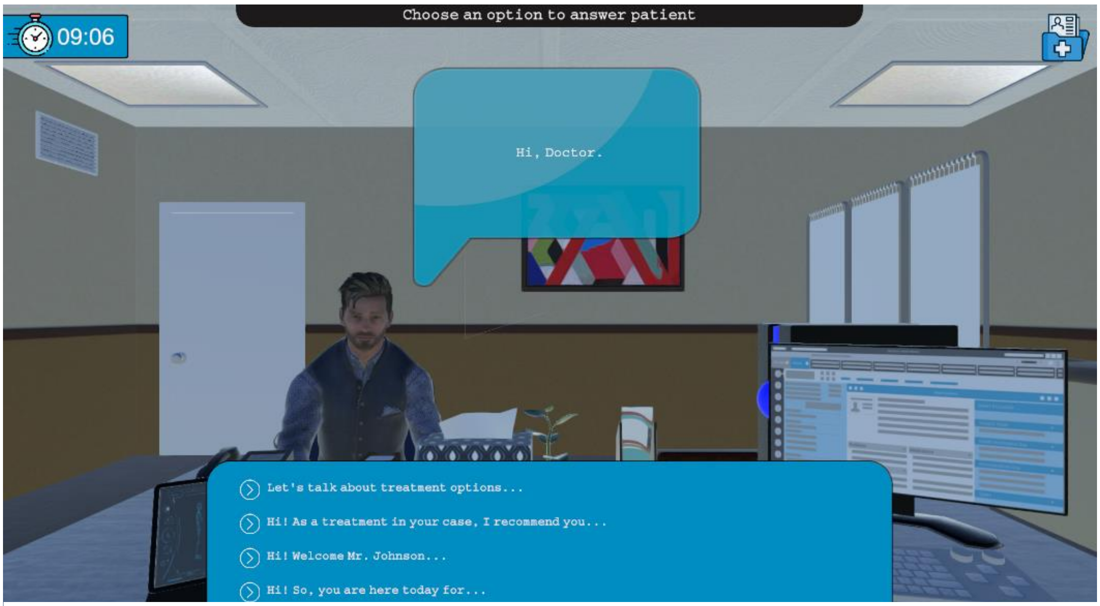

Figure 16. *An example of choices given in the IS station, team talk step.*

Figure 15. *The treatment options opened after selecting recommending a treatment choice.*

The OSCE stations in game are connected to each other to make the game flow without interrupting the player and to imitate a real life consultation process. Therefore, while players do not play the game as station to station, dialogues and choices appears based on the stations which progress to the next based on the choices made. Choices in Figure 17 shows the interconnection between stations. If a player welcomes the patient in the IS station, these choices appear as the next. Here, "So, you are here today…" option still aims to complete IS station and gets the context of the consultation. The rest of the choices are from IRfC station. While choosing "So, you are here today…" option would get the context and shows the same choices without including this one, choosing another one continues from IRfC station, ending the IS station without fully completing it.

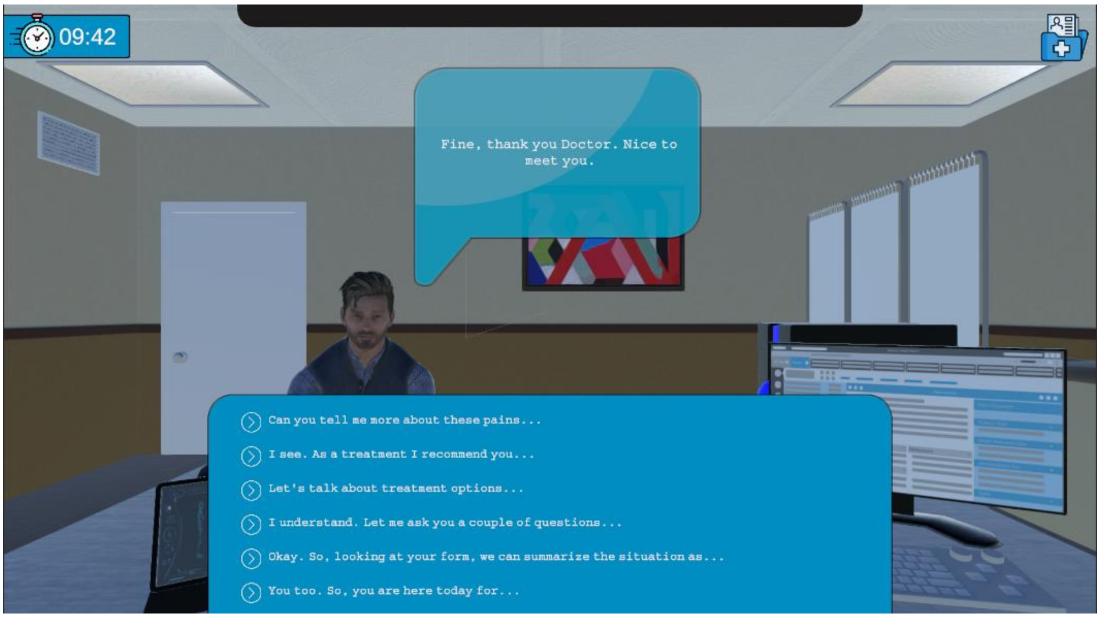

Figure 17. *The presented choices include from two different OSCE station showing its interconnection between them.*

In the IRfC station, the clinician collects information about the medical condition at hand. Here, to achieve that, topics related to the condition are presented to players to get information from the patient. These topics were also prepared by Wamboldt and Loughran's (2017) OSCE guide. There are seven topics to ask the patient, but since some information related to the condition is given on the patient history card and some information can be gathered during the dialogues in the game, the number of topics is adjusted based on the previously available information. Therefore, Figure 18 shows five topics. The players are constrained in how many topics they can ask to save on the overall game length.

Figure 18. *The topics for taking focus history of patient's condition in IRfC station, team talk step of the game.*

Completing IS, IRfC, BR, and PfSDM stations or skipping some based on choices directs the players where they eliminate treatments and skip to the decision talk step (Figure 19). Here, selecting less than two or more than three treatments gives an error message in the information panel.

Figure 19. *The treatment elimination screen in the end of team talk step.*

The option talk step presents a treatment panel on the left of the screen (Fig. 20). Here, only the treatments not eliminated in the team talk step appear. Icons used for treatments in this panel are to save on space and not to tire players with wide UI elements on the screen. Hovering over the icons in this panel expands the icon, showing the treatments' names. Upon selecting a treatment, it turns green, hiding the rest of the treatments to emphasize the currently explained one. This selection also opens up the key points panel. Here, the logic is the same with the treatments panel as each selected key point turns green. However, selecting a key point does not hide the rest to show which ones are unexplained. While explaining a treatment or a key point, it is impossible to jump into another one to explain treatments properly and sufficiently, as the SDM process requires. Key points stay the same in different treatments but are renewed, returning to their initial blue color when moving into another treatment.

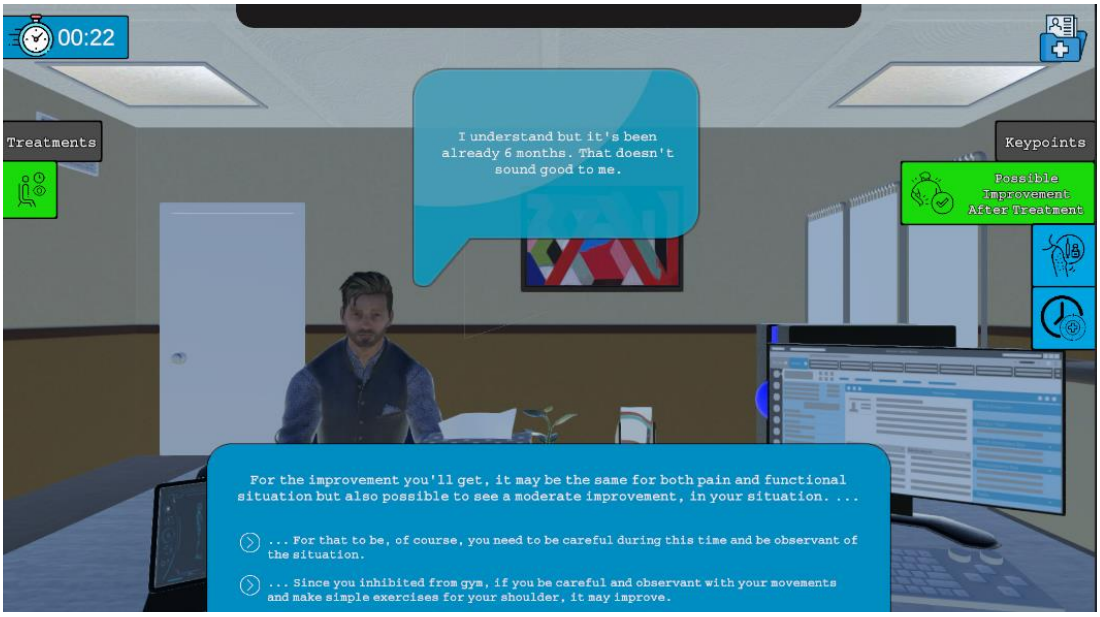

Figure 20. *The screen during game in GTO station and option talk step.*

In the option talk, choices are constructed differently than in the team talk step. Here, players are expected to complete the sentences, with the choices below them, to explain treatments. It was planned as this since the GTO station of OSCE used in this step emphasizes explaining treatments better with points, such as avoiding jargon or giving sufficient information. Therefore, this type of interaction can let us see if players use simpler language or add enough information to their explanation for treatments. Explaining all the treatments and key points opens up the ranking panel (Figure 21). Ranking the key points as patient’s preferences and confirming the order direct the game to the decision talk step ending the option talk.

Figure 21. *The ranking panel in the end of option talk step of the game.*

In the decision talk step, the patient and the clinician need to negotiate on the treatments at hand. The OSCE stations used in this step were ADMP and CC. The former is related to what decision talk proposes in the three talk model (Elwyn et. el., 2017). For negotiating each treatment, a navigation panel is inserted above the clinician's dialogue panel (Fig. 22). Here, next to each treatment, there is an elimination and prescription button; so that players can eliminate a treatment if it does not seem to be suitable or they decide to prescribe a treatment at any point during the negotiation process. Choosing a treatment reveals choices to negotiate that treatment. The points given for ADMP in the guide consist of consulting patients about their opinion on the treatments, clinicians sharing their professional views, exploring the pros and cons of each option to remind patients while deciding, and finally, negotiating. These points are seemed fundamental for negotiating treatments for a proper decision. Therefore, in this step, the choices directly represented these points. However, going through the first three points can also be part of the negotiating process; hence, negotiating point was not put as a choice but instead considered as fulfilled if players go through all the other three choices. Since these points are relevant for each treatment, each treatment at hand has these three points as choices. So, the same choices are presented to the player in each treatment. Every time after choosing one, the rest are presented again until there is none. However, it is possible to jump between the treatments before going through all the choices and to return to any previously visited treatment to complete the rest of the choices. Although the aim is to go through all choices in all treatments as the SDM process suggests, players can finalize the negotiation at any point with the prescription button provided.

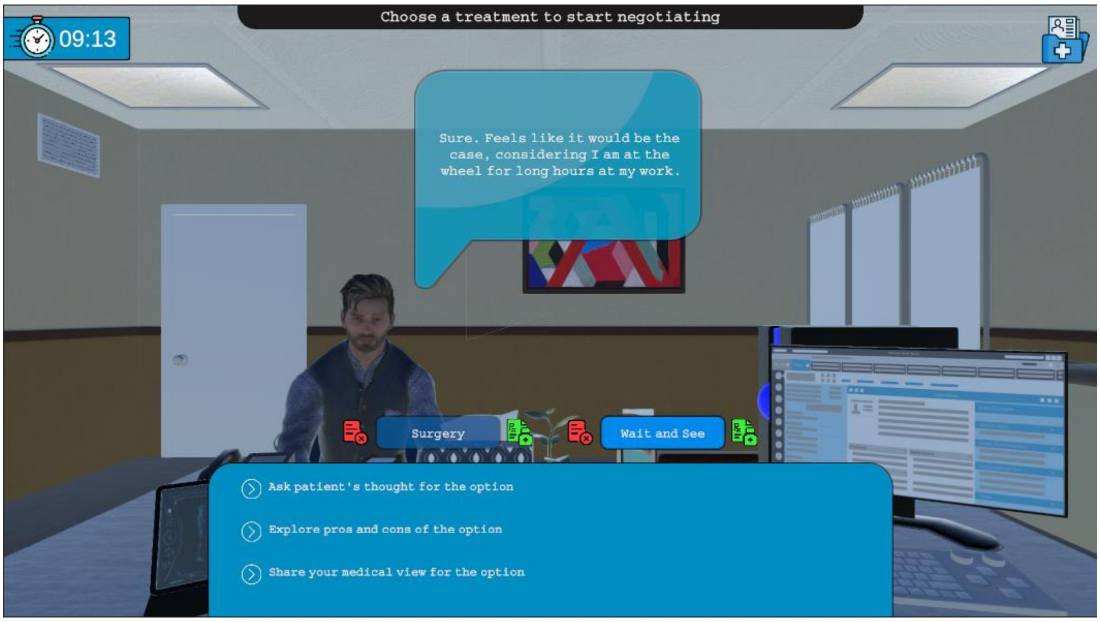

Figure 22. *A screen from ADMP station and decision talk step in game.*

Prescribing a treatment leads to the CC station, where players should give final remarks about the decided treatment and finalize the consultation process. After finalizing the session, a game summary screen is presented to the player (Fig. 23). Here, the patient's name, prescribed treatment, and session completion time summarize the consultation. A score is also calculated based on the choices made using the scoring scheme in the OSCE guide and presented to players. Each station in the OSCE guide has a specific score. In this game, we divided each station's score by the points included in the game from that station. Then, after calculating all stations, the score was proportioned to 100. While scoring does not aim to represent an actual score that could have been taken in a real OSCE, it was tried to stick to the OSCE guide to provide a more systematic calculation. The aim of scoring was so that players could see how they did in the game, and games generally present a score to the players.

Figure 23. *Game summary panel at the end of the game. Also, showing an in-game achievement on the left.*

The “Achievements” button in the game summary screen closes the game summary and opens up the achievements panel, where players can get feedback in the form of achievements. This form of presenting feedback is to inform players about the process while not tiring them with additional long or didactic writings to read. In Figure 24, the gained achievements are represented with salient coloring while others’ transparency is decreased to create a paler image. The icons related to gained achievements are also colored. Here, each achievement represents an OSCE station point. Therefore, a total of 20 achievements were created for the SDM process. Six additional achievements were also created to reward players in terms of gameplay. These six include achievements, such as completing the game in time or ranking key points/preferences in option talk true. In-game achievements were also added to the game but only for the six additional achievements. These achievements are presented as pop-up messages on the screen, as shown in Figure 23. In total, 26 achievements are included in the game, and each has a short description of what they imply below them.

Figure 24. *The achievements panel.*

Clicking the "OK" button on the achievements screen ends the game and returns to the menu screen in the beginning. If wanted, the game can be played again, following the same process at the beginning.

3.3 Qualitative Evaluation of The Prototype

3.3.1. Participants

After the prototype was ready to play, semi-structured interviews were conducted to gather feedback about the game. The participants were two experts, one a working physiotherapist and one a researcher in the field of SDM. Participants were invited with an e-mail that included the game link in case of wanting to examine the game beforehand and a link for the online interview. The interviews took about an hour. At the beginning of the interviews, participants were informed about the study, and verbal consent was taken to participate. Interviews were recorded with the permission of the participants.

3.3.2. Procedure

During the interviews, participants played and reviewed the game while progressing in it. As a semi-structured interview, a total of 6 questions (Appendix E) were prepared beforehand regarding what is good and bad in the game and how it can be improved, but the rest of the interview followed the arisen questions during the gameplay.

The interviewing process took two days. After completing the interview process, recorded data were transcribed. The transcriptions were analyzed to find common directions for improvement mentioned about the game. Among these, suitable ones, in terms of not changing the game as a whole and being implementable before the suitability study, were chosen to adjust the game accordingly. Chapter 4 explains the detail of these adjustments by providing participants' comments and presents the final version of the game as *PhysioInformed.*

3.4. The Usability Study

3.4.1. Participants

The usability study was conducted with 20 participants. They were invited to the study via social media platforms. Participation was voluntary, and selection was based on non-probability sampling. The age of the participants ranged from 23 to 46. They were sent the study link with a short description of the topic and the length of the study. The link provided an online consent form that explained the study in detail and informed about the instructions to participate. Giving their consent in the online form, players were directed to the game link to participate in the study.

As participants were also informed in the consent form (Appendix F), this study had the approval of Middle East Technical University Human Subjects Ethics Committee before the study conducted (Appendix J).

3.4.2. Procedure

The usability study took place online. The game link (https://play.unity.com/mg/other/v0-2-2g0a) was provided to those who gave their consent to participate. The consent form provided additional information on how to play the game, the length of the game, and the questionnaire after playing it. Participants were instructed to play the game in Google Chrome browser and with a good internet connection, if possible, to avoid any technical issues.

The game was hosted on the Unity Play (https://play.unity.com/) website, which Unity Technologies provides for games made in Unity game engine and requires no signing-in for participants. The game gives a total of 15 minutes to players together with additional time. Therefore, after 15 minutes of gameplay or finishing the game, the questionnaire link was provided.

Questionnaires were prepared on Google Forms website (https://docs.google.com/forms/) together with the consent form. The questionnaire form consists of three parts. First, the participants' demographics were taken for age, gender, education, occupation, and gameplay habits (Appendix G). The other two parts included System Usability Scale (Appendix H) and a part of Intrinsic Motivation Inventory (IMI) (Appendix I). The questionnaires were given in that order, and it was not possible to skip to the next before finishing one to avoid any missing data. Filling out all the forms ended the usability study for a participant.

3.4.3. System Usability Scale

Two questionnaires assessed the usability. The first was the SUS, a 10-items scale. In SUS, each item presents a statement in which participants choose their degree of agreement. The agreement is selected on a 5-point Likert scale from *strongly disagree* to *strongly agree.* Brooke (1996) developed the scale to measure a system's perceived usability. Since, it has been used for various systems such as computer software, web-based interfaces, and mobile applications (Bangor et. al., 2008). For its reliability, several studies reported a Cronbach's alpha over 0.90 (Bangor et. al., 2008; Lewis et. al., 2015). The scale was also reported as suitable with small sample sizes down to 12 participants (Tullis & Stetson, 2004).

Yanex-Gomez et. al.'s (2017) systematic review of the usability assessments used in serious games revealed that SUS is the most common method among the standard questionnaires. Though further research is still needed on the topic, it is also argued that SUS can measure learnability in addition to usability (Brooke, 2013; Lewis et. al., 2015).

The SUS score is calculated in three steps (Brooke, 1996; 2013). First, the scale requires adjusting the scores for odd and even items. The odd items in the scale are calculated by subtracting one from each. For the evens, each item is subtracted from 5. Then, the average is taken with these adjusted scores. In the final step, the average is multiplied by 2.5 to present a final score between 0-100.

3.4.4. Intrinsic Motivation Inventory

The second assessment method in the usability study was Intrinsic Motivation Inventory. IMI consists of seven sub-scales. These are interest/enjoyment, perceived competence, effort/importance, pressure/tension, perceived choice, value/usefulness, and relatedness. However, intrinsic motivation is measured by interest/enjoyment subscale, and other sub-scales measure concepts are correlated with intrinsic motivation. A Cronbach's alpha over 0.84 was reported for IMI and its subscales (Leng et. al., 2010; McAuley et. al., 1988; Monteiro et. al., 2015).

IMI was used in studies to examine one's experience in doing an activity. Therefore, it is used for different types of activities ranging from education or exercising to gameplaying (Cortright et. al., 2013; Goudas et. al., 1994; Reyes et. al., 2020). The scale is also flexible to use different subscales for different study aims ("Intrinsic Motivation Inventory", n.d.). Thus, in this study, interest/enjoyment subscale is used to observe participants' self-reported motivations and experience in the game, along with the value/usefulness subscale, which is associated with the internalization of the activity at hand.

While calculating the IMI scores, there are reverse statements to consider in subscales (Center for Self-Determination Theory, n.d.). For those used in this study, the interest/enjoyment subscale includes two reverse statements as in the third and fourth one. On the other hand, value/usefulness subscale does not have a reverse statement. These reverse statements are subtracted from eight, and the final scores for each subscale are calculated by averaging all the answers.

3.4.5. Data Analysis

The analyses of the collected data were performed using IBM SPSS Statistics software (version 26.0). Participants' characteristics were examined with descriptive statistics. Then, scores for each scale and subscale were calculated as the study's main result. Since the study aims to investigate the game's usability with the given questionnaires, further statistical analysis was unnecessary. However, additional correlation analysis was conducted between SUS and IMI's subscales to observe any relationship between the scale measures. Upon checking the assumptions proposed by Field (2013), it was decided to use the Pearson correlation coefficient for the correlation analysis.

CHAPTER 4

RESULTS OF QUALITATIVE EVALUATION

This chapter is dedicated to describing the results of the qualitative evaluation. The results are presented based on the topics revealed in the transcription analysis. Each topic represents an improvement for or a lack in the prototype version of the game, as proposed by participants during the interviews. The topics are covered with quotes from interviews, and relevant adjustments in the game are demonstrated under them as the final game, *PhysioInformed*. For those improvements that are not implemented, the reasons are given and also discussed in Chapter 6, Discussion.

The qualitative evaluation of the game revealed several improvements for the game. After analyzing the transcription of the interviews, these improvement directions were clustered under these topics: game's aim, regarding user experience, the flexibility of the game flow, the similarity between choices, ranking of key points/preferences, changes in decision talk step, game summary and achievements, improvements in wording and finally additional comments on the game. The updated flowchart showing the game's general flow is in Appendix C.

Most directions for improvements were tried to be implemented in the game. However, some of them were not applicable in the time interval of this thesis, and some were evaluated differently by participants. The details of these topics are provided in the following paragraphs showing the adjustments made in the game. While explaining the process, to consider confidentiality, we will address the participants as P1 and P2.

The first adjustments were regarding the game's aim. This topic describes the lack of sufficient explanation before the start of the game. P1 commented several times that the game's aim is not clear enough and stated, "I mean, I didn't understand the aim. Is there an order to do these right, and are we trying to direct doctors to that?". After gameplay ended, as we asked about the general thoughts about the game, the following conversation took place:

> *P1:* ...I mean, do you want to say that a part of them are righter and things you should do? Or is it 'play it as you wish'? I mean, how would you like to direct the player is not clear. I also didn't understand what expected from me while playing. … Am I trying to listen patient more, is that what should be done? Or what I donormally … am I trying to see myself, my current situation with playing the game

as doing what I do normally? What you are trying to do and based on what I do fill these are not very understandable in the beginning.

Interviewer: So, do you think this information should be given step by step in the game or in the beginning, it should be said that do these things and play this way, should it be as such?

P1: I think it should be here (showing the overview part in the menu screen of the game). In this page in the very beginning, it should tell me that do as what you normally do, it will help you to improve yourself. Or do as you think which one is truer or if you had more time and less patients, how would you do. … If it tells me what to do in the beginning, I can go that way.

As the above conversation depicts, it is understood that the information given at the beginning of the game with the "Overview" title (Fig. 12) was insufficient to explain the game and how to play it. Therefore, we changed this part and explained it more explicitly (Figure 25). Before, on the screen where they pressed the "Play" button, the players were instructed to play the game as if they were in an actual consultation. First, the new explanation is placed on the next screen after the "Play" button is pressed. Nothing else is included on this screen, so players' attention can be taken here, and a longer explanation can be provided. The new explanation included that the game is based on the decision-making processes in medical consultations, and the part saying how to play the game was turned bold. Also, the information on the game directing players to different sections (OSCE stations) was added to let players know that if they missed an achievement, this might be related to the game directing them, and they can play the game again to see where different choices direct them. Finally, as this was the game's final version before the usability study, the name *PhysioInformed was* added instead of "SDM Prototype" title in the prototype version (Fig. 12).

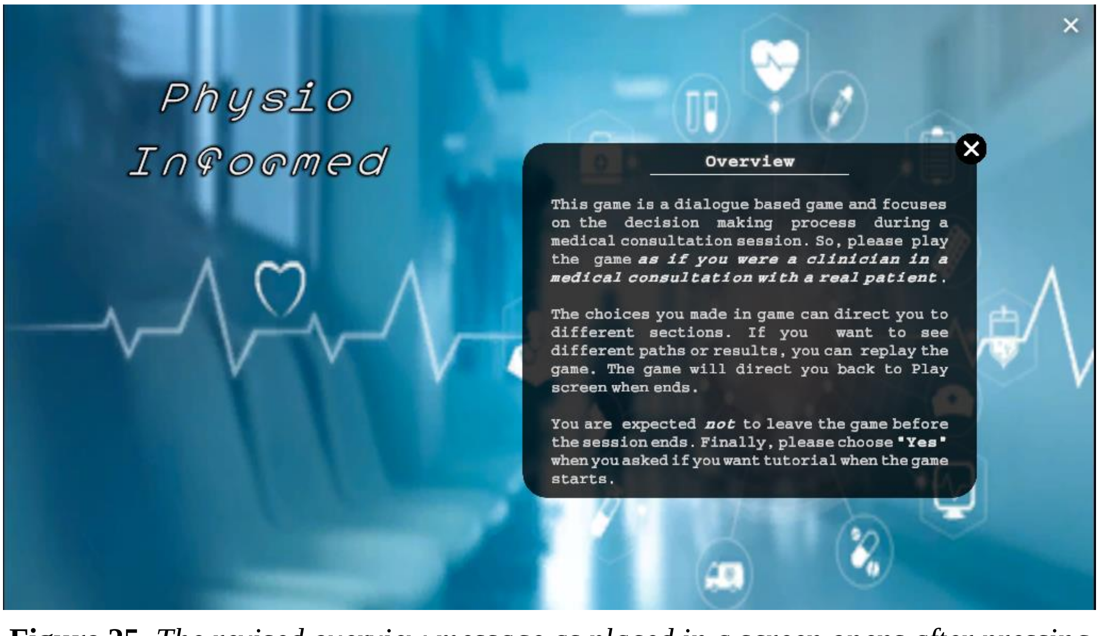

Figure 25. *The revised overview message as placed in a screen opens after pressing "Play" button.*

Secondly, some adjustments were made to improve the players' user experience. Regarding that, the first comment from both participants was about the tutorial. For that, P1 said, "… Isn't there a way to skip this introduction?" as commenting on the tutorials in the beginning. Therefore, we added a part at the beginning that asks players if they want a tutorial or not (Fig. 26).

Figure 26. *The added option to activate tutorials.*

On the other hand, P2 made two comments on the tutorials. The first comment was regarding the button to proceed to the next tutorial boxes: "…I feel like clicking the "X" (close button in the tutorial), I was getting rid of the tutorial. So, it would be better to have a next or like a different button to click just so you don't feel like you are getting rid of the tutorial…" Therefore, we added arrows to go back and forth between tutorial boxes but kept the "X" button to close the tutorial if players do not want to see them at any point in the game. The second comment of P2 for tutorials was regarding the ones that introduce the UI elements. For example, at the beginning of the game, the tutorial introduces elements such as the time countdown or patient history card. Before, there was no visual cue to address which element was introduced. P2 commented on that as "… I think that first one just threw me a little bit, says in the bar above. That it's not actually above, it's off to the side. So, I was looking for something above in the instruction." Therefore, we added a color blinking effect to the introduced element as a visual cue. Figure 27 shows the arrows added and the color blinking effect added to the bar above while introducing it.

Figure 27. *A tutorial box showing added navigation buttons between tutorial messages.*

Other comments on the user experience were about the writings in the game. P1 commented that "…Couldn't be these writings less eye-straining, a bit bigger, on the level of eyesight?". The same participant also commented regarding typing effect; "I never prefer writings appearing in that way, but I don't know if there is anyone to prefer. It is not readable. It would be less tiring for me if it appears without pressing the 'space'…". Considering these, first, typing effect was removed, and dialogues were made to appear immediately. Secondly, the font size increased a little, and the doctor's dialogue box was made bigger and placed higher. Figure 28 shows the changes made in that sense.

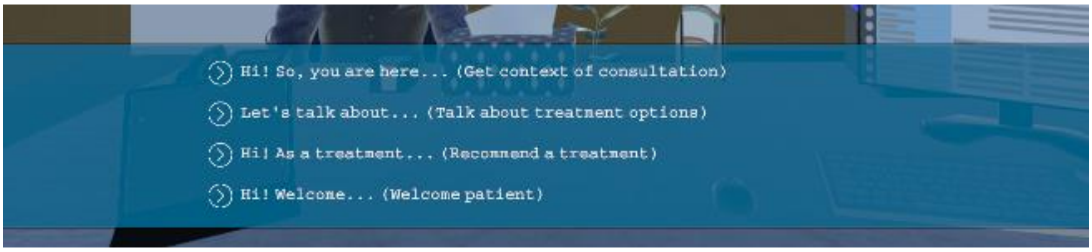

Figure 28. *An example of changed choice representations. Additional explanations added in parenthesis.*

The third topic for the adjustments was related to the flexibility of the game flow. Both of our participants stated that the game lacks some flexibility. This flexibility is examined under two subtopics: constraints in specific stations and constraints between stations. The former depicts some interactions in OSCE stations of IRfC and GTO being limited. The latter reflects the inability to go back and forth between the stations.

Among the constraints in specific stations, for IRfC, taking a focus history of patient's condition was found to be limited. Here, as shown in Figure 16, there were topics presented to players to ask the patient. However, to not increase the game length, the questions to be asked were limited to a number depending on the information given in the history card and what the patient said until that point. However, both participants in the qualitative evaluation commented that this was unnecessary. P1 said, "I feel like I could have been able to ask other options too, if I have a right to ask extra questions…". In the same way, for that part, P2 said that "So, if you wanted it to be quite realistic; then you might expect someone with asking all of these questions." Therefore, here, we added the ability to continue asking other topics or to continue to next section (Fig. 29).

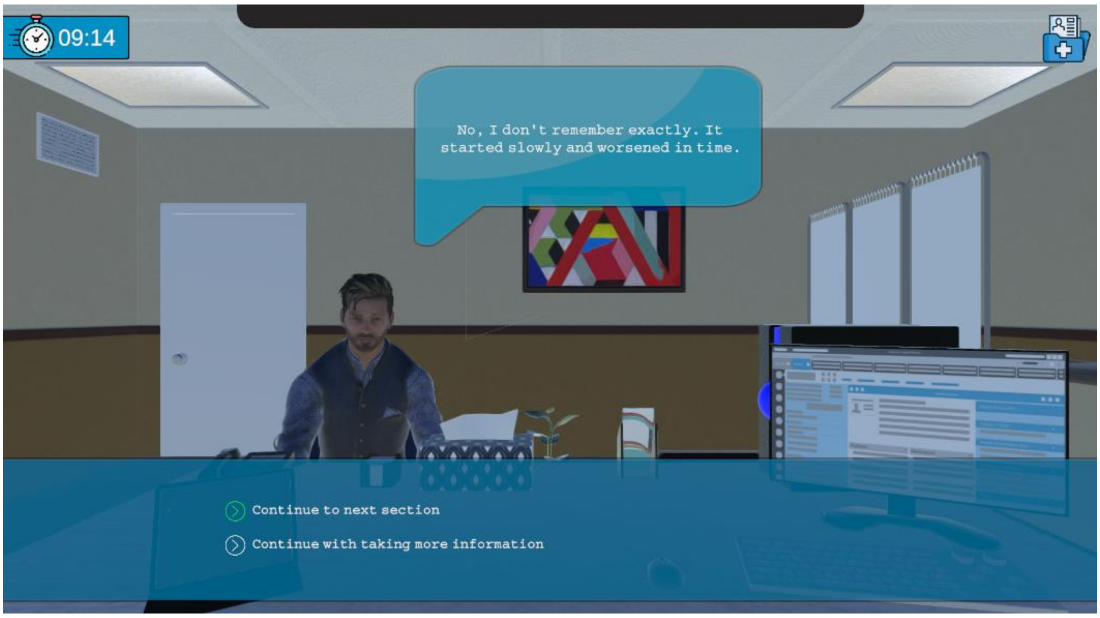

Figure 29. *The choices presented after asking a topic while taking focus history of patient's condition.*

For the constraints in the GTO station, in the prototype, it was necessary to explain all treatment options and key points before moving into the decision talk step. Here, P1 said that "These are very long, generally everything is very long. Though, I am sure you had already shortened it. …" Therefore, since it was hard to subtract the information given, the constraint on finishing every treatment was removed from this part. Instead, at the end of each explained treatment, players are given choices for continuing to explain and proceeding to the next section (Fig. 30). Since this was a practice tool, players might want to continue the next section and focus on that part more. Therefore, this seemed suitable to implement.

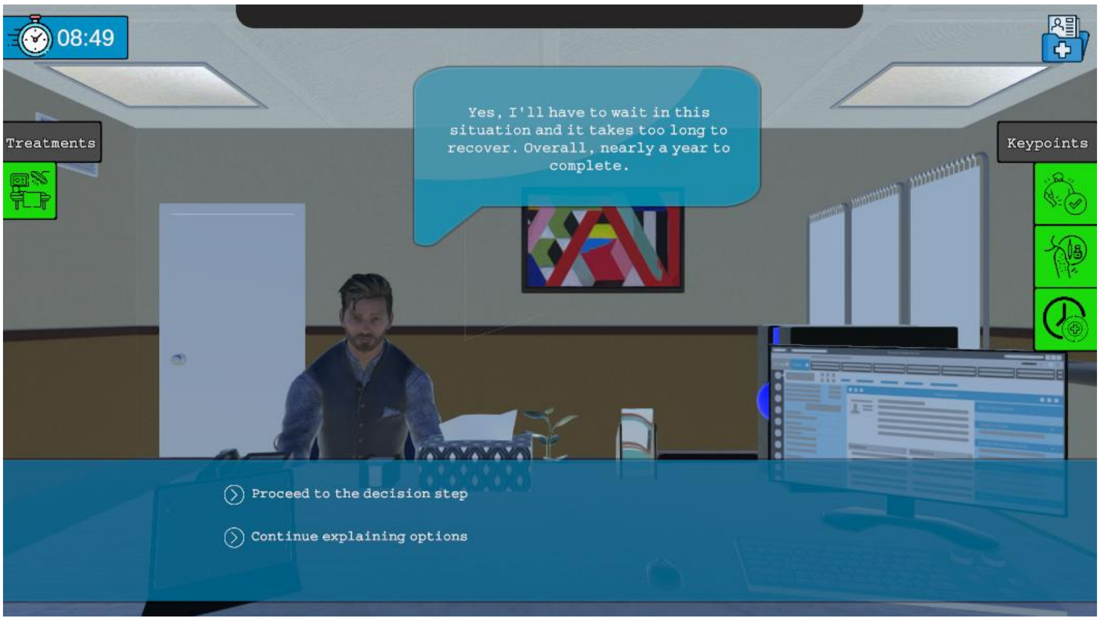

Figure 30. *The choices provided when a treatment explained with its key point in GTO station.*

For the constraints between stations, both participants stated that the game does not give the availability to go back to a previous step. P1 asked, "I can't go back ever, right? In nowhere?" and added later on, "Through all the game, there was a curiosity for what would happen if I were pressed the other one." In the same way, P2 stated, "I feel like I've been able to go one way but I can't go back and try and ask more information which I might decide I want to ask, you know." While these comments were plausible, this study could not implement this option in the game. Since OSCE stations were originally used separately (Rushforth, 2007) and Elwyn et. al.'s (2017) three talk model for SDM also supports linear progression, the game is designed as linear, as stated at the beginning of this chapter.

Another revealed topic in the interviews was the similarity between and the ambiguity in some choices, as reported by both of our participants. Since choices represented points from OSCE stations, participants reported that it was hard to differentiate the choices to follow. As observed during the interview, this was partially because of choices given as the portions of the dialogue they tied to. For example, P1 said that "I didn't understand what these two says. 'You'll understand when we get into…' (the choice in the game) What do I want to say here?". Upon the explanation made by the interviewer, P1 added, "I didn't understand what it says before but I understood when you explained. But it is not understandable. …" P2 also stated in the IRfC part that "So, I'm a bit unsure about precision here… I don't know what's coming next. So, I don't know which one I want to choose…" Especially, in GTO station where players complete the dialogue with the choices as different from the team talk step, they stated it was hard to decide between the choices. P1 commented that "I mean, these options don't look like different much to my eyes. Because of that, it starts to be boring, others may feel the same." P2 also stated here that "So, unless you've got something that tells you here, the information about this is a more technical information and this is a, you know, jargon free explanation. You don't know why you choosing the one over the other." Therefore, considering all of these, each option through the game were added some short explanation next to them. Figure 31 shows an example of the added explanation for choices. On the other hand, Figure 32 shows the choices in the GTO station. Here, players are directly given the context of the choice to complete the explanation.

Figure 32. *Choices given in PfSDM station and team talk step in the final game.*

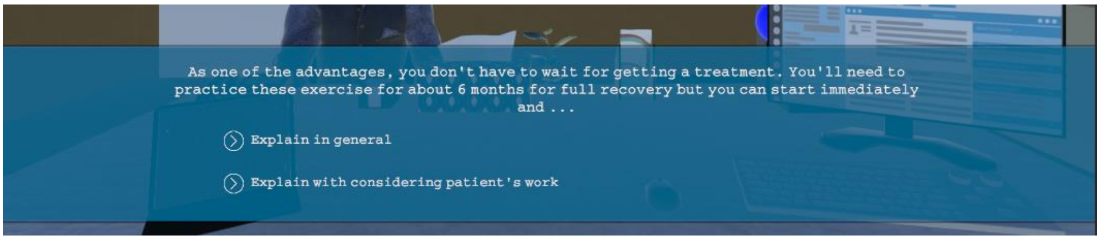

Figure 31. *The choices given in GTO station and option talk step in the final game.*

The ranking part, which was at the end of the option talk step, was criticized by one of our participants. In this part, players were expected to rank the key points, which they use as the preferences of the current patient, while explaining treatment options. Here, it was to see if the game was able to represent patient's preferences. However, P1 said that "True based on who? I think, this is not possible. There can't be something like the right order, you didn't give that much information." Since ranking was not one of the main parts of the game or a necessary step in SDM, it was removed from the game completely.

Change in decision talk step was another topic revealed in our interview. However, there were contradictory comments here. This topic addresses the same three choices given in each treatment in the ADMP station of OSCE. Here, as explained before, players are given consult patient, share medical views, and explore pros and cons choices in each treatment as representing the points given in the ADMP station. P1 commented on these choices that "… Even if I tell my medical view, still I ask the patient (patient's view). Then, I discuss pros and cons. Whatever I do, it goes the same choices. … It feels like waste of time. Let's ask them once (for all treatments)." So, P1 proposed to give these choices once for all treatments instead of repeating the procedure for all treatments. On the other hand, P2 commented on that part as follows:

> "I mean I think, in terms of this pure shared decision making and learning about that process, I think you do need to have this negotiation. You know, particularly, if it's something, this aims to help clinicians to perhaps understand the process a little bit better or you know, learn about helpful things in those negotiations. I think you do definitely need, mmm, all of these different options to make sure that the people aren't just saying here all this information."

Therefore, having two different opinions on that topic, the structure of this station was kept the same before considering it may represent an SDM process better. However, P1's comment was considered to adjust the needs for getting an achievement from the ADMP station. In the final version, this achievement is provided upon going through the choices of consulting, sharing, and exploring once in the ADMP station instead of going through these choices for each treatment option.

Both of our participants evaluated the game summary and achievements from various aspects. The first of these was regarding the order in which game summary and achievement were presented to the player. P1 said that "Aren't these shown when the game ends. I think, there would have been a screen before game summary and these would have been in there. … I think this should be in the previous screen." Therefore, instead of changing the order of the game summary and achievements, these panels are presented together; so that all the information related to the game is on one screen (Fig. 28).

Secondly, the number of achievements was found to be excessive. There were 26 achievements, and 20 were directly related to SDM, each giving a point from OSCE stations. P1 commented on that, "These are too much. Did you make these that much? It would be better if you cluster some of them and decrease the number. … It feels like they could be combined together. It could be more generic and less in number." After that comment, it was agreed that this number of achievements representing feedback could be tiring for players to follow and learn from. Therefore, instead of giving station points as feedback, each station was turned into an achievement. With, regarding the SDM process, there were nine achievements. Game-related achievements were also reduced to three from six, and as the final number, a total of 12 achievements is included in the game.

The third adjustment here was about the scoring. P1 said, "I think clinicians might not like the score." When P2 was asked about how the given score perceived and answered as:

> "Mmm. I don't know really. I think people like to have a score at the end of the game. Mmm.. I don't know really. I don't think that I would be upset about having a score. Yeah, I don't know. I think it would be fine. I think you've got the achievements. So, that's good. You could say, you've got, I don't know, 8 out of 10 achievements."

The idea proposed by P2 seemed a suitable solution in which score could be eliminated for those who might not like the score, but it still gives an idea of how well you performed in the game. Therefore, players are informed of how many achievements out of 12 were gained (Fig. 33).

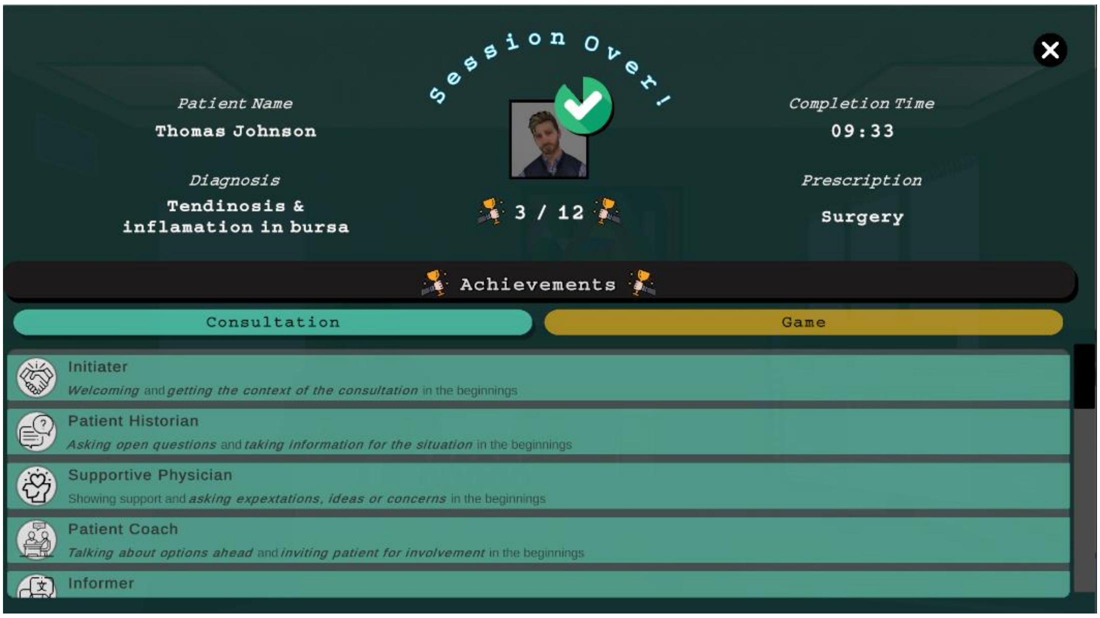

Figure 33. *The new game summary and achievements screen in the final game.*

The final comments on achievements regarded the inadequate information provided as feedback. P1 said that regarding the achievements, "I think, what that is, is not understandable like I said. I mean, I did good on this, I guess. I did also this good. I might have improved on these." While P2 liked the idea of achievements as feedback and stated that with "I think it certainly makes it feel more like a game and I think, it's a good way of doing the feedback.". P2 also added, "I think the only thing I'd say is that it just needs a little bit more explaining. You know, of potentially like saying which… Like get the context of consultation. Well, which option did I choose that help me get this, this achievement in the game?" Therefore, since new achievements represented OSCE stations directly, in the explanations, the points related to these stations were given but in a similar way to the explanation added to choices. This way, while they were more explanatory, they were also linked to the related in-game choices in a way that P2 also asked for (Fig. 33).

Table 1. *Team Talk Step Achievements*

OSCE Stations	In-Game Choices	Achievement
Initiating Session (IS)	Welcome patient – Get context of consultation	Initiator
Identifying Reasons for Consultations (IRfC)	Direct open questions – Take more information	Patient Historian
Building Rapport (BR)	Ask about expectations	Supportive Physician
Preparing for SDM (PfSDM)	Talk about options and invite patient to involve - Ask if have questions	Patient Coach

The above and following tables summarize how players can earn achievements after the adjustments mentioned above are applied. Table 1 demonstrates the achievements given in the team talk step of the game. In this step, four achievements can be gained, representing the four relevant OSCE stations. The in-game choices column shows the explanations given in parenthesis for each choice, as seen in Figure 28. Following these choices in the game, which represents the points given for each station in the OSCE guide (Appendix A), grants the relevant achievement to players, and under each achievement in the achievements panel, the provided information points to that in-parenthesis explanation (Fig. 33).

Table 2. *Achievement for Giving The Options(GTO) Station in Option Talk Step*

Station Points	In-Game Choices	Achievement
Avoid Jargon	Explain in general* vs. Explain referencing rotator cuff and bursa	
Provide Sufficient Information	Explain more* vs. Continue to next key point or treatment	Informer
Apply Patient's Ideas, Concerns and Expectations to Information	Explain with considering patient's work* vs. Explain in general	

*Choice providing the requirement

Since each achievement is given for a completed OSCE station and only one station is in the option talk step, Table 2 summarizes how to gain the *Informer* achievement in this step. The first two columns show the points given in the OSCE guide for this station (Appendix A) and relevant choices in the game for this point, for which an example can be seen in Figure 30. In this step, players need to choose a more patient-friendly option to get the achievement. However, this step is recursive since there is more than one treatment to explain, and the number of station points associated with each treatment differs. While in the prototype, players had to explain each treatment to proceed into the next step, in the final version, it is possible to proceed to the decision step after explaining one treatment in line with the feedback given in the qualitative evaluation study. Therefore, here, the achievement is granted upon following the more patient-friendly choices for a station point in a treatment regardless of the treatment players explaining or the number of treatments explained.

Table 3. *Achievements in Decision Talk Step*

OSCE Stations	In-Game Choices	Achievement
Assisting Decision Making Process (ADMP)	Share your medical view – Ask patient's thoughts – Explore pros and cons	Negotiator
Closing Consultation (CC)	The final remarks for the treatment - Thank you	Dealmaker

In the decision talk step, there are two OSCE stations and one achievement for each station (Table 3). For the ADMP station, the OSCE guide provides four points for this one (Appendix A). The in-game choices in the table represent these first three points. The final point, negotiating, is considered practiced by the player upon making the relevant choices for the first three points since they are part of the negotiation process. As in the GTO station, there is also a recursive process here since every treatment needs to be negotiated. However, considering the feedback from our participants in the qualitative evaluation study and to not lengthen the process or the game, *Negotiator* achievement is granted when players complete following the choices for three points in the ADMP station in any treatment without forcing players to go through each choice in a treatment or doing that for every treatment option.

The final main OSCE station in the game and in the decision talk step was CC. Here, players earn the *Dealmaker* achievement upon following the in-game choices in Table 3.

Table 4. *Achievements for The Additional OSCE Stations*

OSCE Stations	In-Game Requirement	Achievement
Structuring Consultation	Summarize the situation (choice in team talk step)	Professional Consultant
Process	Visiting all 7 main OSCE stations	Consultation Master

There are also two additional OSCE stations in the game and the OSCE guide (Appendix A). The achievement for *Structuring Consultation* station is granted upon making the relevant choice in the game, which is put based on the point given in the OSCE guide for this station (Table 4). Players earned the final SDM-related achievement upon visiting all the main stations in the game based on the choices made throughout the game since *Process* station suggests a well-organized SDM process.

Final adjustments aimed the wording in the game. For example, a conversation took place with P1 as the following:

> *P1:* What does possible effects means? What does possible effect during treatment mean?
>
> *Interviewer:* There were seven key points. We clustered them and reduced the number to three. These are side effects and discomfort caused by treatments. The effects can be seen while taking the treatment.
>
> *P1:* Then, it could be better if you explicitly state that it’s negative. This was something negative. It is not clear. It would be understandable if I read the previous ones (dialogues) carefully but I might have forgotten too.

Taking these propositions into account, the names of the key points changed in the final version. *Possible improvements after treatment* has changed to *improvement in* *pain and functionality*, implying the positive effects in each context. As the P1 suggested, *possible effects during treatment* has changed as *possible side effects* implying negativity. *Required time for treatment* has left unchanged as it seemed straightforward enough.

Another change in wording was in focus history topics in IRfC. Among the topics to get information from the patient, it was understood that some might be confusing. P1 reported, "I didn't understand completely that these were the categories for my extra questions. … Especially the first one, Radiation. What I am asking, where did this come from is not very understandable. I felt like I come the (treatment)options part." As P1 said, especially radiation could be mistaken for the radiation given during a treatment. Therefore, the topic names in IRfC changed, as shown in Figure 34.

Figure 34. *The changed topic names for taking focus history in IRfC station, team talk step in the final game.*

There were also additional comments on the game that did not impose any or were unsuitable for adjustments. One of them was regarding the length of the game. P1 commented while playing that "I skip without reading much. I mean it is too long. I don't know if other people do that read all of these." This was a concern for study from the beginning, and the dialogues were shortened continuously to present better gameplay. However, since this was a game based on a process that progresses through good communication, it was hard to cut things out without losing the essence of it as a practice tool.

Another comment was on the patient as an NPC agent for SDM acting very in line with the process. P1 said that "This patient is acting a lot logical, as if we expected him to be. He behaves like he wants SDM, aware of he needs something like that, wanting to involve, right?" This was because, in the game, it was planned to have more than one patient with different personalities. However, this thesis focuses on the game's usability as a system. Therefore, one patient was presented in the scope of this study, for participants to evaluate the game rather than the SDM process. However, this comment was valuable for developing other patients if needed.

These are all the adjustments that were made for the final version and the comments provided for the game. After that part, the game was ready for the usability study as *PhysioInformed*. The following section describes this process.

CHAPTER 5

RESULTS OF USABILITY STUDY

This chapter presents analyses regarding the pilot study for the usability of the *PhysioInformed*. First, demographics of participants are provided. Then, the two scales, SUS and IMI's results are presented. Finally, the correlations between SUS and IMI's subscales are examined.

5.1. Participants' Characteristics

A total of 20 people participated in the usability study. Table 5 shows the complete demographics of the participants. Among the participants, 13 were female (65%), and seven were male (35%). Though there were two other choices added to the demographic form as "Prefer not to say" and "Other" with a short space to fill, there were no given answers for those. The age of the participants ranged from 23 to 46, with a mean age of 29.7 (*SD* = 5.88) (Fig. 35). For the educational background, the majority had a bachelor's degree (65%) followed by master's and doctorate degrees (15%). There was only one participant with a high school degree (5%) and no report of an educational degree below that.

Table 5. *Sociodemographic Characteristics of Participants*

Sample Characteristics	*n*	%	*M*	*SD*
Gender				
Male	7	35		
Female	13	65		
Age			29,7	5,89
Education				
High School	1	5		
Bachelor's	13	65		
Master's	3	15		
Doctorate	3	15		
Gameplay Habit				
Often	7	35		
Sometimes	9	45		
Never	4	20		

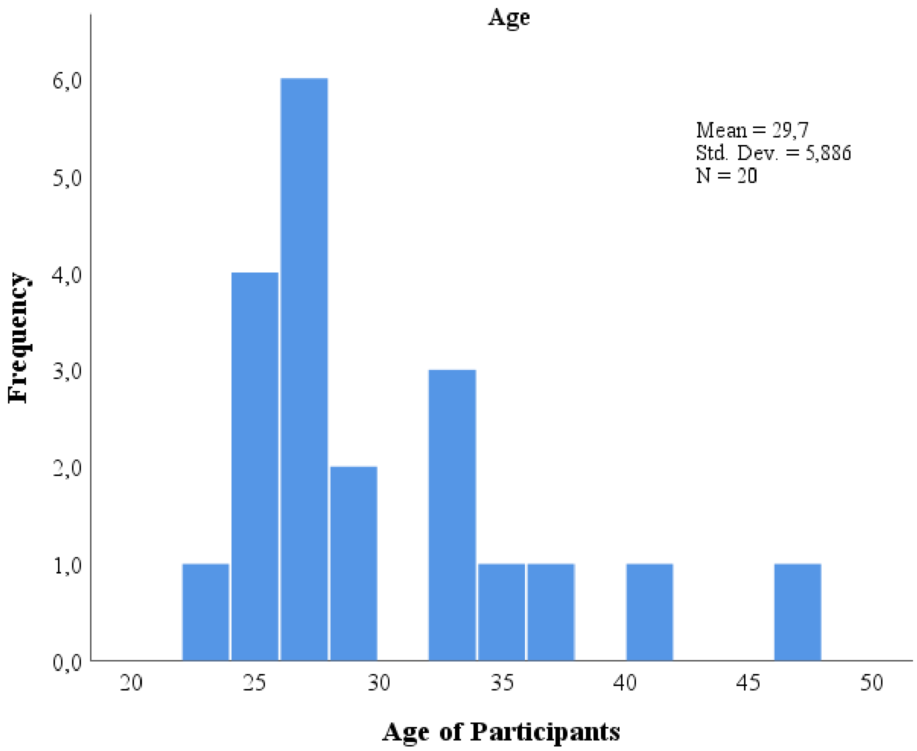

Figure 35. *The histogram showing distribution of the age for the participants in the usability study.*

Another demographic variable was the occupation of participants (Fig. 36). Types of occupations were diverse in the study, but the majority of participants were academicians (25%), followed by students (15%) and service industry workers (10%). Participants were also asked to state their game-playing habits with an open-ended question. The answers clustered into three categories as *often*, *sometimes*, and *never*. The majority reported playing games *sometimes* (45%). Seven participants stated as *often* (35%) and four as *never* (20%).

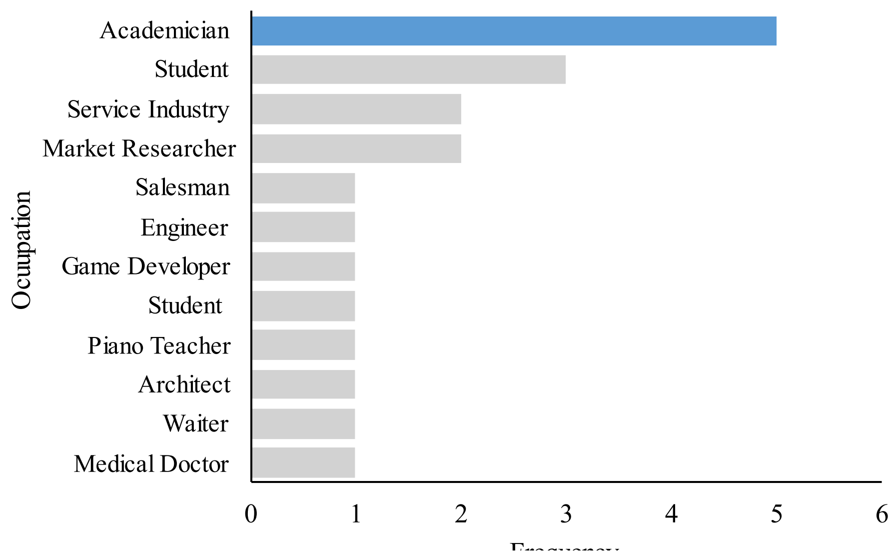

Figure 36. *Participants' distribution based on occupation.*

5.2. Usability Assessments

The first questionnaire used in the study was System Usability Scale. The calculation of score in SUS is explained in the Section 3.3.3. Following the calculation steps and averaging all scores, the overall usability was concluded as 74.5 (*SD* = 13.09). Scores ranged from 50 to 100.

It is emphasized that although the score represented by SUS is in the range of 0 to 100, the score does not represent a percentage and should be considered accordingly (Brooke, 2013). In addition, SUS should be evaluated by the resulting score, and any further analysis considering items in isolation was argued invalid (Bangor et. al., 2008).

The second measurement was conducted by Intrinsic Motivation Scale, which consists of two subscales in the scope of this study. Following the calculation method in Section 3.3.4., the result showed an average score of 4.43 (*SD* = 1.44) for interest/enjoyment subscale and 4.40 (*SD* = 1.74) for value/usefulness subscale.

5.3. Correlation Analysis

A correlational analysis was conducted on the SUS, IMI interest/enjoyment, and IMI value/usefulness subscales. Before the main analysis, the assumptions were checked to decide which test to use for correlation. Field (2013) described that a parametric correlational analysis requires data at least on the interval level and normality. For the level of measurement, all of our variables were at least in the interval level.

For the normality assumption, the data is checked with normality tests, P-P plots, and considering kurtosis and skewness values. Table 6 shows the results of the normality tests. Since Kolmogorov-Smirnov is argued to be best when $n \geq 50$ (Mishra et. al., 2019), Shapiro-Wilk results were considered for the analysis. The results showed that SUS ($W(20) = 0.98$, $p = 0.93$) and IMI interest/enjoyment subscale SUS ($W(20) = 0.95$, $p = 0.39$) scores were distributed normally. However, IMI value/usefulness subscale scores showed a significant deviation from normality ($W(20) = 0.88$, $p < 0.05$). For a more deeply examination, P-P plots and skewness and kurtosis values were evaluated. Figure 37-39 shows the P-P plots for each scale. These showed similar results to the Shapiro-Wilk normality tests. On the other hand, while skewness and kurtosis values (Table 7) also showed similar results for SUS and IMI interest/enjoyment subscales, for IMI value/usefulness subscale, skewness was reported as 0.35 and kurtosis -1.48, which is debatable for normality. The skewness of interest/enjoyment subscale was in the acceptable range, but the kurtosis value depends on the range accepted for normality. It is argued that -2 to +2 is also an acceptable range for these values (George & Mallery, 2019). Therefore, in the correlation analysis, the Pearson correlation coefficient was used as a parametric test, but bootstrapped confidence intervals were also considered, as Field (2013) suggested, to use in normality issues.

Table 6. *Tests of Normality*

Scales	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
SUS	0,11	20	,200*	0,98	20	0,93
IMI Interest / Enjoyment	0,16	20	,200*	0,95	20	0,39
IMI Value / Usefulness	0,21	20	0,018	0,89	20	0,02

* This is a lower bound of the true significance.

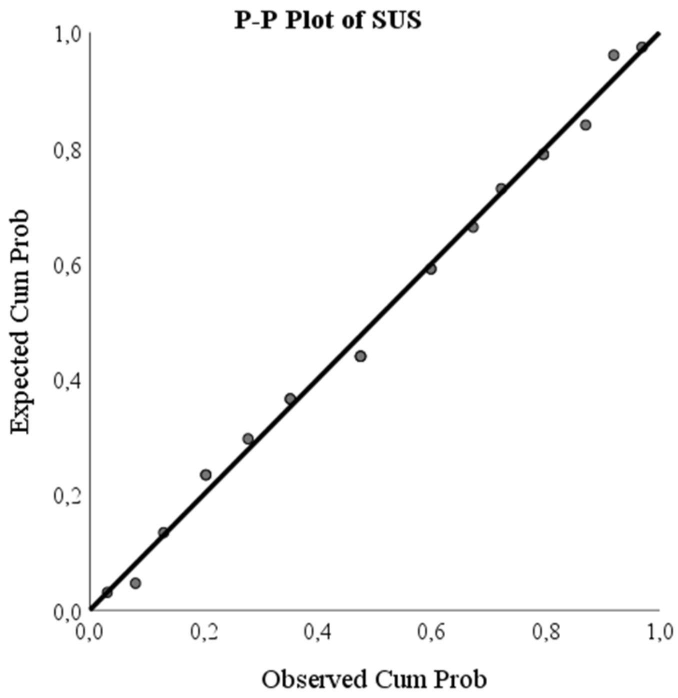

Figure 37. *The P-P plot built for normality assumption of SUS scores.*

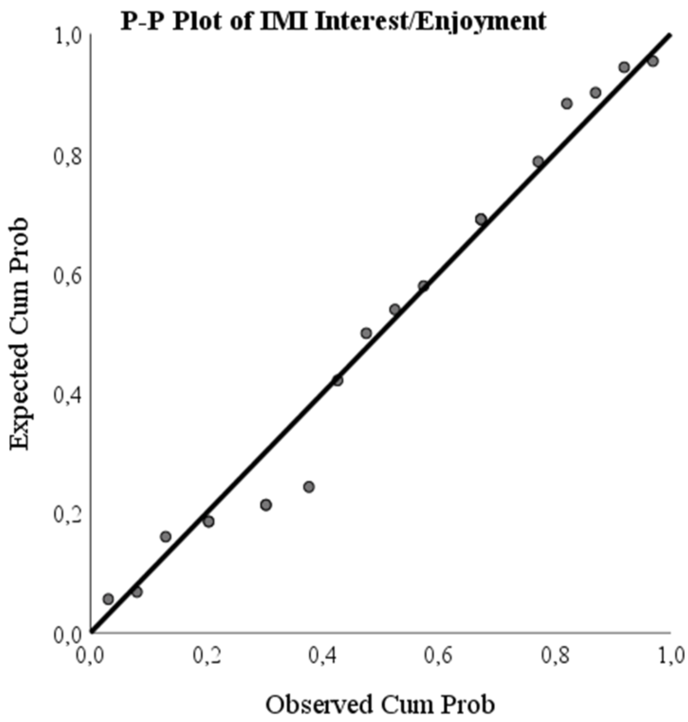

Figure 38. *The P-P plot built for normality assumption of IMI interest/enjoyment scores.*

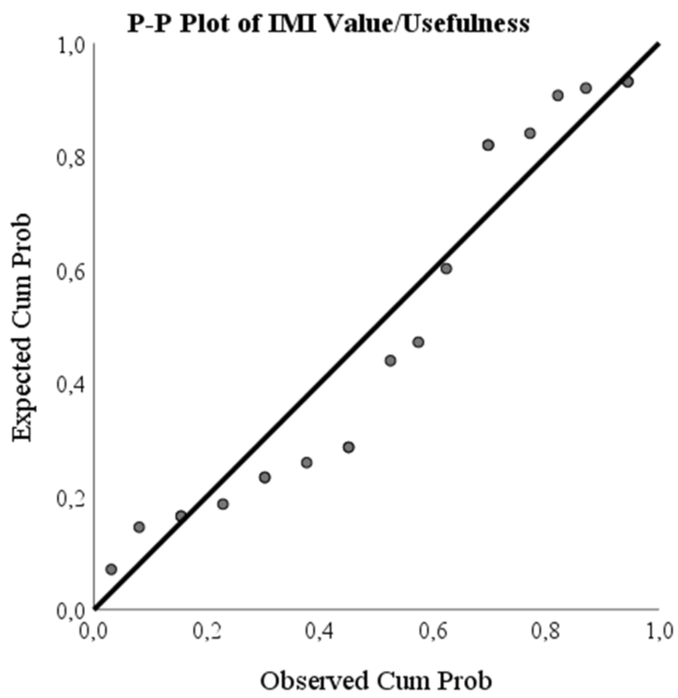

Figure 39. *The P-P plot built for normality assumption of IMI value/usefulness scores.*

Table 7. *The Descriptive Statistics for Scales*

Scales	*N*	Min.	Max.	*M*	*SD*	Skewness		Kurtosis	
						Statistic	*SE*	Statistic	*SE*
SUS	20	50	100	74,5	13,09	0,09	0,51	-0,05	0,99
IMI Interest / Enjoyment	20	2,14	6,86	4,43	1,44	0,14	0,51	-1,05	0,99
IMI Value / Usefulness	20	1,86	7	4,41	1,74	0,35	0,51	-1,48	0,99

As Table 8 summarizes, the Pearson correlation analysis showed that there is no statistically significant relationship between SUS scores and IMI interest/enjoyment subscale scores, $r = 0.38$, $p = 0.10$. In the same way, bootstrap 95% CIs showed that the range includes 0, which makes it possible to have no effect.

Table 8. *Correlation Results Between SUS and IMI Interest/Enjoyment Subscale*

Scale	IMI Interest / Enjoyment						
	Pearson Correlation	Sig. (2-tailed)	*N*	Bootstrap (c)			
				Bias	*SE*	BCa 95% CI	
						Lower	Upper
SUS	0,38	0,10	20	-0,01	0,22	-0,21	0,76

(c) Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

On the other hand, Table 9 shows the correlation analysis between IMI value/enjoyment and other scales. The IMI value/usefulness subscale scores were significantly related to both IMI interest/enjoyment scores, $r = 0.71$, 95% BCa CI [0.28 – 0.92], $p < 0.01$ and SUS scores, $r = 0.62$, 95% BCa CI [0.20 – 0.88], $p < 0.01$. While IMI value/usefulness' scale normality could be an issue for the results, the bootstrap CIs showed that both intervals do not cross zero, indicating a genuine effect. Value/usefulness subscale had a variance of 37.95% shared with SUS and a variance of 50.41% shared with interest/enjoyment subscale.

Table 9. *Correlation Results of IMI Value/Usefulness and SUS – IMI Enjoyment/Interest*

Correlations

Scales	IMI Value / Usefulness						
	Pearson Correlation	Sig. (2-tailed)	*N*	Bootstrap (c)			
				Bias	*SE*	BCa 95% CI	
						Lower	Upper
SUS	0,62**	0,004	20	-0,005	0,16	0,20	0,88
IMI Interest / Enjoyment	0,71**	0,00	20	-0,005	0,13	0,28	0,92

** Correlation is significant at the 0.01 level (2-tailed).

(c) Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

CHAPTER 6

DISCUSSION

The study conducted by this thesis developed a serious game for the shared decision-making process based on the objective structured clinical examination and a model of SDM for clinicians as a tool to practice. Johnsen et. al. (2016) argued that to provide a learnable and usable system, it is crucial to include an evaluation of the usability of a serious game during the development cycle. Therefore, while evaluating serious games, adopting qualitative and quantitative approaches and incorporating them into the development process is a suggested practice (Reichlin et. al., 2011). Although this approach, as a mixed-methods design, is suggested to use in serious game studies, Warsinsky et. al. (2021) reported in their review that in the serious games research regarding the health care domain, only 12.1% of the 206 studies adopted a mixed-methods design. To address these suggestions, the development process for the game in this study included a qualitative evaluation with experts from the domain.

The qualitative evaluation showed that the game needed several improvements before being presented to end-users. The suggested improvements included the removal of specific tasks, providing more flexibility to players at certain points in the game, adjusting instructions and interactions for a better experience, and revision of the content and feedback. These suggestions were implemented in the final game as much as possible.

The participants in the qualitative evaluation criticized the flexibility in the game flow. Comments such as “Through all the game, there was a curiosity for what would happen if I were pressed the other one.” or “I feel like I’ve been able to go one way but I can’t go back and try and ask more information…” were taken during the interviews. However, flexibility as such poses an implementation issue. The game developed during this study was planned as linear. This linearity means the destination that the game directs players was pre-determined before. While it is possible in the game to jump further steps depending on the choices made, this aims to represent that players may not know the requirements of SDM fully and miss some steps. In such situations, the feedbacks in the achievements form at the end of the game shows that there are more things to do for a proper SDM process. However, it is not possible to go back and forth between three talk steps or stations or for the player to define the order of the steps in a non-linear fashion. This was due to two reasons. First, the OSCE method used to structure the game consists of different stations, in which students tested separately for each station in educational settings (Rushforth, 2007). Therefore, though stations were connected in-game, it was not planned to move backward in the game flow. Secondly, the three talk model (Elwyn et. al., 2017) used in the game was first developed as a linear model (Elwyn et. al., 2012). However, the revised 2017 version allows using the model as both linear and fluid. This concept of leaving the decision of linearity to the practitioner is based on the study conducted for revision. Elwyn et. al. (2017) reported that about half the health care providers in the evaluation study of the revised model favored the linear flow while the rest favored the fluid flow. Therefore, there was no majority to propose a flow either way, and the numerical representations in Figure 28 were added to reflect the order of the process. Considering this and the OSCE method together, the game is also presented in a linear flow.

It is also vital to address validity in serious game research. Graafland et. al. (2014) stated that this is achieved from three aspects: face validity, content validity, and construct validity. In the scope of serious games made in the healthcare domain, face validity represents how well the medical set-up and context in reality are reflected in the game (Graafland et. al., 2014). In terms of that, the medical expert in our interview commented on the question about how well the game represents the medical setting as "Yeah, I mean it's quite realistic. In the end, the conversations are quite realistic." Content validity means the level of representation of the aimed medical construct in the game content (Graafland et. al., 2014). In terms of that, the medical information and the patient cases in the game regarding the physiotherapy domain were collected in a previous study in which physiotherapists developed the provided information and cases. The literature constructed the information regarding SDM. However, the degree of representation of this was not evaluated in this thesis as a usability study. Finally, the construct validity represents how well the game outcomes reflect the difference between experts and novices (Graafland et. al., 2014). The game developed in this study does not aim to assess clinicians' knowledge or practice skills in terms of SDM. While before a score was represented in-game, it was implemented as a game feature rather than a representation of SDM skills and removed after the comments in the qualitative evaluation.

Following the improvements after the evaluation study, the final game was named *PhysioInformed.* The usability study with that version resulted in a 74.5 usability score as evaluated with SUS. For the classification of SUS scores, a rule-of-thumb approach was adopted (Bangor et. al., 2008). This approach resembles the grading systems in universities where certain intervals of grades are represented with letters as A, B, C, etc. Though the rule of thumb was not developed or suggested in the SUS guide developed by Brooke (1996), it is a commonly adopted way of evaluating the score both in scientific and industrial research (Bangor et. al., 2008). However, different classifications were made for the rule of thumb (Bangor et. al., 2008; Sauro & Lewis, 2016); Brooke reviewed the SUS in 2013 and provided information for grading the scores. According to that, our score falls in the "C" grade, which is an acceptable and good score. In line with these, in our qualitative evaluation, the game was also commented as "…You had it clear clicking all the different options. It's really clear when you done the choosing the treatments, with the things come up in corners. They were really clear and that they turned green once you completed."

IMI scale was used in studies to represent the self-reported experiences with an activity (Prahm et. al., 2018; Vandercruysse et. al., 2016). For our game, the IMI score turned out to be 4.43 for the interest/enjoyment subscale and 4.40 for the value/usefulness subscale. For the evaluation of IMI scores, there is no certain threshold to check or any categorical representation. Instead, it is evaluated as the higher scores meaning higher levels of self-reported motivation and usefulness. Therefore, considering the scoring of each item on a 1-7 Likert scale and 4 being the average score on this scale, it might be said that our game induced an average level of interest/enjoyment in participants, and participants perceived the game as averagely useful.

IMI is constructed based on the self-determination theory. It is a meta-theory that combines six different theories, focuses on human motivation, and studies the intrinsic and extrinsic sources affecting motivation and social cognitive development. (Deci & Ryan, 2013). The subscales under IMI consider these sources; some are positive predictors with the main interest/enjoyment variable, while others are negatively correlated (CSDT, n.d.). The value/usefulness subscale in that scope is a separate variable. The research examined this association between the two variables. For example, Davis et. al. (1992) examined the usefulness and enjoyment variables in using computers and their relation to the intention to use. Their study found a strong relationship between usefulness and enjoyment as well as reported that both variables affect the intention to use. Perceived usefulness is also one of the main external factors in Technology Acceptance Model (TAM). TAM was proposed to examine one's interaction with and acceptance of technology as well as users' behavioral intentions to use it (Abdullah & Ward, 2016). It is a commonly accepted model developed by Davis (1989) and widely used in serious game research (Wang & Goh, 2017). Along with various other factors, TAM's main two external factors are perceived usefulness and perceived ease of use (Nikou & Economides, 2017). A meta-analysis regarding TAM showed that all the studies under review found a positive relationship between perceived usefulness and enjoyment which is a factor affecting intrinsic motivation (Abdullah & Ward, 2016). Our scores for value/usefulness and interest/enjoyment were also related to each other and were in line with this argument. Therefore, considering both subscales and their relationship, *PhysioInformed* can be an averagely acceptable technology regarding the TAM's perceived usefulness factor.

While TAM’s other main external factor in the acceptance of a technology was perceived ease of use (Abdullah & Ward, 2016), SUS is considered a reliable method to measure perceived ease of use since it aims to measure usability (Revythi & Tselios, 2019). As TAM considers perceived usefulness and perceived ease of use, research showed that these two variables are also related (Lee et. al., 2005). In line with these, our SUS and value/usefulness scores showed a similar relationship between the two variables. As SUS scores indicated good usability or, as the research suggests, good perceived ease of use, *PhysioInformed* can also fit into TAM in terms of perceived ease of use.

Finally, enjoyment is the main internal factor in TAM, and research also showed that enjoyment and perceived ease of use are also related (Lee et. al., 2005). Our analysis did not find a similar result regarding that. This may be since the number of participants in the study was small and collected with a non-probability sampling method. However, our interest/enjoyment subscale was also scored averagely.

Therefore, as a final implication, *PhysioInformed* can also fit into TAM in terms of the main internal factor.

CHAPTER 7

CONCLUSION

This thesis proposed a serious game named *PhysioInformed*. The game aims to create a safe space for physiotherapists to practice SDM and provide a tool that is easy to use and reach while increasing awareness of the SDM process. The game was developed in an iterative process. The process started with constructing the framework for SDM by reviewing the literature. This provided the basis for OSCE procedure, medical information regarding physiotherapy and health domain, and the SDM process. With the framework established, the prototype of *PhysioInformed* was developed in Unity game engine and presented to experts to evaluate the game with interviews. The feedback in these interviews led us to adjust the game both in terms of functionality and the framework. Then, the usability of the reviewed game was assessed. The usability study results showed that *PhysioInformed* has a good usability score and is perceived as an averagely enjoyable and useful game. Further examination of the scores and literature may indicate that the game can also be evaluated as an acceptable technology based on the external and internal main factors of Technology Acceptance Model (Davis, 1989).

7.1. Contributions

The main contribution of this thesis is a novel serious game for SDM. To our knowledge, this is the first serious game developed with such purpose. In addition, our literature review showed that although there are examples, the studies incorporating OSCE into a game were very limited (Tucker Edmonds et al., 2019; Tucker Edmonds et al., 2020). This study also indicates an example in that sense, though it was not the main aim of this study. Similarly, literature was scarce on developed OSCE examples for SDM (Tucker Edmonds et al., 2019; Tucker Edmonds et al., 2020), and studies rather focused on decision-making skills assessed by the OSCE method (Hsiao et al., 2202; Kupke et al., 2012). Although this study does not provide an original example of OSCE for SDM, it puts an example to study the two concepts further. Finally, there was no research in the literature to study SDM, SGs, and OSCE concepts together. This thesis could provide a base to investigate the three concepts together to teach SDM or train clinicians in a structured way that is also easy to use.

7.2. Limitations

One of the main limitations of this study was the sample size. Although the literature suggests that for System Usability Scale, small sample sizes do not pose a problem (Tullis & Stetson, 2004), it may cause a limited evaluation of the Intrinsic Motivation

Inventory. The correlation may be biased with such sample sizes, although bootstrapping was used for more robust results.

Similarly, the qualitative evaluation conducted during the game development process included two experts in the study. However, qualitative research and interviews as such made with less participants compared to quantitative methods.

Another limitation is that the game developed for this study adopted the physiotherapy domain for the health aspect of the SDM. Therefore, it is crucial to evaluate the results in that sense.

Since the OSCE research is limited regarding the SDM process and current literature does not provide details on the OSCEs designed for SDM, the OSCE used in this study was a guide rather than an applied example. Hence, the game and the results should be evaluated considering that.

Finally, the measurements used in the usability study are based on scoring the items on a Likert scale. While there are supporting arguments for using Likert scales, there are also related issues such as the "anchor effect" in which participants tend to score the neutral answers (Bishop & Herron, 2015). Therefore, evaluating this study's results as limited to issues brought by the Likert scales is essential. However, as Yanes-Gomez et. al. (2016) showed, standard questionnaires with Likert scales are the second most preferred evaluation method in serious games, following the ad-hoc questionnaires, which are also criticized for lacking any reliability and validity assessments.

7.3. Suggestions for Future Studies

The length of our game and the flexibility between OSCE stations were reported as a criticism in the qualitative evaluation. Further studies could consider these while conducting a similar study to provide a more fluid flow in the SDM process and increase participants' motivation, which may be affected by the length of the game.

Serious games are valid mediums for studying many concepts. Elwyn et. al. (2017) state that SDM is not known well in the health domain, and clinicians need to be educated about the process. In that sense, an SG can provide a way to conduct a study on teaching, training, and increasing awareness of the SDM process.

While this study aimed that the game used by physiotherapists, SDM is also an unfamiliar concept to patients. An SG can also be used to address patients to familiarize them with the process.

Finally, our game proposed a dialogue-based game for the SDM process. On the other hand, OSCE can be used to assess various skills. Future studies can design a game where medical tests and inspections are also incorporated into the game, extending the use of OSCE and providing a more interactive game.

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APPENDICIES

APPENDIX A - OSCE GUIDE

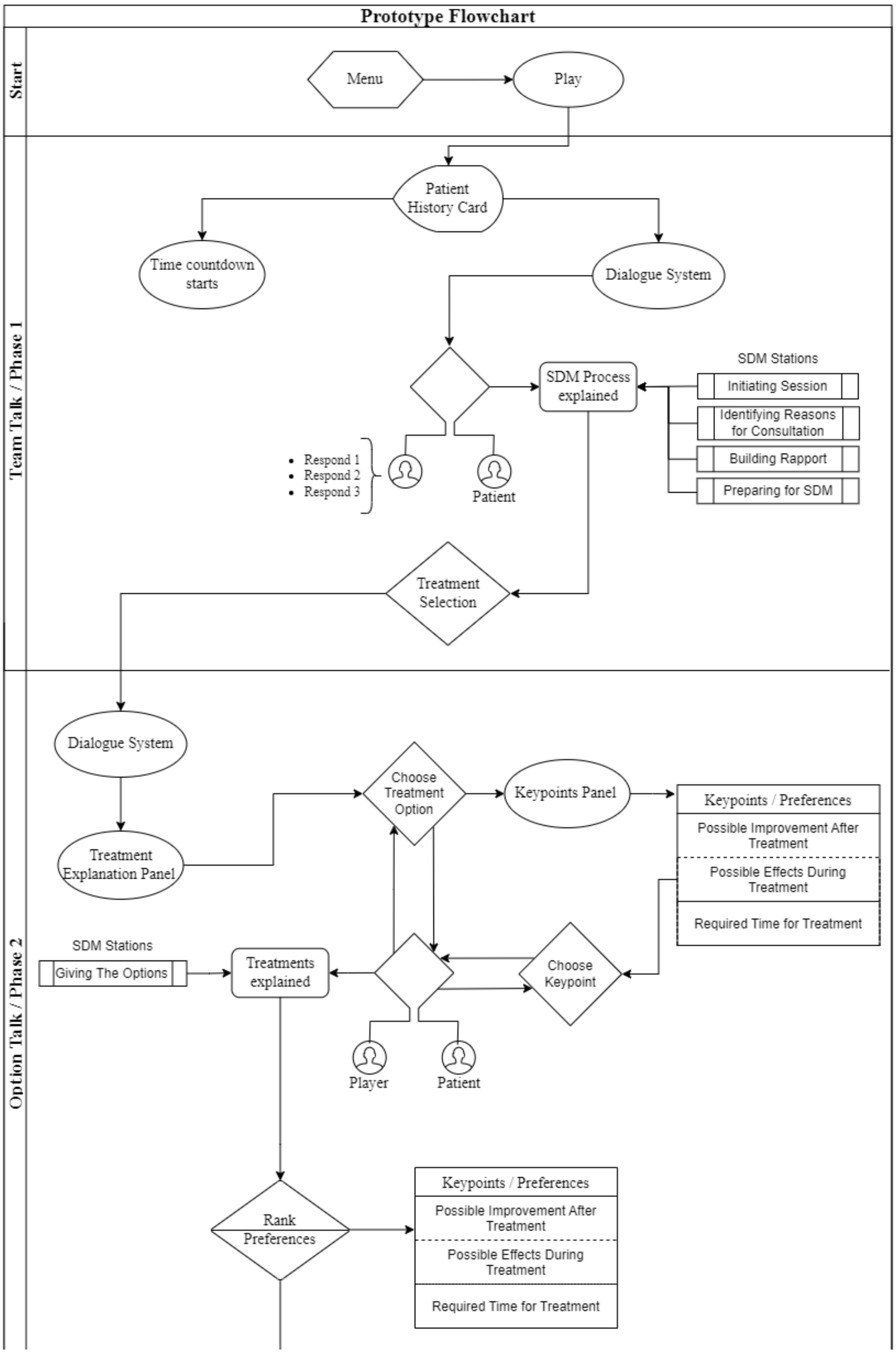
Shared decision making process

Requirement	Max mark	Score
Initiating session • Greets/introduces/context of consultation	1	
Identifying reason for consultation • Asks open question to establish the reason for the consultation • Takes a focused history	2	
Building rapport • Shows interest and respect. Acts supportively • Establishes the patient's ideas, concerns and expectations	2	
Preparing for shared decision making • Outlines that there are various options for management and invites the patient's involvement • Asks the patient if they have any specific questions before continuing • Establishes an agenda for the consultation with the assistance of the patient (signposts the options) • Asks about initial preference	4	
Giving the options • Checks patient understanding • Avoids jargon and uses appropriate language • Gives relevant and an appropriate amount of information • Applies the information to the patient's ICE	2	
Assisting with decision making process • Explores the advantages and disadvantages of each option discussed • Patient consulted and encouraged to reflect on options provided • Shares medical perspective (own insight) • Negotiates and agrees on a plan	4	

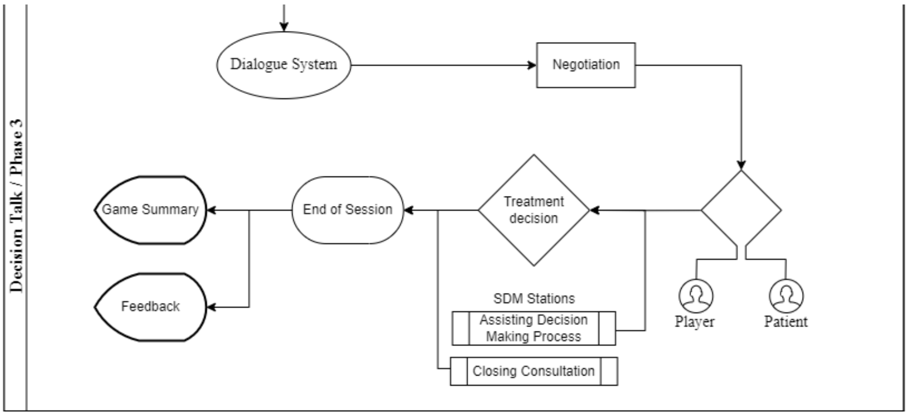
OSCE GUIDE (cont.)

Closing the consultation • Outlines relevant follow-up and opportunity for further questions • Thanks the patient	2	
Structuring consultation • Signposts, summarizes, screens • Recognizes, acknowledges and validates feelings and concerns	3	
Process • Overall organization of the consultation	4	
Total	25	

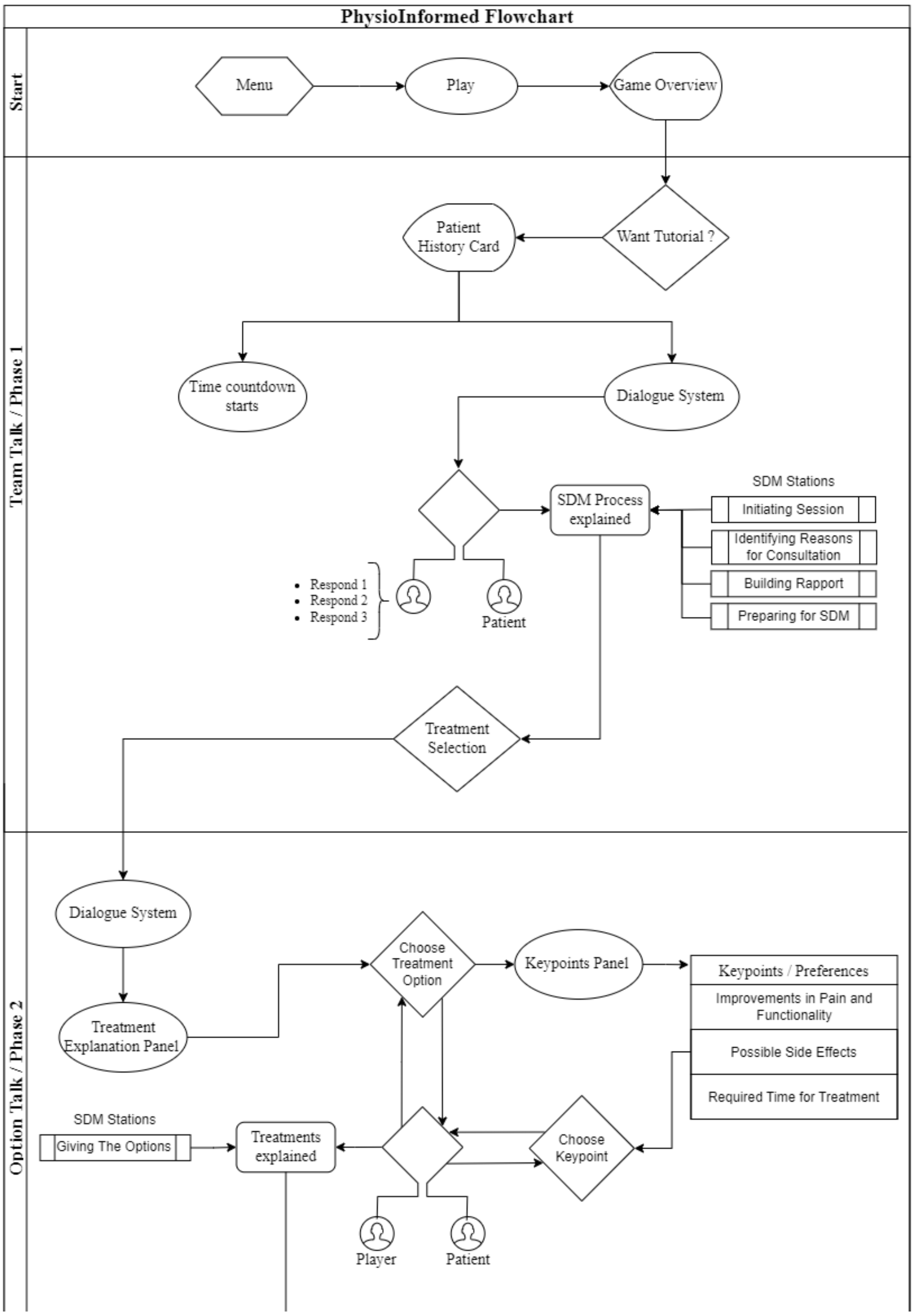
APPENDIX B - PROTOTYPE GAME FLOWCHART



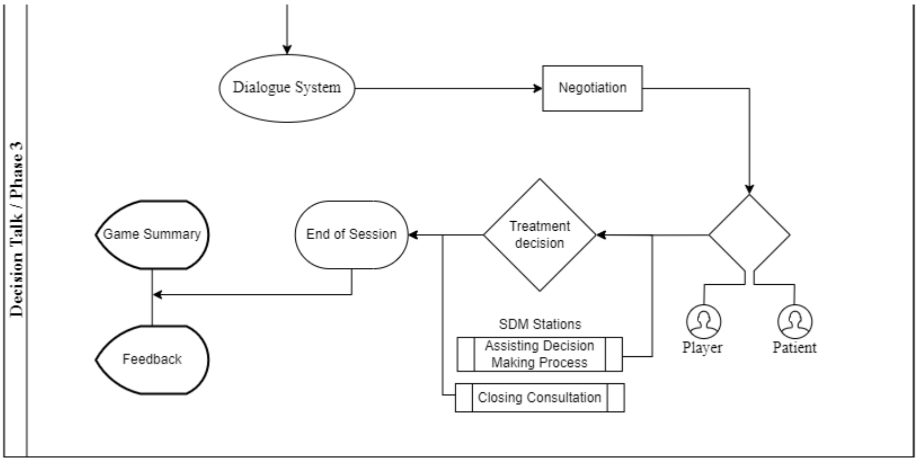
PROTOTYPE GAME FLOWCHART (cont.)



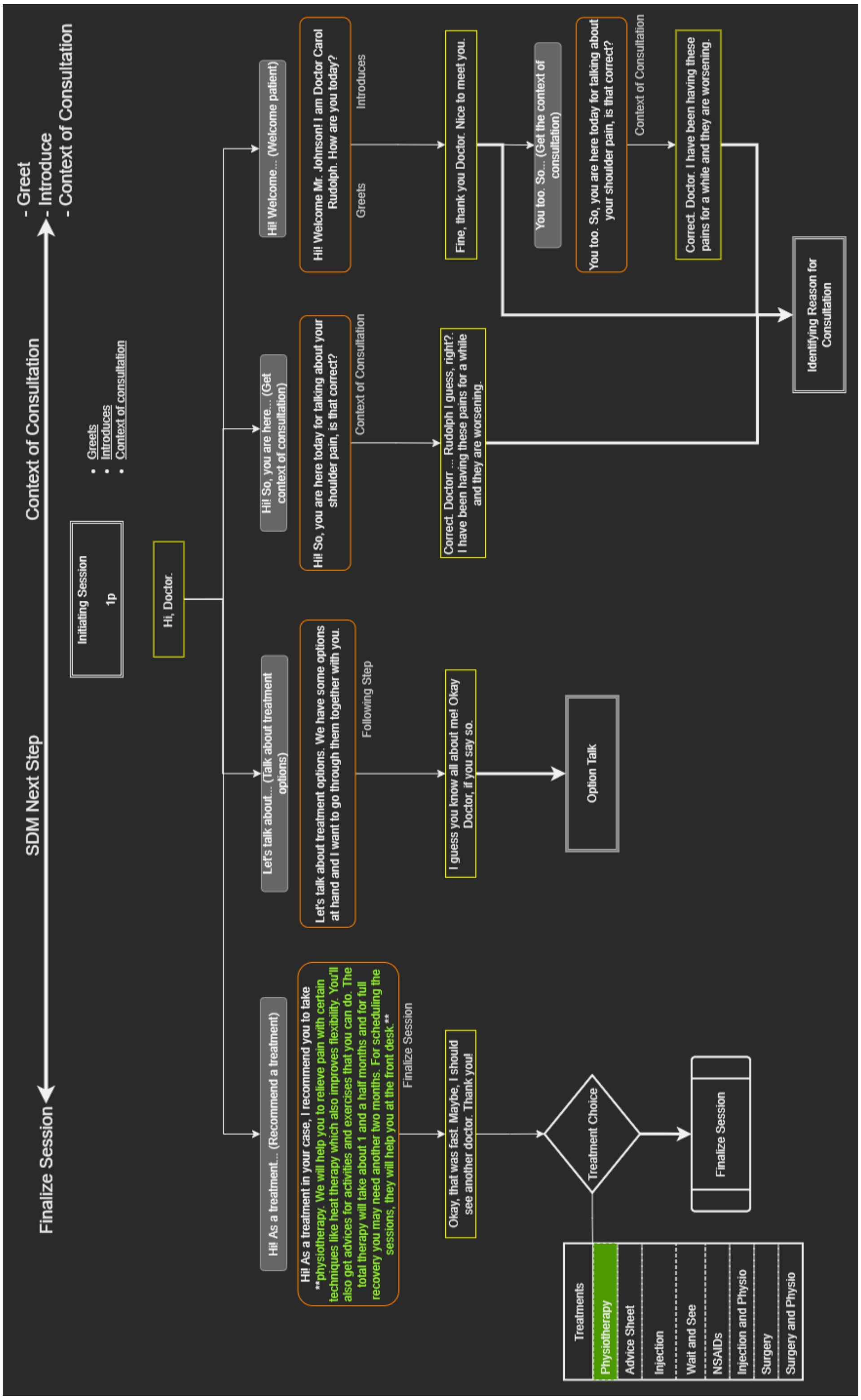
APPENDIX C - PHYSIOINFORMED GAME FLOWCHART



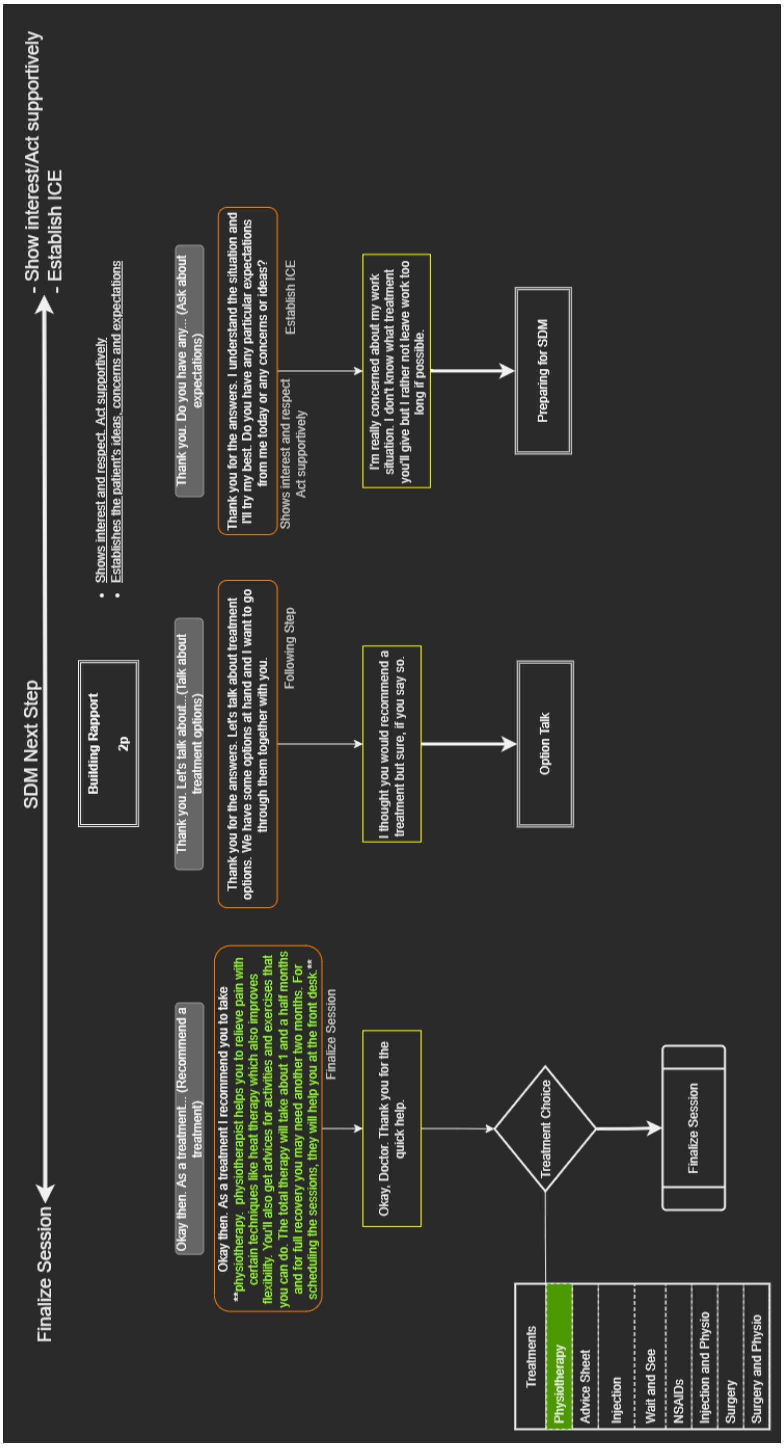
PHYSIOINFORMED GAME FLOWCHART (cont.)



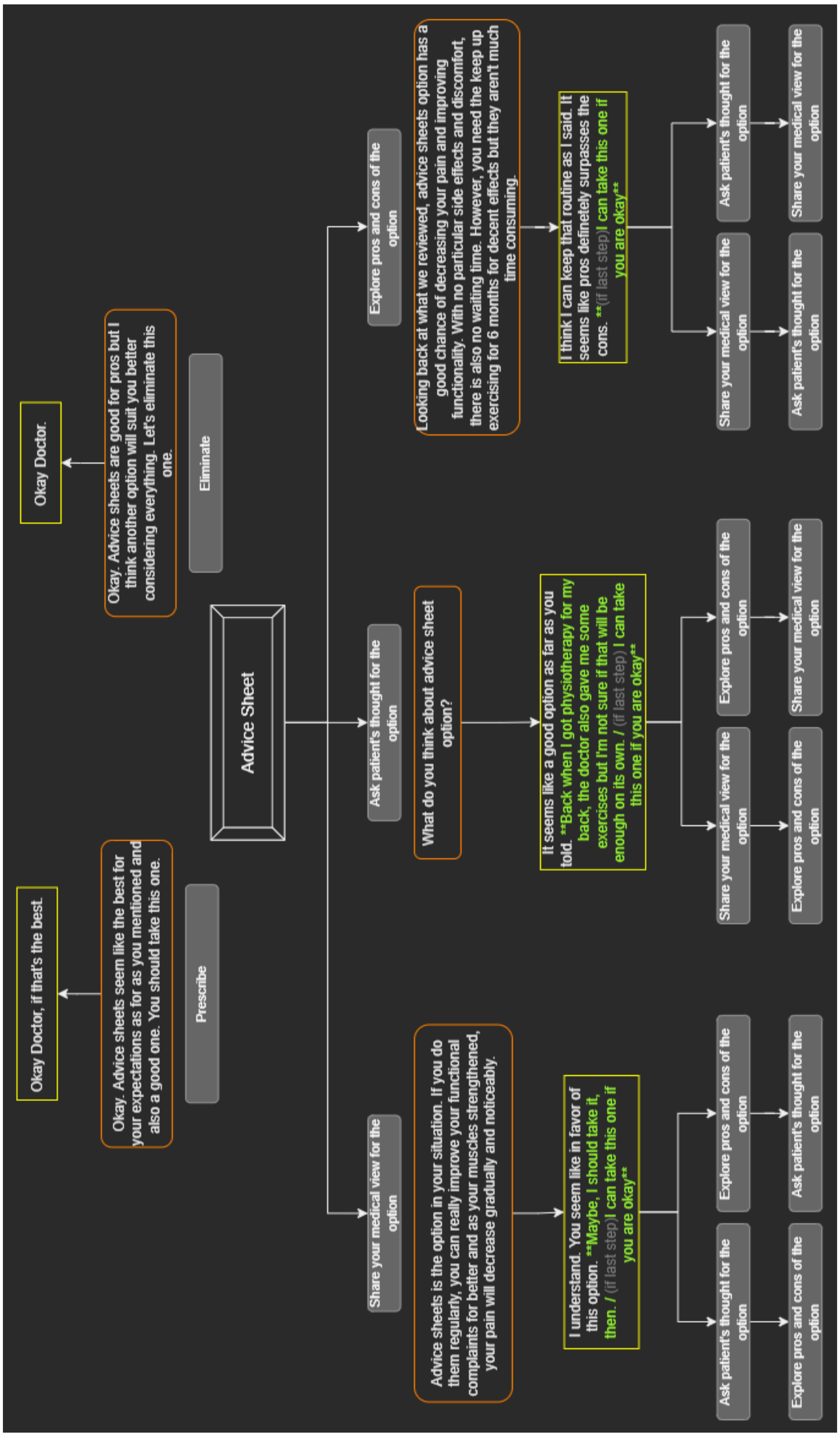
APPENDIX D - SAMPLE DIALOGUES



SAMPLE DIALOGUES (cont.)



SAMPLE DIALOGUES (cont.)



APPENDIX E - SEMI-STRUCTURED INTERVIEW QUESTIONS

1) Do you think the instructions given in the game were clear?
2) Do you think there were any difficulties in the game?
3) Do you think the feedback given by the game was understandable?
4) What parts you didn't like in the game?
5) What did you like most while playing the game?
6) What can be improved in the game?

APPENDIX F - INFORMED CONSENT FORM

This study is an ongoing research in the scope of a graduate thesis and conducted by Middle East Technical University, Cognitive Science Department student Ahmet Sülün who is advised by Assoc. Prof. Barbaros Yet. With this form, it's aimed to inform you about the circumstances related to this study.

The Aim of The Study
This research aims to observe the decision making process for a patient and a doctor during medical consultations. For that purpose, a dialogue based game is designed. In this study, we want to evaluate the user perception of the game.

What Do We Expect From You?
If you give consent to participate in this study, it's expected that you will play the game with the link given which will be provided upon completing this form. The game session will take approximately 10-15 minutes. In the game, you will play as a physiotherapist who is in a medical consultation process with a patient. If you come across with something you don't know during the game or a decision point you think you aren't sure, you can follow the direction you think would be the best.

After the game ends, you will be directed to a questionnaire to evaluate your experience with the game. Please play the game carefully to fill the questionnaire. You will be directed to the questionnaire when the game ends.

How Are We Going To Use The Information Gathered?
The participation to the study is completely voluntary. During the game you play, there will be no information asked to determine regarding your identity or your institution. All the information gathered will be kept secret and only be evaluated by the researchers. Evaluation will be done collectively considering all the participants and will be used in academic publications.

Things you need to know about your participation:
This study does not contain questions, information or practice that can be perceived as sensitive. However, if you feel uncomfortable for regarding the content or anything, you are free to leave the study at any point.

If you want to request more information about the study:
After study is completed, if you want to know more than that, you can contact graduate student Ahmet Sülün (e-mail: ahmet.sulun@metu.edu.tr).

APPENDIX G - DEMOGRAPHICS

1) Gender:
   ☐ Male
   ☐ Female
   ☐ Prefer not to say
   ☐ Other: ……………

2) Age:
   ………………

3) Education:
   ☐ Elementary School Degree
   ☐ High School Degree
   ☐ Bachelor’s Degree
   ☐ Master’s Degree
   ☐ Doctorate Degree

4) Occupation:
   …………….

5) How often do you play digital games?
   ……………………..

APPENDIX H - SYSTEM USABILITY SCALE

Strongly disagree				Strongly agree
1	2	3	4	5

1. I think that I would like to use this system frequently.
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. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

APPENDIX I - INTRINSIC MOTIVATION INVENTORY

not at all true			somewhat true			very true
1	2	3	4	5	6	7

Interest/Enjoyment
I enjoyed doing this activity very much
This activity was fun to do.
I thought this was a boring activity. (R)
This activity did not hold my attention at all. (R)
I would describe this activity as very interesting.
I thought this activity was quite enjoyable.
While I was doing this activity, I was thinking about how much I enjoyed it.

Value/Usefulness
I believe this activity could be of some value to me.
I think that doing this activity is useful.
I think this is important to do.
I would be willing to do this again because it has some value to me.
I think doing this activity could help me.
I believe doing this activity could be beneficial to me.
I think this is an important activity.

APPENDIX J - ETHICAL APPROVAL PROVIDED BY METU APPLIED ETHICS RESEARCH CENTER

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

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20 HAZİRAN 2022

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Barbaros YET

Danışmanlığını yürüttüğünüz Ahmet SÜLÜN'ün "Ortak Karar Verme: Hekimler için OYKS Tabanlı Bir Ciddi Oyun" başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek gerekli onay **0331-ODTUİAEK-2022** protokol numarası ile onaylanmıştır.

Bilgilerinize saygılarımla sunarım.

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