TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

APARAJITA CHOWDHURY

EXPLORING THE USER NEEDS AND EXPERIENCE OF THE UNIVERSITY GUIDANCE ROBOT

Master of Science Thesis

Examiner: Dr. Aino Ahtinen
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ABSTRACT

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During the orientation week, new students face different challenges that are hectic. International students are especially confused about the new education system and come across many difficulties to overcome these challenges. There are too many information, which can be overwhelming. Not only for internationals, but for Finnish students also face information management issues. Although there are tutors assigned to help and take care of them, the tutors are not available at all times. Thus, we decided to design an interactive university guidance robot that could help the students whenever needed with relevant information.

Our aim was to understand the users' expectations and design the guidance robot to provide relevant information. There were also latent user needs and these can vary according to different culture. Thus, we addressed the needs according to Finnish, Chinese and Indian culture and aim to design the robot according to the needs of the target users. In the second phase, we conducted trials with new students to understand the experience of the participants. Moreover, we tried find out what was the preferred tasks among the students.

We used Pepper robot as the platform for guidance robot. According to our research, the new students found the robot useful and it successfully addressed the needs of the participants. Moreover, the university guidance robot evoked experiences like *nurture, fellowship, natural/humanlike and playfulness.*

In this thesis, we report how we collected the users' expectation, analyzed the data to gather design implications, implemented functionalities in the university guidance robot and performed trials.

PREFACE

Robots have always been interesting for me. Since childhood, I had a fascination towards humanoid robots and watched many television series on them. Getting an opportunity to work with humanoid robots was a dream come true. Hence, I am immensely happy that I got this opportunity to work with human centered robotics project, which was funded by the same project. In the beginning, it was intimidating for me as the research area for human robot interaction is vast. Nevertheless, my supervisor, Aino Ahtinen, has always been helping and supporting me to solve my queries. I would like to thank her to supervise and guide me.

Although, Aino Ahtinen directly supervised me, many people behind the scene supported and guided me during my thesis phase. I would also like to thank Kirsikka Kaipainen and Aleksi Hiltunen were always helping me with technical details, as I am technically not so sound.

I owe a big thanks to my colleagues Pouya Eghbali and Nasim Beheshtian to help me during my trial and help me gather as much participants as possible. I would also like to thanks Elina Hilden and Pavel Chistov for supporting me. Thanks to Kaisa Väänänen for giving valuable feedback on my thesis.

Finally, big thanks to my friends and family who has always been by my side during this phase and supported me continuously.

Tampere, 30.9.2018

Aparajita Chowdhury

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1 INTRODUCTION

This thesis is based on the pre-study, design, implementation and evaluation of a university guidance robot prototype on the social robot Pepper developed by Softbank Robotics [49]. When the international students arrive in a new environment, they need to absorb a lot of information. Not only that, their environment and circumstances are also different from their home country. Thus, the experience can be very overwhelming and stressful. Although the university assigns tutors for the new students, they might not always be around. Moreover, there were not many researches done on university guide robots. Therefore, we tried to implement functionalities on a social robot since robots can be utilized 24/7 and can hold much more information than human. The thesis aims to explore what are the expectation and experience of the newly arriving international students and how Pepper can help the newcomers as a university guide.

1.1 Background

According to Wang et al. [48], there is a high possibility of the emergence of social robotics due to the speedy growth of Chinese economy and upcoming trend of the world, since the Chinese government is focusing on the growth of service robots. Social robots should be able to interact with a human to relate in a personal way [43]. Moreover, a social robot should understand human and act accordingly [8]. This understanding can vary from culture to culture. According to Sabanovic et al. [43, p.1], “Culture shapes how humans interact with their environment – technology included – but it does so through a lens of situated practice and cognition.” Furthermore, these norms do have an impact on user experience. According to Alengjung et al. [4], it is important for robots, just like all other interactive systems, to mediate a positive user experience to gain user acceptance. Otherwise, it can result in adverse outcomes, such as, avoiding interaction with the robot or spreading negative publicity about the robot. If a robot acts up with the human in any aspect, he/she will have a negative experience with the robot, which might have a negative impact on the overall interaction and attitude. To understand the varied experience, we decided to conduct user studies in the Tampere University of Technology, where the students come from different background. Thus, our research goal is to study how university students from diverse backgrounds perceive the interaction with the guidance robot and what experience does it invoke in them as well as what features they consider beneficial for the guidance robot.

1.2 Pepper in Context of University Guidance among Different Cultures

The context of the research is university guidance with social robot Pepper[1] for new students at the Tampere University of Technology. The reason for selecting Pepper is explained elaborately in section 2.1.1 and 2.1.2. Most of the international students face problems related to food, accommodation, habituation, orientation and language barrier when they arrive into the new culture [14]. Being an international student, the author realized how difficult it could be to adjust in a foreign country. Not only that, the local students sometimes face problems due to the discontinuity of their tutors. Thus, the thesis aims to dig out the challenges students meet during the orientation week and how do they expect Pepper to solve them. The thesis also aims to study the initial experience of new international and local students with the social robot after implementing expected functionalities. Cultural aspects also play a vital role when it comes to experience and expectation, especially with international target users. According to Sabarnovic et al. [43], culture is an important context when it comes to human-robot interaction, but the nature of these differences varies among researches. There have been instances where participants from Japan and USA behaved similarly with the robot. For instance, according to both Japanese and American participants, humanoid robots should be partially autonomous and be only responsible for decision making during easy tasks [41] On the other hand, the opposite is also true. Nomura et al. [41] found in their study that Japanese participants to some extent agree that small humanoid robot can autonomously make decisions, whereas, the participants from the USA contradicted with this opinion. However, cultural influence does exist in user preference [36]. Wang et al. [52] have shown in their study that Chinese culture, which is a high context culture [19], prefers indirect method from the robot to express disagreement, whereas participants from the USA, who belong to the low context culture, expect the robot to express its opinion. The high context culture usually communicates profoundly with gesture and context, whereas low context culture depends mostly on verbal communication [19]. The comparison was mainly visible between western and eastern culture. Thus, the initial plan of the thesis was to compare the expectations, experience and preferred tasks between western and eastern culture. We decided to focus on three cultures, Finnish, Chinese and Indian, that would reflect eastern and western cultures. Lewis' cultural model [36] and Hofstede's cultural model [25] helped to identify these cultures. The focus was to select cultures that would represent the eastern and western culture and to choose three countries that would vary according to the scale of these cultural models.

[1] https://www.softbankrobotics.com/emea/en/pepper

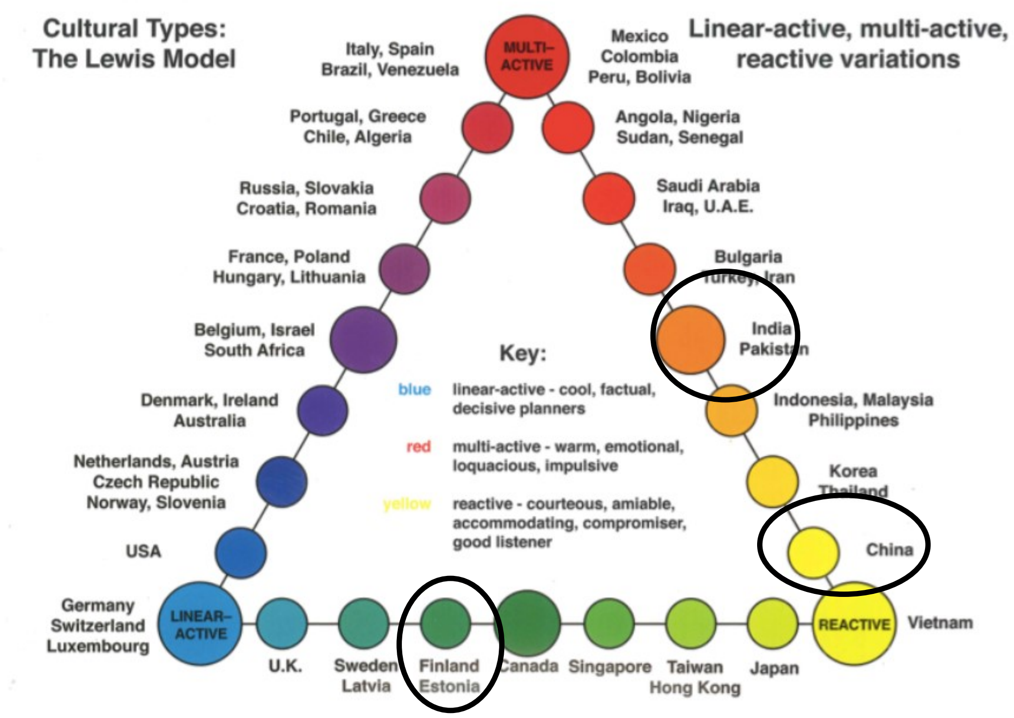

Figure 1.1 The Lewis Model. Adapted from The Lewis Model Explains Every Culture in the World, by G.Lubin, Retrieved 15th October from https://www.businessinsider.com/the-lewis-model-2013-9?r=US&IR=T&IR=T

The Lewis' cultural model above shows that Finnish culture is between to linear active and reactive culture. On the other hand, both Chinese and Indian culture falls between to reactive and multi-active culture. However, Indian culture lies in the middle and Chinese culture deviates more towards reactive culture.

Thus, these cultures were selected based on their cultural diversity. Moreover, these three cultures will be efficient to evaluate the western and eastern cultural cues in human-robot interaction Finnish culture is considered to be western and the other two cultures considered to be more eastern [40]. Thus, it is vital for us to understand the cultural influence while designing Pepper as a university guidance robot.

1.3 Role of User Experience in Designing University Guidance Robot

In this section, we discuss why extracting user expectations, as well as understanding user experience is essential for this research.

1.3.1 User Experience and Target Experience

According to the definition of ISO 9241-210 [13], the user experience is the experience of the users that is influenced by a product or service before, during or after the interaction. It also depends on meeting the user requirements [21]. Thus, it is crucial for designers to understand the needs of the users and hence design a product that addresses users' requirements. User experience more than just addressing user need. It is more about focusing on how to make a product pleasurable to use [47]. It is especially true in the case of interactive systems. Since we are planning to design functionalities for a guidance robot, we need to consider users' need not only to develop functionalities but also to ensure a pleasurable experience with the guidance robot. One of the crucial elements in human technology interaction is emotion. Human experience is usually derived from their emotions [20]. For example, if an interactive system arise any negative emotion, the users generally link negative experience with the interaction and vice versa. Thus, it is inevitable to understand the emotions that occurs during the interaction to deduce the experience the system evokes.

As mentioned above and confirmed by Law et al. [33], the experience the users go through are usually divided into three sectors; before the interaction, during interaction and after the interaction. Moreover, social robots are yet novel among the general crowd. Thus, the users' emotional arousal caused by the novelty of the robot before interaction might affect their experience after the interaction. On the other hand, the opposite can happen. Users might expect more than the robot can perform and experience negative emotions. Experience cannot be forced on to the users; instead, it should be evoked by designing the system according to the users' expectation [20]. Thus, we need to collect the user's needs and expectation for our university guidance robot and design the interaction and features accordingly. Furthermore, we need to record the experience users undergo before, during and after the interaction. In this way, we would be able to confirm if our understanding of users' expectation was valid or not. According to Maslow et al. [37], human needs can be divided into several categories, and they thrive to achieve others once their basic needs are met. The basic requirements are usually physiological and are essential for survival. As we move up the hierarchy, the needs become spiritual. Furthermore, according to Hassenzahl et al. [21], an interactive product should have pragmatic and hedonic qualities (described in section 1.3.2) to satisfy these needs. It is crucial for us to understand what are pragmatic and hedonic attributes, and how can we utilize them to meet user needs and expectations.

1.3.2 Pragmatic and Hedonic User Experience

In this section, we report what pragmatic and hedonic user experience is, and why are they necessary to address user needs.

Pragmatic Qualities

According to Hassenzahl et al. [20], pragmatic attributes are used to manipulate the environment to "access a functionality". It means that pragmatic qualities can be utilized to achieve primary goals. Hassenzahl et al. [20] compared pragmatic attributes with a hammer, which is used to drive a nail in the wall but it is the user's responsibility to figure out the process of doing it. Thus, *a product possesses pragmatic attributes if the users can successfully achieve the target of a task* [20]. In our study, the importance of pragmatic qualities lies in successful information retrieval, usability and operability of the design in the context of university guidance robot. Thus, our target will be to create a platform for the users to extract necessary information related to the university via the guidance robot. This information shall be vital for their survival in the university during the initial phase. Thus, it is inevitable that we set pragmatic UX goals (goals set to create functionalities that are used and works very well [20]) from user's expectation for successful implementation of features to satisfy user needs.

Hedonic Qualities

According to Hassenzahl et al. [20], hedonic products produce "pleasurable" user experience. Hedonic attributes address users' latent psychological needs [21]. Hassenzahl et al. [18] again used the hammer's example to address hedonic quality. If someone uses a hammer that is inherited from a family member, it might carry some emotional value. Thus, the inherited hammer evokes pleasurable experience and nostalgia each time the user manipulates it. It is not different when it comes to interactive systems. The user might feel attracted towards a system before interacting with it due to some emotional attachment. Although pragmatic and hedonic attributes are independent, hedonic attributes seem to be somewhat more efficient than pragmatic characteristics [20]. Väätäjä et al. [48] addresses the needs of users and sets hedonic UX goals such as safety in operation, security, sense of control, the feeling of presence, stimulation, competence, self-efficacy, etc. In our case of university guidance robot, these goals are addressed as hedonic goals, which evokes a pleasurable experience among the users and might attract them before interaction. Social robots are capable of building an emotional bond with the users [7]. Therefore, it is wise for us to understand what emotional bond the users expect to form with Pepper and build the hedonic goals around them. Moreover, it would be interesting for us to evaluate the emotional experience users go through in the trial.

Of course, it is not enough to form the pragmatic and hedonic goals for the robot. It is necessary to investigate if the guidance robot responds to these goals. Hence, we need to conduct evaluations after designing the robot to analyze if the robot achieves the pragmatic and hedonic goals set from the users' expectations.

1.4 Objective and Methodology

To explore the university students' expectations, experiences and preferred tasks related to university guidance robot, we decided to formulate our research questions as follows:

- What are the expectations of students for the university guidance robot?
- What is the experience of the students with the robot?
- What are the preferred tasks for Pepper in the university guidance context?
- Are there any cultural differences in expectations, user experience and preferred tasks?

The target was to interview three different cultures to understand the expectations of students for university guidance robot. Based on the gathered data, we would construct our pragmatic and hedonic UX goals to deduce the design implications for the guidance robot. As mentioned in section 1.3.2, it is necessary for us to conduct a trial with the new students to understand their experience with the robot. Thus, it was essential for us to do user studies to evaluate user´s needs and expectations and design Pepper's functionalities. The thesis work consists of the following parts:

1) To collect qualitative data about the expectations for Pepper on the university guidance context, **pre-studies** were conducted with 30 participants in total. In this phase, the participants were mainly asked about their experience arriving at the university as a student. They were also given scenarios where they had to imagine that it was their first day at the university and how can Pepper help them in different situations.
2) We then analyzed the gathered data to derive design implications and functionalities for the guidance robot. We also implemented the design functionalities on the robot using GUI called Choregraphe and few programming languages.
3) **Trials** were arranged to evaluate the university guidance robot with the students who arrived at the university in fall 2018, where they were given particular tasks to complete. After completing the tasks, they were asked to fill up a questionnaire about their experience, preferred tasks and what role was Pepper playing according to them.

1.5 Structure and Phases of the Thesis

In chapter 2, we discuss about social robots, previous work done related to guidance robot, cultural factors affecting human-robot interaction, and user needs and emotions in human-robot interaction. We then draw a conclusion based on the learnings from the related works. Chapter 3 presents the pre study methodology, how we collected data from the target audience and deduced the design implication and functionalities. We then move on to Chapter 4 where we discuss how we implemented the functionalities in the university guidance robot, and what GUI and programming language we used to implement those functionalities. We evaluated our guidance robot with trial participants, which was discussed in Chapter 5. We also discuss about how we analyzed the data to achieve the results. Chapter 6 discusses about the research question in light of our related work and about the limitations of the research. Chapter 8 is the conclusion of the thesis. Reference and appendices are the last part of the thesis.

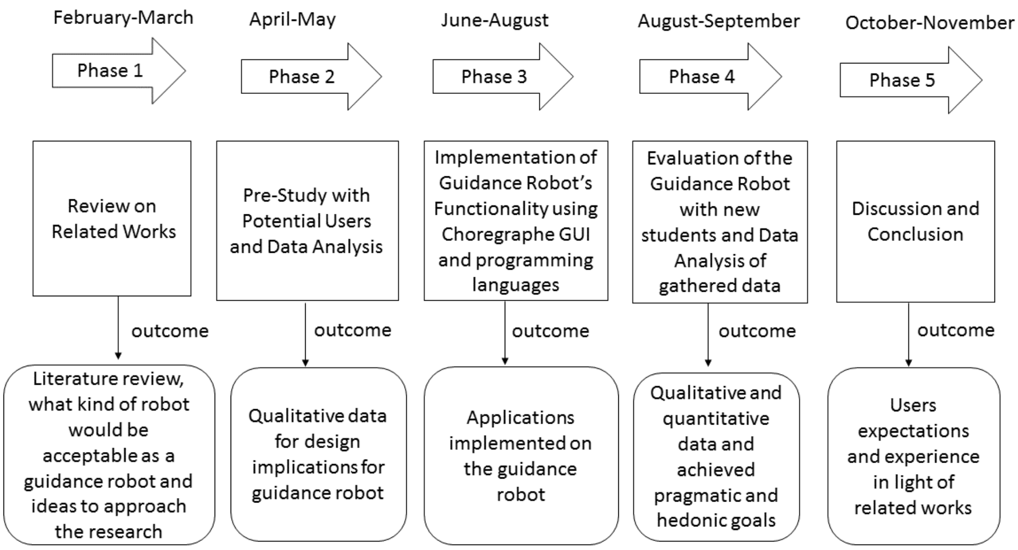

Figure 1.2 Phases of Thesis

The thesis is divided into the following parts:

Phase 1: In this phase, we describe the findings from related works and summarize the findings we utilized in this thesis. This phase was completed in March 2018.

Phase 2: In this phase, we conduct user studies in order to collect user expectation. This helps us solve the RQ1. We analyze the collected data in this phase and deduce the design implication, pragmatic, and hedonic experiences. This phase was completed at the end of April 2018.

Phase 3: In this phase, we implement functionalities on guidance robot using Choregraphe GUI, Python programming language, HTML, CSS, and JavaScript. This phase was completed at the end of July 2018.

Phase 4: In this phase, we evaluate the guidance robot with the new students during the orientation week. The students interact with guidance robot, fill a questionnaire where they answer what was their experience, and which were their preferred tasks. We also analyze the data to find out if the pragmatic and hedonic needs of the users are met. This provides us the answer to RQ2 and RQ3. This phase was completed at the end of August 2018.

Phase 5: In this phase, we discuss our findings in the light of related works. We also try to discuss our research questions and their answer. This phase was completed at the end of November 2018.

2 RELATED WORK

In this section, we discuss the relevant theory around social robots, human-robot interaction, culture and guidance.

2.1 Social Robots

Our study involves designing a social robot for the university guidance purpose and studying the experience of international students with it. This chapter discusses what social robots and robotics are. In addition to that, this chapter discusses the existing studies around social robotics. Finally, we consider how these findings helped us to narrow down our scope of work.

2.1.1 Defining Social Robots and Related Terms

According to Duffy et al. [15], the term "robot" is associated with compiling items in an assembly line. However, the term "social robot" is defined as embodiment agents that can recognize and respond to social cues [17]. Duffy et al. [15] described social robots in three layers:

Physical: The robot has motors and sensors and is driven to act with the help of those.

Reactive: The robot receives a signal from other layers (for example, physical layer) and processes a signal to react, which is sent back to the physical layer to drive the motors.

Deliberative: In this layer, the robot has a Belief-Desire-Intention architecture. In this layer, the system perceives data and events, converts them into beliefs, and adds them to the existing set. The results are compared, updated, and sent to social layer if it needs to communicate, or it is sent to a reactive level if it needs to carry out physical action.

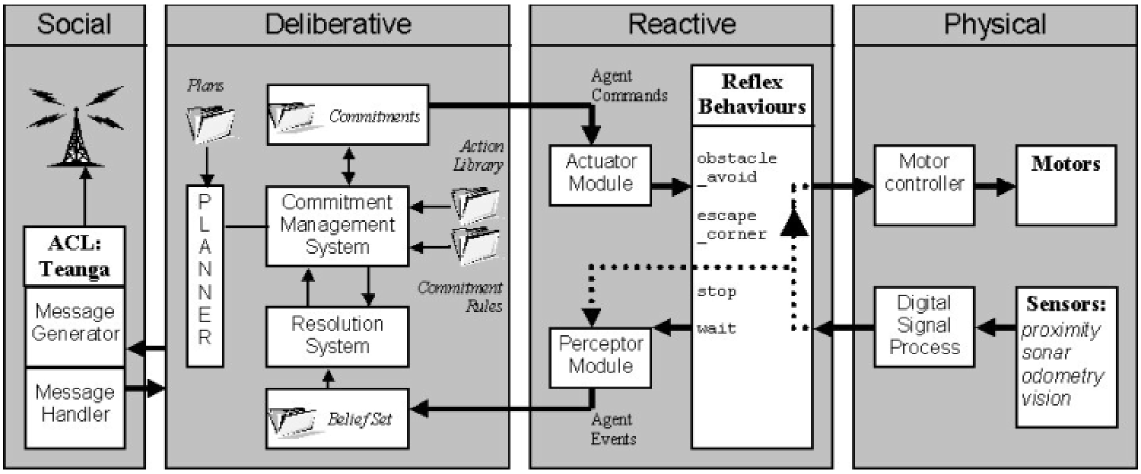

***Figure 2.1. The social robot architecture: The Robot Agent. Adapted from "What is a social robot," by B.R.Duffy, 1999,* 10th Irish Conference on Artificial Intelligence & Cognitive Science, p. 6**

According to Breazeal et al. [8] social or societal robot should be able to communicate and connect with us. Not only that, but humans also need to be on the same page with the robot socially and should be empathetic towards it. To sum up, a social robot should be intelligent as such that when humans interact with it, they feel as if they are interacting with another human being [8].

Pepper robot [53] best satisfies all the qualities of social robots mentioned above. Pepper is a humanoid robot that understands human emotion and responds to it accordingly [2]. Since Pepper has features similar to a human, they can easily connect with it and share an emotional bond. Pepper has touch sensors, actuators, perception modules and speech recognition capabilities that enable it to interact with human maintaining social norms [53]. Since we have chosen a humanoid robot for this purpose, it is essential for us to explain the reason behind it.

2.1.2 The Uncanny Valley

The term uncanny valley is associated with the appearance of the robot. Mori et al. [39] compares the acceptance of appearance of robots with a mathematical equation. He also explains which looks for robots are accepted and when the acceptance level drops. In this section, we define some terms related to "the uncanny valley".

A Valley in One's Sense of Affinity

Mori et al. [39] discuss that human's acceptance of social robots' appearance is not a linear curve. The author compared this event with the accomplishment of making robots appear as human. Human's affinity or attraction towards them increases until they fall in what is called "the uncanny valley".

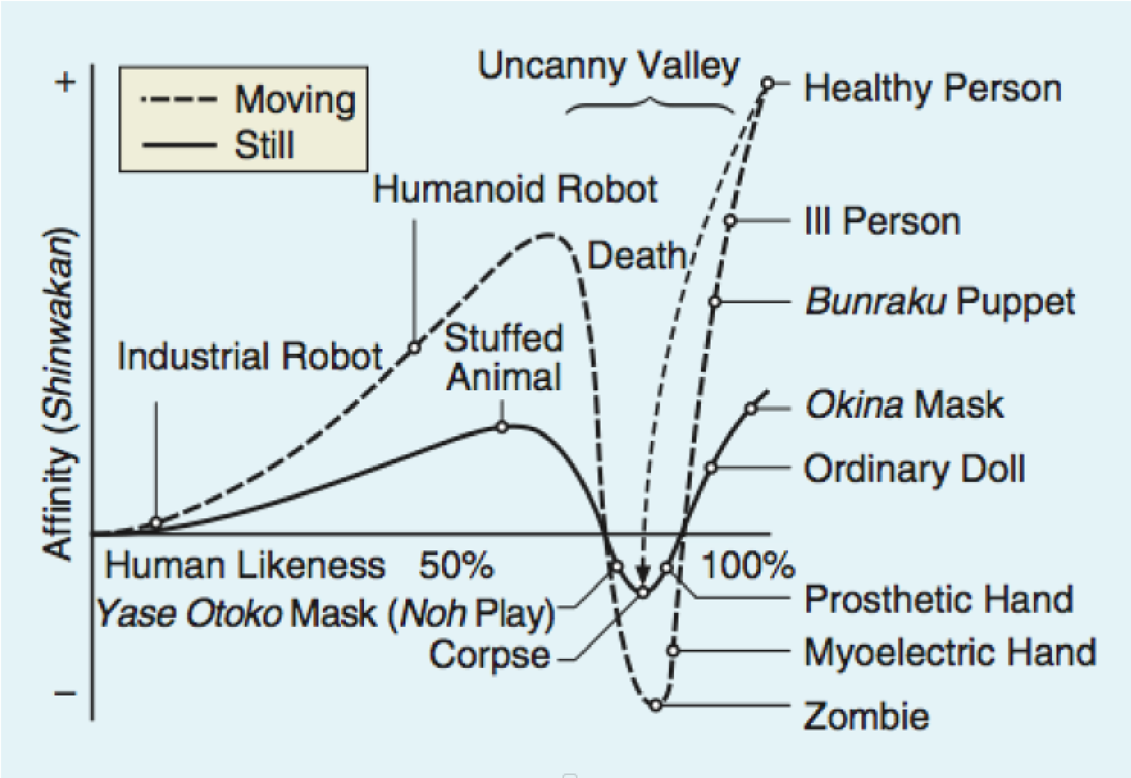

Figure 2.2. The Uncanny Valley. Adapted from "The uncanny valley" by M.Mori, 1970, Energy, p. 33.

The author describes that industrial robots are only made to perform like industrial workers. However, they do not look like one. Humans hardly feel an affinity towards them as there is no similarity with a human being. Hence, they are placed on the bottom of the graph. A humanoid robot, on the other hand, has roughly human-like features and users have a deep attraction towards them. Thus, they are placed halfway up the hill. Prosthetic hands, in contrast, are metal covered with skin and look similar to human hand. Nonetheless, when a human feels it is artificial, due to its boneless grip and coldness, their affinity falls into the valley, which is known as the uncanny valley. The affinity then appears to be negative, as the feeling is nowhere near to human-like. The atmosphere is even creepier when the artificial hand starts to move. Thus the myoelectric hand, which generates a signal to drive the fingers, is placed below the prosthetic hand.

We are conducting our studies with Pepper, which is a humanoid. According to the above research, humanoid robots are in the best position in the graph. In short, human feel the most fondness towards a humanoid compared to an industrial robot or human-like robot, Human-Like robots might make the participant feel uneasy. Human feels companionate towards Pepper and will its appearance will have a positive impression on the participants. Nevertheless, there are other aspects of communication such as gesture, tone, expressions etc. that might have a pleasant or repulsive impact on people depending on the context. Since our study is related to guidance, we try to explore the aspects that influence human-robot interaction in guidance. There have been studies related to guidance in shopping malls [29], hospitals [11] and office [44]. Since there have been very few studies related to human-robot interaction in university, we explored the fields where robots have been used as a guide.

2.2 Social Robot in Guidance Context

Social robots have been used in different areas, such as medical, education, office environment etc. to guide, motivate and support in learning [29] [42] [45] [32] [31]. However, there are few implementations in the university context. Onchi et al. [42] are one of the few to develop a female hostess IOMI to guide people indoors for a university. The robot aimed to guide people indoors. They decided to design a female robot because according to their findings female robots are considered to be empathetic and emotional. The purpose of the robot was to guide the students to their destination. The students were first asked to fill a questionnaire and reach a specific destination. Later they were asked to fill one more questionnaire. The participants were not aware of the presence of a robot guide in the campus. According to their finding, IOMI was more warmly accepted than paper maps. However, they found out it was not as useful as human help. Since the university only has a paper map to guide the students, we thought it would be a good idea if Pepper displays an interactive map instead of hand guide the students to their destination. One more reason for it was that our university had a lot of buildings, unlike the IOMI robot case where people are led to only one destination. Thus it would have been challenging to instruct Pepper to come back from far away buildings. Even though it was not mentioned in the paper how many IOMIs they used, in our case, hand guiding people to their destination would have been a challenge with only one robot.

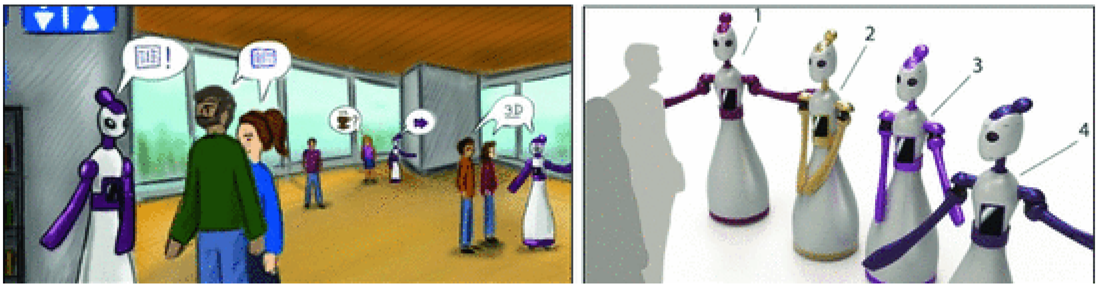

Figure 2.3. (a) Conceptual art of IOMI interacting with groups of people and (b) set of gestures: (1) Greeting Stance; (2) Waiting Stance; (3) Follow-me Stance; (4) Pointing Stance. Adapted from "Introducing IOmi - A Female Robot Hostess for Guidance in a University Environment", by E.Onchi, 2016, 8th International Conference, p. 765. Copyright [2016] by Springer International Publishing.

Kanda et al. [29] designed another guidance robot for shopping malls. They conducted a trial for 25 days with 235 participants to find out if robots can act as an information provider in public space. They mentioned in their paper that even though malls have a map, visitors usually ask for human help. Furthermore, the map does not have enough information about specific queries for instance, where to find an umbrella. In our case, we also observed something similar to our experience of previous orientation weeks. Students often reach classrooms late because it is difficult to find them. Furthermore, during their first day, it is tough to find admission and student union office. Thus, it was also interesting for us to find out if robots can help in public spaces. According to Kanda et al. [29], 63 participants followed the robot's suggestion. The robot suggested some new thing that the users wanted to try out for the first time. The robot made shopping experience exciting to encourage visitor, especially kids, to visit the same mall repeatedly. It gave us an impression that, robots can evoke specific target experience that motivates human to visit the robots more often. Thus, we are interested in exploring what kind of expectations people have towards the robot and what do they experience during the interaction. Burgard et al. [9] on the other hand studied a robot RHINO that arranges museum tours for visitors and virtual visits for people around the world. According to them, the robot should be friendly, reliable and intuitive. They believe that interaction with the human is the most crucial aspect in human-robot interaction. We also think that the robot should be friendly and the information it provides in reliable. Otherwise, students might avoid interacting with the robot next time.

Nowadays, social robots are not only used to show directions in shopping malls or public places, but they are also used to guide children in learning. Komatsubara et al. [30] studied a social robot, Robovie, to guide children to learn science. In their study, the robot would greet the students and ask them questions related to science. The robot provided 2 or 3 options for the students, and it would repeat essential sections of the quiz. After the student picks an answer, the robot discloses the correct one and explains it shortly. They experimented with 114 children of grade 5, and according to their result, the robot could establish a strong relationship with the kids that helped the kids ask questions without any hesitation although the scores were not affected. Thus, we believe gamifying the experience with the robot will also help us build an emotional bond with the users. Although the quiz introduced by Komatsubara et al. [32] was related to science, we aim to gamify a learning activity that would be suitable for all kinds of students. We also understand that feedback for the human is essential, according to Berns et al. [7] and it is very crucial in human-robot interaction. Thus, we plan to provide feedback after each level of the gamified functionality.

Humanoid robots are also used to guide and motivate people to perform exercises. Meyns et al. [38] studied how to encourage children with cancer to perform exercises. They aimed to evoke pleasurable exercising experience among these patients utilizing robot and music. They first performed a set of exercise with therapist solely and with therapist including music. The same set up was repeated replacing the therapist with a robot. According to their findings, children enjoyed exercising in the presence of music and a humanoid robot. They also achieved their target, pleasure, to bring joy to the children. They also deduced that music could evoke playfulness regardless of the guiding agent. In our scenario, international students are usually stressed in an unfamiliar environment.

Moreover, humanoid robots are yet uncommon in university guidance context. Therefore, it is prevalent that students might be anxious to approach a social robot for help in this context. In this case, we can utilize music as recreation to refresh the student's mind and to motivate them to approach the robot for help.

Kaipainen et al. [28] studied experience evoked by Pepper robot at a service point. They aim to understand what kind of experience a social robot can elicit while serving as a guide/entertainer. In this context, Pepper robot also conducted a quiz, along with other functionalities, about places in Tampere with few provided options. The field trial was held with 89 participants in total. According to their finding, 86% of the participants tried out the quiz. Thus, it was clear that people tend to enjoy playing quiz or games with the robot. However, in their study, they mentioned a few people would not notice Pepper and walk past. It could also be interesting in our research to observe if people would ignore the presence of the robot. Kaipainen also mentioned about few observed experiences like Autonomy, Relatedness, Competence and Stimulation. However, they suggested that there is still scope to explore more experience goals in the guidance context. Thus, it is an excellent opportunity for us to explore more user experience goals in guidance context.

In another study Joose et al. [27] conducts a trial with a social robot named Spencer to guide passengers in an airport. Their target was to design a friendly and trustworthy robot for the passengers. Thus, they developed a robot with a head that can respond to nonverbal cues and body that serves as the information desk. The robot was also built with touch screen and boarding pass reader for physical interaction. According to their contextual inquiry, they found out some cultural difference in human-robot interaction among passengers of different cultures. Their main finding was based on proximity, and they found out that Chinese participants were more comfortable if the robot entered their intimate zone. They aimed to make the robot more socially acceptable since the airport is an international public area. Similarly, in our case, it is essential for us to consider culture since the Tampere University of Technology has many international and exchange students. Therefore, it is inevitable that the robot should be socially acceptable for all cultures.

From the finding of the previous work, we could deduce some guidelines for our design of a robot guide for the university context. Participants generally enjoyed playing small games with social robots and seemed to build a better connection with them [26] [32]. Social robots could also be used to guide people indoors rather than a map [42]. Most of the time, people expect the robot guides to provide authentic information. Thus, social robots could be utilized as a platform for information retrieval.

All these studies and previous work made us realize that robots are capable of evoking certain emotions if they are appropriately utilized. The functionalities should be built to have a balance between both pragmatic and hedonic attributes, as both are independent and equally important [20]. Some of the basic needs observed in the related works were safety and trust. However, some latent needs differ by context. For example, Kanda et al. [29] discovered that some children developed affection towards the shopping mall guide robot that convinced them to visit the mall repeatedly. Not only that, but it also differs by culture. As Bugard et al. [9] mentioned some culture might prefer if the robot is intimate, whereas, for other culture, it might be offensive. Thus, we need to take into consideration the cultural aspects and the target experience related to that culture when designing a robot for an international platform.

2.3 Robot and Its Impact on Different Culture

Shortly, robots will enter our workspace and home. Hence, it is essential to know the how a robot should interact and function according to the cultural values [52]. According to Wang et al. [52], robots, which behave culturally appropriate, are considered trustworthy and amiable. They decided to adopt a slightly different approach. They examined two different scenarios, where the robot does and does not behave culturally appropriate. Their target participants were Chinese and American. These two countries are considered culturally different according to the cultural model of Geert Hofstede et al. [25] and Edward. T. Hall et al. [19]. They pointed out an essential fact that international students might have a slight influence of foreign country, which might induce fluctuation in the result. To minimalize these effects, they conducted their study in different universities of China and USA. The task was shaped to be culturally meaningful, where the participants were asked to produce an eco-friendly chicken cooperative. The participant had to make six choices related to chicken and they were briefed that the robot would assist them during their task. The robot used both implicit and explicit communication style. The results showed that Chinese participant trusted the robot and changed their decision according to it during implicit communication, which was opposite for the US participant. According to their hypothesis, Chinese culture is a high context culture where people tend to understand indirect communication [19]. On the other hand, Americans tend to misunderstand indirect communication, especially in work sectors [52]. The US participants believed that the robot could not have any personal motive to harm them. On the other hand, the Chinese participant perceived the robot to be more social and part of the team. Therefore, they expected it to behave more culturally appropriate. Since Chinese culture is a high context culture, they found common ground with the robot and worked as a team. It would be interesting to see in our study to what extent the participants accept the humanoid to be a part of them and connect emotionally with it.

Sabanovic et al. [43] adopted a different approach to studying the cultural difference. Their study involved three cultures; Chinese, American and Argentine. The purpose of their research was to determine how people from different culture allow robots to enter their personal space. They conducted an online-based survey with the target group, where they showed images of 3D pictures of family and the position of the robot after it approached. The participants were asked to evaluate the appropriateness of the position assuming that the robot completed the approach. From there studies, it was noticed that Chinese people allowed the robot to enter their intimate zone whereas, Argentine and American participants were uncomfortable about this. The results were as expected for Chinese and American participants; however, it was not the same for Argentine participants. According to the cultural models, the results of Argentine participants should have been similar to Chinese participants. Thus, it is also necessary for us to study how accurate are these cultural models when it comes to human-robot interaction.

Culture does not only belong to a country or race. A group of people might have the same preferences when working for an organization or institute. Sabanovic et al [44] focused on studying the functional requirement and effectiveness of physical technology interaction of a break management robot in office culture, where they conducted three design iteration for the robot and performed user testing. They did several iterations and found that the employees shared the same break taking the schedule and somehow the same opinion about the break management robot. For example, all the employees were asked to keep a record of their break taking, and it was found that most of the employees would take a break for 5 minutes at an interval. Another example of unity is the opinion of the employees that loud noise from alarm disrupted the working environment. Moreover, most of the employees agreed that one particular implementation was sufficient for them. This finding exposes that the employees follow a specific office culture. In the same way, students might also develop a specific culture that might have an impact on our studies.

From the above-mentioned related works, we could summarize that target experience differs from culture to culture. Some culture would appreciate intimacy, whereas some culture would like robots to enter their zone. Moreover, culture is not bound to countries only. Different professions maintain different norms and thus develop a specific culture. Wang et al. [52] gave one example about work culture, where alarms or too much movement by the robot might be considered disturbing. However, this could be utilized in some other culture as amusement. In our case, we have to discuss two different aspects, students' culture and demographic culture. We need to consider how to design robots that would evoke positive experience among students. Furthermore, we need to consider the demographic culture they belong to and their expectations from a social robot.

2.4 User Needs and Emotions in Human-Robot Interaction

We have already discussed human-robot interaction related to guidance and culture. However, it is also crucial for us to understand the emotional attachment participants feel and expect from the social robot. There have been studies to explore emotional characteristics. In this section, we are going to report the methods used to cultivate users' needs related to human-robot interaction. Furthermore, we are also going to report what emotional arousal other researchers observed during human-robot interaction.

Leong et al. [35] took inspiration for their robot dog by interviewing dog owners. The researchers interviewed the participants about their lives to extract the experiences of their lives. Their approach was to ask the participants about their everyday activities and to understand the most critical and valuable phase in their lives. According to their findings, the elderly spend their most intimate and precious time with their dogs. They deduced a few experiences that the owners had with their dogs (comfort, companionship and security). Thus, they went ahead to develop a robot dog for their research purpose

The purpose of extracting the hedonic goals is to arouse positive emotions. Arnold et al. [5] explore how children design a robot and what emotional aspect they consider when designing. They conducted a co-creation session where 8 to 10 children per group take part in the designing session. The children are aged from 6 to 11 years old. According to their study, each child designed own robots with both positive and negative emotions. We believe it is also vital for us to develop a robot that expresses joy or interest when the user agrees to something or gives a correct answer. On the other hand, the robot should also be sad or distressed when the user disagrees with something or gives a wrong answer. It will help to bring natural feeling when interacting with a robot as a human would also react the same.

When considering natural interaction, the phenomenon that leads to it is touch and gesture. Kheng et al. [31] conducted a repetitive study where they analyzed the most preferred communication method. They held the research with 2 pre-trials, 5 exploratory trials and 1 post trials. They wanted to find out how participants preference change over time and what parameters influence the change. In this paper, they focused on the results obtained from pre-trials and post trials, which were based on physical interaction, verbal interaction and no interaction. These interactions were based on a task where the user needs to find out the darkest colored cube from three cups on a tray. During the physical interaction, the robot would approach the users with the tray to find out the cube. During verbal interaction, the users controlled the robot with verbal commands, and in the no interaction phase, the robot turns away from the users assuming them to be an obstacle. In the results, they found out that physical interaction was most preferred than other two form of interactions. We also believe that physical interactions like touching the robot's head, hugging and handshaking would bring a pleasurable experience for the participants. However, unnecessary movement and avoiding the user while moving might be unacceptable for the users. It might evoke negative experience like distrust.

Willemse et al. [54] analyze the impact of robot-initiated touch on human emotion and behavior. One of their research questions was to find out whether the robots' touch calms the users in a stressful environment. They carried an experiment with 39 participants, and they used 2 Nao robots to conduct the research. In the trial, the participants were requested to watch two short, exciting movies. These movies had some alarming scenes. The Nao robots try to soothe the participants either verbally or verbally with gestures. To measure user's responses, they measured physiological responses like the heartbeat, respiration etc. After the experiment, the users were asked to fill a questionnaire, and the robot asked them to give donations to Red Cross. According to their result, robot initiated touch does not add any support to only soothing speech. That gave us an impression that the participants only responded to the speech in this case.

Tanaka et al. [45] mentioned in their study that toddlers started to treat the robot as a friend as they developed a caregiving nature for the robot. They also analyzed if the children would socialize with the robot by assessing the frequency of touching and hugging the robot. According to their study touch proved to be effective in social interaction.

Most of the participants of the related work experienced friendliness from the robot [29] However, there were also case where participants wanted to take care of the robot [45]. However, the new experience might evolve in human-robot interaction, as this field is not fully discovered yet [28]. Moreover, the expectation is culturally different [36]. Thus, our motivation is to determine the participant's expectation and experience during the interaction and try to observe the anomaly.

2.5 Summarizing the Design Decisions

From the related works, we deduced design and research decisions, which would be beneficial for our guidance robot concept development.

Social robots are preferred over any paper maps [42]. Thus, this gives us an implication that **guidance robot will be acceptable over any static screens**. However, the users prefer human help rather than a robotic help [42]. It gave us an impression that users prefer social robots as they can response close to human. Therefore, **we can utilize the robot to provide information related to direction and frequently asked questions**. Users tend to follow the robot's suggestion [29] although sometimes it is culturally dependent [48]. Thus, **we could utilize the robot to encourage people to socialize. It will help the students adjust in the new environment**.

Nevertheless, there might be some basic things that can be taught by the robot. Users usually enjoy gamified teaching with the robot, and it helps to build a relationship with it [32]. Thus, **we can utilize our university guidance robot to teach something new for the students**. These findings will help us **deduce our pragmatic needs and goals**.

In human-robot interaction, there is a scope to explore user experience as this field of research has not been investigated vastly [28]. **Addressing the hedonic goals is one of the crucial elements in user experience research as it addresses the latent user needs**. As mentioned in our related works, users often encounter a *friendly* [29] and *warm* [45] experience with the robot. However, there could be other hedonic needs. To address those needs, Leong et al. [33] made **the users walk through their daily routine and extracted**

hidden hedonic needs like *competence*, *safety and comfort*. Therefore, we could adopt such a methodology to refresh the orientation week's memory in the students' memory.

3 PRE-STUDY TO FIND OUT USER EXPECTATIONS

Due to the novelty of the topic, there was not much information available about how students could utilize the robot to help them during their orientation phase. In our study, it is difficult for students to describe their needs during the orientation week. Furthermore, students go through so many phase and hectic process that the experience is overwhelming. Therefore, it is natural for them to miss out their actual needs. Thus, the interview method mentioned by Leong et al. [35], to walk participants through the past events, proved to be beneficial for us to refresh students' memory. In this stage, we tried to find out what are the students expecting from Pepper as a university guidance robot. Moreover, we asked them what functionalities they are expecting and how would they like to interact with it. This helped us to respond to our first research question "What were the expectations of students for university guidance robot".The objective of this study is to extract user needs, expectations and understand what kind of problems they faced during the orientation week.

3.1 Participants

We advertised the user study via social media and fellow researchers to get at least 30 participants. Since we considered appointing Finnish, Chinese and Indian participants, we already had diversified target audience. We invited 16 female and 14 male participants for a face-to-face interview. The participant who filled up the questionnaire agreed to be contacted if required. All the participants were currently students from TUT or UTA, and they were studying subjects such as Information Knowledge Management, Data Engineering, User Experience, Human Technology Interaction etc.

3.2 Study Design

The pre-study was divided into two parts. We started with the distribution of an online questionnaire. In this set of questionnaire, they were asked to provide some background information about themselves, for instance, nationality, age group, if they have previously studied abroad, country of residence and email address (for contacting them for interview purposes, if they want to participate). We also asked how actively they use technology. In the questionnaire, we attached a picture and a video of Pepper and asked them a few questions about how they feel about the robot. The questionnaire was aimed to find out if people would be excited, curious or anxious if they see the robot in the university. Furthermore, we asked for what period would they like to interact with the robot. We also asked the participants to suggest some functionalities for Pepper if they would design it. We adapted our questionnaire from Almere model (The unified theory of acceptance and use of technology (**UTAUT**)) [23] and modified it according to our context.

For the next step, we invited 30 participants in a one-to-one, face-to-face interview. The interviews were recorded with the permission of the participants for further data analysis. The duration of the interviews was 45-60 minutes. The interviews were held in the Tampere University of Technology in the human-centered-technology department. We asked them the following two sets of questions:

i) What was their initial experience in the university? The issues were mainly about finding direction in the university, looking for a friend, finding a suitable restaurant in the university, etc.

ii) In the second set of questions, participants were given 13scenarios where they have to imagine Pepper helping them. In this phase, we asked them what kind of help would they ask from Pepper if they face certain trouble, and how would they expect Pepper to help them in those scenarios.

From the recorded data, we generated transcriptions, which was used to formulate affinity notes to build affinity diagram [1]. Affinity Diagram is a tool to organize and rearrange a large amount of qualitative data and sort them into groups [1]. For our data analysis phase, we cut each comment of the users from the interview and put them on the wall. We would put related items in one section and categorized them under one theme. The results and findings of the affinity diagram are reported in section 4.1.1.

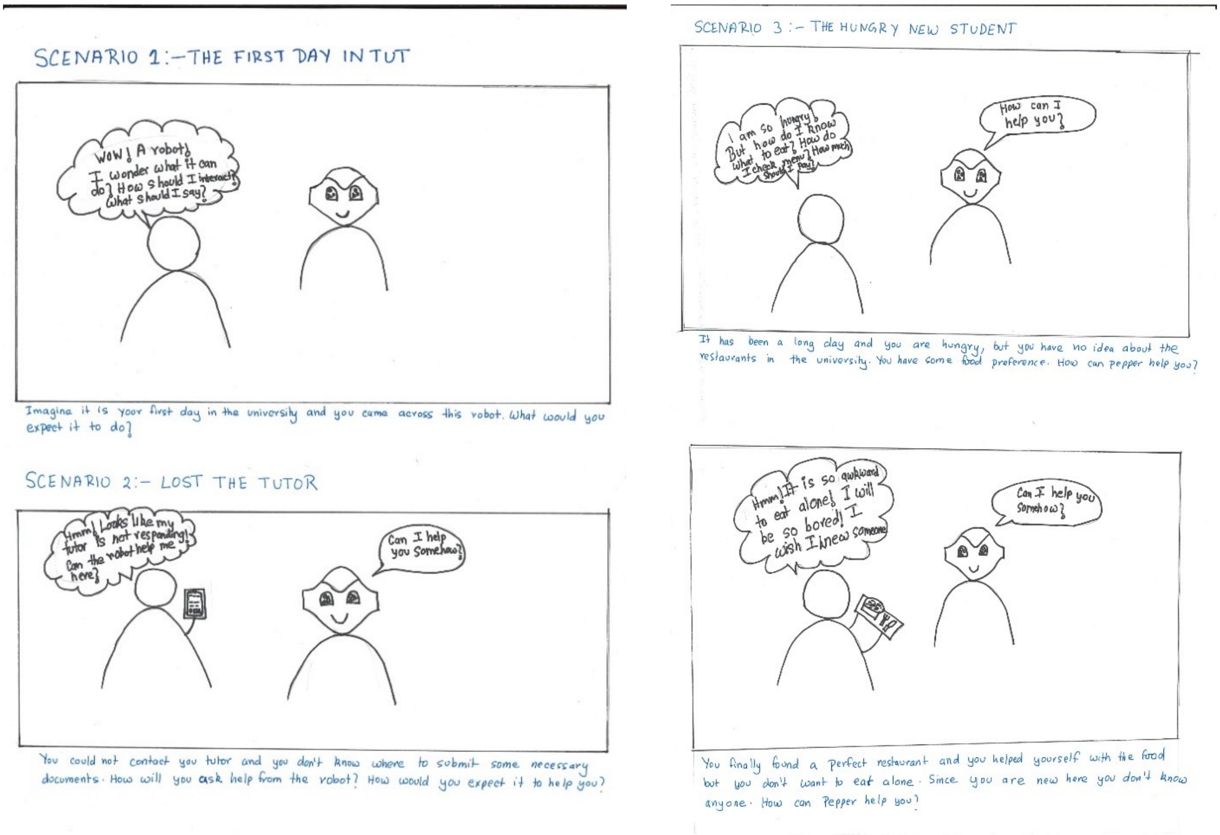

Figure 3.1. The scenarios presented to the users to understand their expectation from the guidance robot.

The scenarios shown in figure 6 are also described elaborately in Appendix A under pre-study questionnaire.

3.3 Data Analysis

As mentioned in 3.2, we recorded the interview sessions with the participants and generated transcriptions out of it. Based on the transcribed data, we created an affinity diagram [1]. Building affinity diagram is a process to sort recorded data into categories by recording the user interviews on cards or notes. Each card is read and similar ideas are categorized under one theme [1]. The affinity notes were cut out of the transcribed interviews. Since we wanted to design Pepper to be suitable for international students, the affinity notes were divided into three cultures: Finnish, Indian and Chinese. The purpose of dividing it into three cultures was to understand the difference between the different cultures so that it also reflects in our design. We adopted this method in order to sort massive data into categories, so that it is easier for us to see the big picture and categorize the data accordingly. Moreover, we wanted the analysis to be visible for the other researchers of human centered robotics to raise discussion.


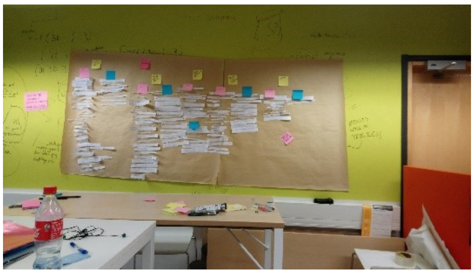

Figure 3.2 Affinity wall constructed from the affinity notes from the transcribed data

3.4 Findings

In this section, we report the findings from the pre-study and the data analysis conducted using Affinity Diagram method. We also inform our design implications and decisions based on the findings.

3.4.1 Pragmatic and Hedonic Findings

As mentioned in section 1.3.2 we categorized our results into two parts: pragmatic and hedonic. As reported in section 1.3.2 and according to Hassenzahl et al [20], our primary pragmatic goals are ensuring usability and operability. However, we want to discover other pragmatic needs that would satisfy students' basic needs. The pragmatic findings mainly reflect on the functionalities, and the hedonic outcomes focus on the emotions and experience that we should target to achieve. We further categorized the data in five pragmatic sectors. Two categories (information participants want to know and connecting people) emerged during data analysis procedure, while the others were pre-determined. The main findings were:

1. **INFORMATION PARTICIPANTS WANT TO KNOW: (61 FINDINGS, 3 SUB CATEGORIES)**

Chinese: During the interview, the participants mentioned that it was information overload for them during the orientation week. (Male, 30) suggested that there should be a section like FAQ or "trouble for fuksis" to support them during the whole week. Students also mentioned that the education system in Finland is very different from China. At least 5 participants wanted to know about information regarding submitting certificates and how to enrol as a student. (Male, 30) suggested about some course recommendation. Participants also mentioned that they know little about the student events and its popularity. (Female, 26) mentioned, "*Event for example, "Wappu", I have no idea why people get into the water during May; it is so cold and weird. But after you know why it is, you will feel it is interesting and significant. So, of course, background culture is important.*" She also mentioned that it would be useful if there were instructions given on common software "*like repolainen*". The students would also mention about including information outside of the university. (Female, 25) suggested to mention about second-hand stores as "*many exchange students do not like to spend much*". (Female, 30) expected to get information on weather forecast; "it should say that it is going to rain soon so please go back home."

Participants mentioned about emotions they might feel during the interaction. These were amused, excited and happy. "It is so *exciting* to see a robot welcome you" (Male, 30).

Finnish: Finnish students already knew most of the general information. Furthermore, they wanted independently look for information that was not accessible easily. They also did not want to depend on the robot for socializing. (Female, 37) mentioned that "*That's something that not typical to a Finn. If you are coming alone, you don't probably have a problem eating alone. I would not come up with that kind of question like oh I am here alone because I already know that I came alone.*" However, few participants wanted to know information outside the university. For instance, (Male, 25) was expecting Pepper to provide information about cafes and shops in Tampere. (Male, 23) was expecting hints and tips about things to do in Tampere. Considering their first day at the university, few students were expecting information about orientation rooms, gym location and enrollment fee in the university.

Participants mentioned about emotions like shy, scared, excited and anxious during the interview phase. "I will be too *shy* to ask it anything" (Female, 25).

Indian: Most of the Indian students were expecting Pepper to give information about Tampere. Few of the participants mentioned that they want to get general information about Tampere. "*Maybe Pepper can show me a documentary on Tampere*" (Male, 26). (Female, 26) was interested to know about places that had student discounts or affordable bars in Tampere. (Female, 30) expected Pepper to suggest any interesting movie which was playing in Finnkino. On the other hand, (Female, 25) wanted to get some suggestions about tourist destinations in Finland.

Participants mentioned that emotions like amusement, excitement, proud, happiness and anxiousness might be aroused after seeing the robot. "I will be very *proud* if my university has this robot" (Female, 25).

2. EVENTS AND ACTIVITIES (97 FINDINGS, 3 SUB CATEGORIES)

Chinese: Most of the participants were expecting Pepper to provide details and background about any events or activities happening. Some participants expected Pepper to show a picture from last year of this event. Participants were also eager to see an event calendar and wanted to sign up to the events via Pepper. "*It would be nice if I can sign up for the event through Pepper*", (Female, 22). Overall, the participants expected a breakdown of the event with the explanation of timetable and the reason to organize these events. Most participants were interested in activities where they could meet new people like sports, social event, sauna, university events etc.

Finnish: These participants were interested to know the necessary information about the event, like location, time and ticket price. (Male, 25) was also looking forward to suggestions about top three things happening in Tampere. (Female, 29) expected Pepper to display event calendar. She added "*Pepper should display events of that day and maybe like for the next week, but I think it should recommend first the once for that day. Because now there are students, who get all information does not participate in anything, like you have to get them out to join events immediately*." Most of the participants were interested in events like a music concert, sauna, sports, alcoholic and non-alcoholic events.

Indians: This target group also wanted to know necessary information about the events, like location, ticket price, how to reach there etc. However, some of them were eager to know who were attending these events. (Female, 30) mentioned, "*Maybe Pepper can tell me who all are going. Is any of my friend going? Just like Facebook does for the events*". Like the Chinese participants, this group was also interested to know about the background of the event. "*What's the culture, for example, people wear overalls or suits or something like that*", (Male, 28). Few participants wanted segregation between alcoholic and non-alcoholic events. "Pepper should mention if the event provides food and drinks, if drinks, what kind of drinks? Does it have only alcohol or drinks without alcohol?" Some participants also expected Pepper to help to create their events and to invite people on behalf of them. "Like it could send invites to my friends and tell them the location of my house and what time it starts, and when they arrive, Pepper should be should be there, (Female, 30)". It also gave us an impression that some participants wanted to access Pepper remotely.

3. **DIRECTION (123 FINDINGS, 3 CATEGORIES)**

Chinese: Most of the participants expected Pepper to be mobile and lead them to the destination. Few of them wanted to know the location, which was not quite visible when they first come to TUT. "*You cannot find student union and international office when you come through Tietotalo*" (Male, 30). They wanted to know the place where they could get a clear solution to the trouble they are facing. Most of the participants expected an interactive map with marked source and destination. (Female, 29) gave reference of google map. There was a suggestion about 3D and navigational maps. Many of them wanted to know room numbers and direction to them because they are not comprehensible. Some expected clear verbal directions to the classrooms. "*I cannot understand what TE means. It takes so much time to find the rooms here*" (Female, 25). Some participant wanted to know about bus routes if some location is outside TUT. A possible explanation for these requirements could be that this target group was coming to a new place for the first time, so they wanted Pepper to display as much information as possible. They also expected Pepper to assist just as a human would do.

Finnish: Different participants had different opinions in this case. For some participants, it was easy to follow a 2D map, but some mentioned that they quickly got lost when they first visited the university. However, most of the students agreed that finding the rooms could be tricky because the room numbers were not understandable. "*For example, Tietotalo, the abbreviation is starting with a T, so you don't know which building the actual room is in, because, but they are given by the code.*" (Male, 26). On the other hand, (Male, 23) mentioned about a simple 2D map with the flexibility to switch between floors, '*I will prefer like a 2D maps, just where you can see the corridor, but like an interactive map could be a better option in some situations if you need to move between the floors or something.*' Most of the students expected to find rooms, building where the rooms are located, gym, office and guild rooms.

Indians: In this case, most of the participants were looking forward to an interactive map that would show the participant's current location and the destination. However, the participants wanted to retrieve information in various ways. "*For example, you can have a map, a GPS based map or something and you can choose the destination or something, then the location you want to reach and give a QR code and then scan it in your phone to get the map, and you can just walk.*" (Male, 26). Some people would expect Pepper would verbally explain the way, just as a normal human would do. On the other hand, some participants expected Pepper to lead the way. "*It would be great if he could accompany me to that location since I am new. He would probably say, let us go I will show you the room and I will follow him? Her? to the room.*" (Female, 27). Some participants also expected Pepper to mention some hotspots so that it is easier to track where they are going.

4. **MENU AND RESTAURANT (97 FINDINGS, 3 CATEGORIES)**

Chinese: Most of the participants expected pictures of the food because they could not comprehend the food by its name. Few students wanted to know the rules of the lunch lines. They also expected Pepper to mention the price. "It will also be nice for Pepper to inform that I will give you some hints about eating in the university. You can only choose one main dish and do not forget to show your student cards or study rights to get student price and also for the drink you can only take one, or for the bread; you can only take how many pieces." (Female, 25). P21 wanted to know where he would find a particular cuisine. Most of the students wanted to see the menu, ingredients of the food, price and location of the restaurant.

Finnish: Most of the people replied that they would choose a particular restaurant and then it should show the menu. Some participants think that it is essential to mention the student price. 'I know the student prices are affordable, but I also think that foreign people when they come here, they are surprised by the prices, and they are confused that the 2,60 lunch. So it should somehow state that its student restaurant and its cheap for you.'

(Female, 27). Participants also wanted to know about the ingredients as some of them have allergies and some prefer vegetarian food.

Indian: Most of the students replied that they wanted to know where the restaurant was on the map. (Male, 26) expected to know about the closest café where he can get some coffee ‘like if I want to grab a cup of coffee, it should not tell me to go to Reaktori if I am in Tietotalo. It should be able to tell me that Bitti would be the nearest one to get a coffee.” Participants preferred if Pepper verbally explains and well as display the information on the tablet. Many participants were expecting Pepper to explain what kind of food it was. “Maybe if there was a system, where you could see that this place serves Indian food and, let’s say, 8 Indians recommended it.”

5. **CONNECTING PEOPLE (63 FINDINGS, 3 CATEGORIES)**

Chinese: Participants expected Pepper to form groups related to their coursework so that they can solve it together. Often the participants said their language skills are not very good so it was difficult for them to form a good team. “You know my English is not very good, so it is difficult for me, of course, if it were Chinese, it would be easier” (Male, 30). Few participants mentioned that they got help from seniors in the university because the education system is very different from that of their home country. Participants also wanted Pepper to monitor the group works. ‘If I have group work, Pepper should monitor the process and take the managers role to control’ (Female, 29). Few people wanted Pepper to communicate with the course responsible person on behalf of them and fix an appointment to meet. Many participants wanted to arrange a get together where pepper should also participate.

Finnish: These participants did not seem to like this idea very much, because they felt Pepper could not force anyone to have friends. One participant suggested that Pepper could somehow gather all people and make them interact. “*Maybe it can like to collect information for everyone who is alone; it can ask, “are you fine with other people being on the same table with you*?” *When it finds another one, it can say,* “*there is a person who wants to have your company. They are sitting over there, and you are allowed to go*.” ” (Female, 28). Participants also mentioned Tinder, but for finding friends and not dating. The idea behind this was that people do not have to go and socialize actively, but choose people with whom they want to interact. There were also suggestions for homework making events if students wanted to meet people from the same department.

Indians: This target group also mentioned Tinder, but for friendly purposes. However, one participant suggested, “*I don’t want to do this publicly, this is something personal*” (Male, 28). Some participants also mentioned about coming up with own events, and if other people are interested, they can join. “*Maybe we can have some groups where I can create a group or an event and make it public in some way so that people can come in and check if anybody is interested in having.*” (Female, 27).

Based on the interviews, we also categorized the hedonic attributes

6. HEDONIC ATTRIBUTES

Chinese: The main finding with this target group was nurture and fellowship. According to the gathered data for this target group, it showed that they wanted Pepper to act as a guide or caretaker. There were comments like "*I will take pepper to my table. I can ask, "Come to eat with me". It doesn't matter what pepper replies, I will take him anyways*" (Male, 30). "*It will be nice if he can lead me to the room, yeah. At least show me the room number and tell me to go straight and then the end of the lobby and turn right, just like how a human will say the direction*" (Female, 25). These kinds of comments helped us derive that this user group wants Pepper to interact more naturally, just like a human, and be with them whenever it is needed. Some participants wanted to touch Pepper to build a better connection, which led us to the target experience sensation. When we asked participants how Pepper could entertain them, we retrieved two more target experiences. These were recreation, playfulness and humor. People expected Pepper to sing, dance, and play small games with them in recess.

Finnish: The main experiences that we extracted from this target user group were playfulness and machine-like. "Machine-like" in this case would be that the participants would want to obtain the information they want to. They did not want to form any bond or be dependent on Pepper in some way. The other target experience with this group was playfulness, humor. They wanted Pepper to entertain them by playing some small games or making jokes. We got the impression that they tried to use Pepper just as another mobile device that would serve their purpose and sometimes entertain them.

Indian: The primary target experience derived from this target group was natural/humanlike. Participants mentioned that they wanted to approach Pepper just as they would approach a human. "*I think I will exactly explain to him in a way I would have explained myself at the info desk. I will say, "Hi my name is this, I am a student of this batch, and I need to submit my documents where can I do it?*" They expected Pepper to carry on a normal conversation just as a human and reply to the answers based on the context. Thus, we derived another target experience, adaptive and emotional. "*It should be more natural and understand your emotions when you are talking and the context of it. For example, it should adapt to you*" (Male, 28). The other target experiences were control and heroic. Participants felt if a robot could achieve their expectations; it could be the hero of the university. "*I am giving ideas that can make pepper the hero of TUT*" (Female, 27). The target experience related to entertainment was humor and recreation. Participants expected Pepper to sing, dance and tell jokes to serve the purpose of entertainment.

Participants often mentioned about few normal emotions that might reflect when they interact with the robot. These were amused, happy, scared, anxious, shy etc

3.4.2 Design Implications and Features

Based on the above finding, we derived the following pragmatic and hedonic design implications for the guidance robot:

Pragmatic:

- The preferred communication methods are voice, tablet and gestures. The main reason for displaying information on the tablet was that the students do not miss any necessary information while Pepper is talking. The gestures were mainly important for showing direction and natural interaction.

- Pepper should be able to give as much information as possible. For instance, information about classrooms, where should the student go for help, what are they serving in the university restaurant etc. Moreover, they expect the guidance robot to provide information outside the university. Since it is a robot, it has a better memory than human and can store more data.

- Pepper should also be a part of any activity it organizes, to cheer and support the participants.

Hedonic:

- According to the Indian participants, Pepper should behave as naturally as possible, as many students have their way of expressing themselves and interacting with Pepper.

- According to the Chinese participant, Pepper should nurture them. They wanted Pepper to solve their problems just as a friend or family member would. "He could be just like a senior friend in the university" (Male, Chinese). It also helps develop empathy towards the robot.

- Pepper should also be friendly so that the participants feel enthusiastic to interact with it.

The cultural finding was not visible on the pragmatic design implications as they mostly reflect basic needs of "student culture". However, the students' hedonic needs varied among culture. The Chinese participants wanted the guidance robot to take care and nurture them whenever they were in trouble. They also expected the interaction to be as natural as possible. However, the Indian participants only wanted the interaction to be natural and adaptive. They expected the guidance robot to adapt to their emotional state and answer accordingly. The Finnish participants, on the other hand, did not expect Pepper to be human-like and would only utilize Pepper to extract information. Thus, the experience machine-like emerged in their case. They did not want the robot to try to build any relationship, as "it is not a human" (Female, Finnish). Nevertheless, they wanted Pepper to entertain them occasionally. Although we could not design different experience for different participants, we tried to evoke these hedonic needs by through our functionalities. For example, we opted to keep the university guidance robot's gesture as natural as possible. Moreover, we fed as much information as possible to the guidance robot for taking care of the participants. Due to the limitation of technology, *adaptive* experience was not possible to be induced.

The primary purpose of designing Pepper in the university context is to help the new students adapt to the university better. Using the above design implications, brainstorming sessions were conducted to derive functionalities and ideas that would help to serve our novel purpose. According to Onchi et al. [13], students appreciated if robots show the direction instead of following a paper map. It gives us a hint that, we could also use Pepper to show routes to different places within and outside the university. In addition to that, Kanda et al. [8] designed a robot that helps students in classrooms by offering a relevant quiz. It engages children to interact with the robot. In our case, we decided to develop two quizzes that the users could take in groups or alone. In this way, Pepper could take part in the teaching activity and provide information at the same time. However, Lee et al. [12] found in their study that their snackbot might sometimes disturb university staff if it tried to engage them in conversations when they were busy. Thus, we also decided to keep a few display options, since many students will have a hectic schedule during the orientation sessions. We chose to display a few necessary information that the students could just read from the tablet without Pepper's interference.

We also focused on the preferred methods of communication. According to the user data, the most effective way of communication would be voice, tablet and gesture. Thus, we decided that Pepper would communicate with the users using voice, tablet and gesture when showing direction, playing quiz or providing information. However, according to Willemse et al. [17] robot initiated touch could develop a relationship between the robot and the human. Thus, we decided to utilize some of Pepper's inbuilt applications to serve the purpose of haptic interaction. Furthermore, we chose to implement command and functionalities where the users need to initiate touch interaction; a few participants mentioned that they want to touch the robot.

4 IMPLEMENTATION

Pepper runs on Linux operating system and Naoqi framework. NAOqi is the name of the software that runs on the robot and controls it. This framework is cross-platform and cross-language, which means the robot, can be programmed in both Linux and Windows platform and has similar API for both python and C++. Furthermore, there is a graphical user interface named Choregraphe, which simplifies the programming experience for the beginners. For implementing the prototype, we decided to use the GUI to develop the prototype conveniently. The following section presents what functionalities were deduced from the findings, how we programmed Pepper in Choregraphe and other necessary prototype implementation details. It was done with the help of a colleague, Aleksi Hiltunen, whose Masters' thesis was also related to social robotics.

4.1.1 Functionalities for University Guidance Robot

Based on the findings reported in section 3.4, the following functionalities were deduced to satisfy pragmatic and hedonic user experience. The solution to pragmatic needs are listed below:

1. Show Me the Way: Pepper displays the names of the buildings on the tablet, with the essential and visible spots in that building. When participants click on a building, Pepper displays an interactive google map. Furthermore, it explains the direction verbally and using gestures. The map also provides a QR code for the users to scan and have on their phone.
2. Restaurant Menu: This application shows the menu of all restaurants on one page. The participants could go to the restaurant's main page by clicking on the restaurant's name.
3. Events and Places to Visit: In this application, Pepper displays what kind of activity the university and the city offer for the whole week. It was also possible for the users to create their event, which would be displayed in Pepper's tablet if other participants were interested in joining.
4. Find a Friend: This application introduces a few people Pepper met during its stay at the university. Pepper also asks the participants if they want it to send it a customized email to their preferred person. In the end, Pepper also asks if the participant wishes to register herself to the system.
5. Fun and Entertainment: We tried to compile two in built applications on Pep-per in this application. These applications were "sing and dance" and "tickle me". We added a third application, "language quiz", which taught the new stu-dents some basic Finnish terms.
6. Random Contacts: This application displayed a list of information the inter-viewed participants wanted to know, for example, gym website, hospital web-site etc.

7. TUT Freshman's Quiz: We introduced another quiz, which would inform the new students about some facts about the university through a quiz.

The following functionalities are utilized to induce hedonic experience, which was culturally distinct:

- The university guidance robot would frequently ask participants to hug, fist bump, hi five, handshake etc. to make the interaction more natural and to develop a bet-ter relationship with the users. These features were already in built-in Pepper robot, and we integrated those features with our application. Since touch is a natural gesture in human interaction, we tried to make it comfortable for the users to touch the robot by implementing a few users initiated touch gestures. For example, the user could quickly return to the main page of Pepper's tablet, or make Pepper stop dancing by placing their hand on its head. Furthermore, the application "find a friend" implements user initiated touch. Apart from using the tablet, the users could touch Pepper's right hand to send a customized email to their chosen friend. Otherwise, they would just touch Pepper's left hand.
- It was challenging to evoke nurture experience among the participants due to some restrictions in movement. Thus, Pepper could not accompany them somewhere to address their problems. However, Pepper provides all kinds of solutions that students face in the university environment via the applications we decided to build to address pragmatic needs. In this way, Pepper could guide the participants to solve their problems, which would also solve the purpose of nurturing.
- To evoke fellowship and recreation, we designed quizzes where the students learn necessary information about the university and Finnish words in a gamified environment. It will also help us achieve our target experience playfulness. The university guidance robot tries to teach them what it has learnt during its stay in the university and challenges the students in a friendly manner. The feature "find a friend" is also a friendly approach to introduce the new students with friends the university guidance robot made during its stay.
- It was difficult to evoke the machine-like experience, as Pepper is interactive. However, we tried to minimalize voice interaction for few applications to get users' feedback.

4.1.2 The Graphical User Interface, Choregraphe

We decided to program Pepper using Choregraphe. Choregraphe has in built libraries that can be utilized to program Pepper. The GUI has some ready to use boxes that enables us to run a behavior in Pepper without writing any code. In addition to that, if someone wishes to personalize the robot by creating their functionalities, it can be done by creating custom-made boxes. The programmers can write their code in those boxes and load it in the robot. It is also possible to connect Choregraphe to the virtual robot to test run functionalities when Pepper is not physically available.

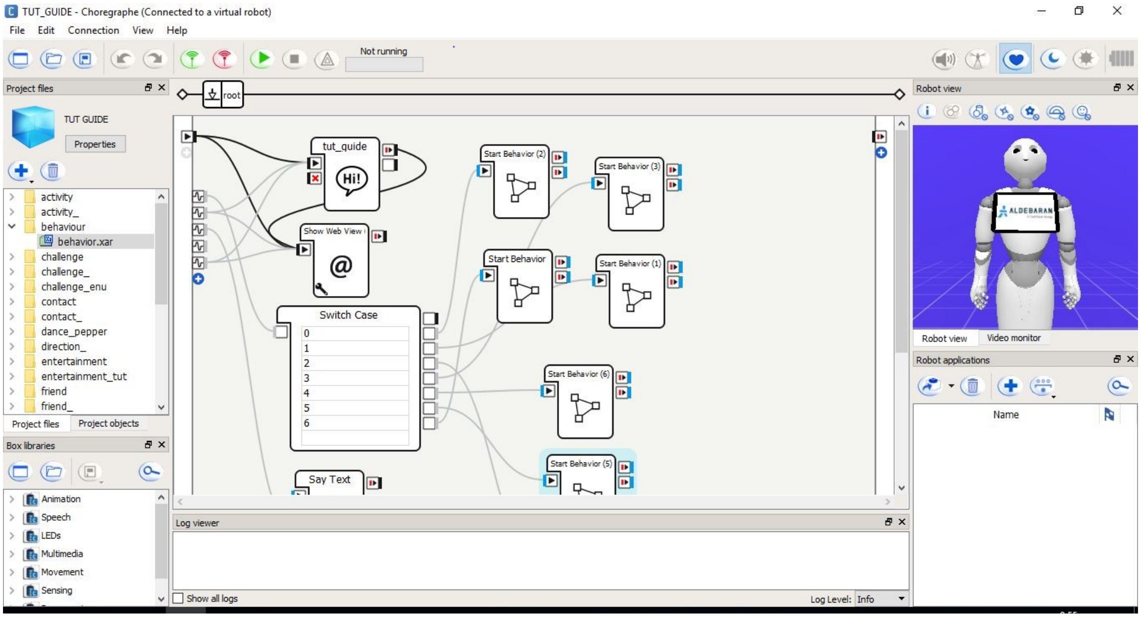

Figure 4.1. The graphical user interface, Choregraphe

We divided the implementation into two categories:

1. Implementing applications for the tablet

2. Implementing gestures and dialogues in Pepper.

The applications for Pepper’s tablet are programmed in HTML, CSS and JavaScript. Uploading the applications via Choregraphe is possible. Choregraphe provides a ready-made box for displaying webpages named “Show web view”. This box needed a slight modification, to demonstrate the applications we programmed. This box has one input, one output and one parameter field where we insert the URL of the webpage we want to show. It is also possible to edit the number of inputs and outputs.

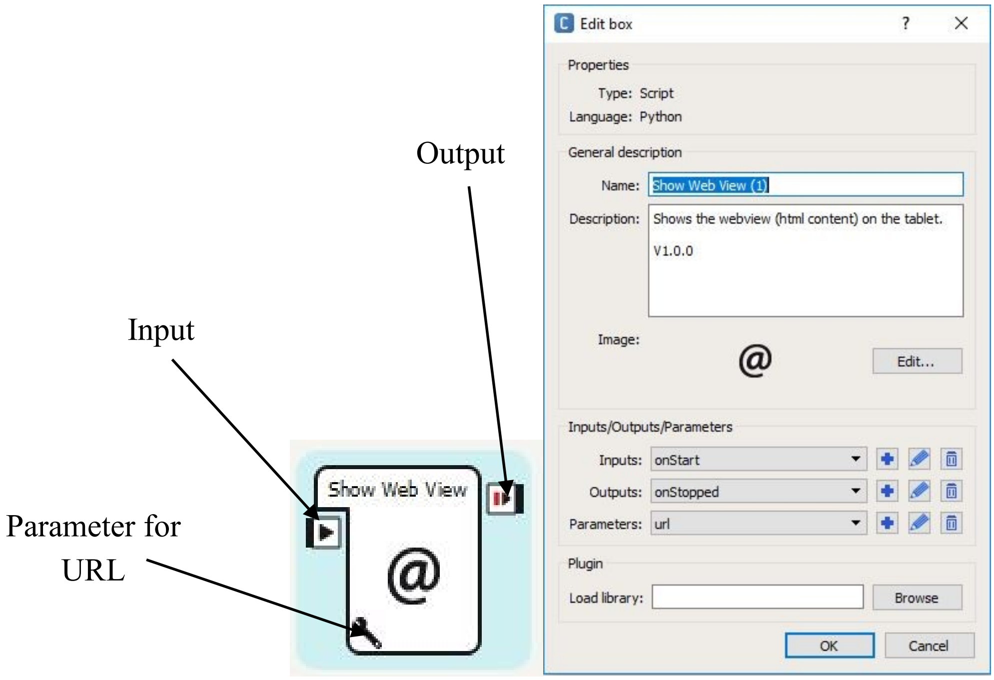

Figure 4.2. "The show web view" box from Choregraphe GUI and its functionalities

We needed to display webpage or images for all applications. Initially, we had to create the landing page for the tablet. In the landing page, the users had the freedom to select their preferred task. The landing page was designed in HTML and CSS. However, the links to the buttons were programmed in JavaScript.

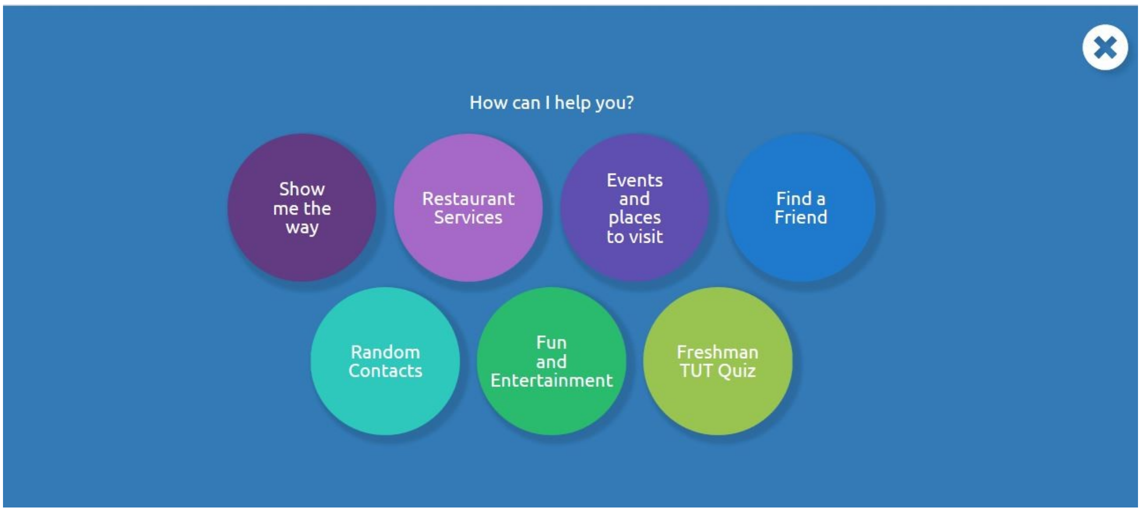

Figure 4.3. The landing page for the applications on Pepper's tablet

After creating the buttons, we linked it with Choregraphe with the help of raiseEvent() method of ALMemory. ALMemory is a subclass of ALModule. It means ALMemory can inherit any method that ALModule has. AlModule is the base class for user modules, that helps execute their methods.

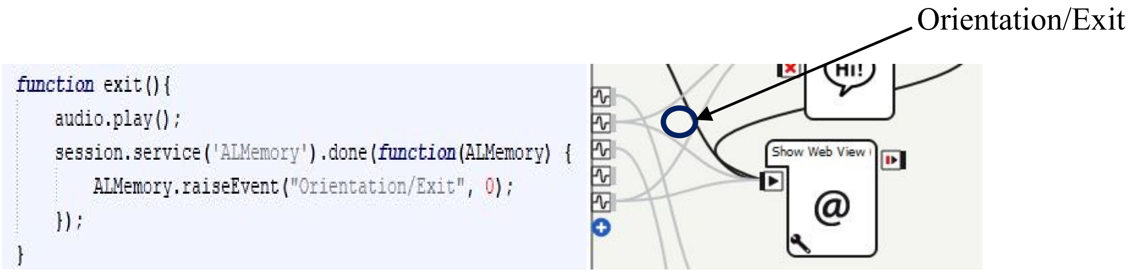

Figure 4.4. AlMemory raiseEvent() (left: Javascript code, right: Choregraphe box)

Figure 10. displays an example of how ALMemory.raiseEvent() method works. The left picture shows a snippet of the Javascript code, which was used to send signals to Choregraphe. The image on the right displays the event from ALMemory. The example function here is exit(). When the user clicks on the exit button, the function exit() is called which raises the event Orientation/Exit and sends signal “0” through the event. This event was connected to “Show web view”, and the signal “0” was sent to the corresponding box. Based on the trigger condition, the defined program was executed. Most of the tablet based applications were built based on the raiseEvent() event.

To execute different applications from the same landing page, we utilized the pre-made start behavior box. Based on the user’s selection, the signal was passed through a “switch case” box.

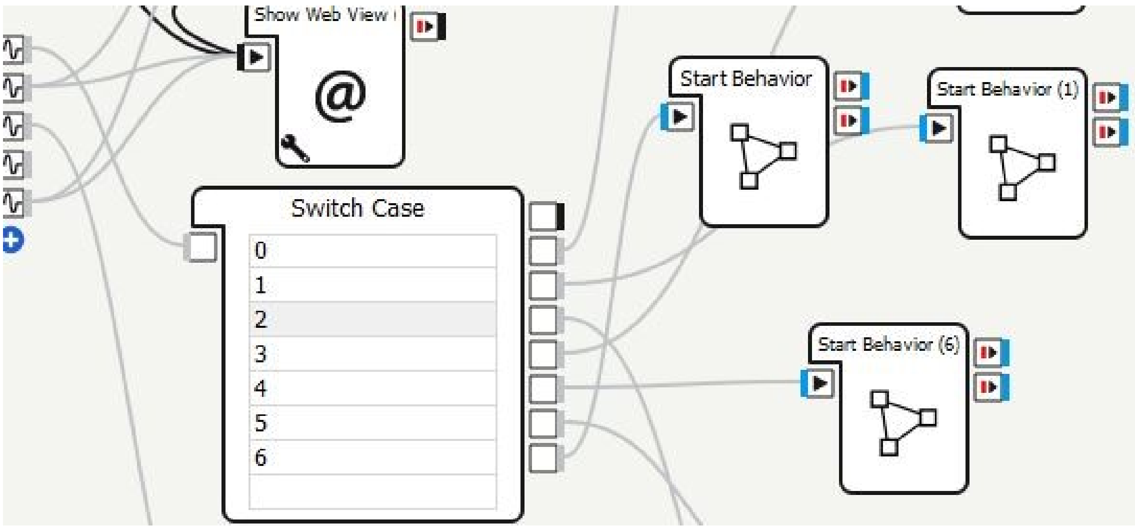

Figure 4.5. Switch case to trigger the behaviors in Choregraphe Graphical User Interface (GUI)

We connected the switch case box with orientation/startapp event so that whenever the user would select their preferred application, it will send the signal to the corresponding behavior. For instance, in Figure 13, if signal “2” was sent through the event, the switch case triggers “Start Behavior (1)” to start.

Each behavior contained one functionality that we designed. There were seven functionalities in total that was mentioned in “Design Implications and Features” section. We adopted a similar technique while programming, as mentioned above. We mostly used switch cases and ALMemory events to program the navigation between different applications and webpages.

4.1.3 Programming Pepper’s Dialogue and Gesture

To program gestures and dialogues, we utilized the “Dialog” box of Choregraphe. After creating a new dialogue box, Choregraphe creates a dialogue script where it is easy to define dialogues for the robot.

The dialog box is the same as any other box in Choregraphe. However, we needed to define the languages for Pepper. Since we required Pepper to pronounce some words in Finnish in the language quiz, it is necessary to set both English and Finnish languages for Pepper. Just as the other boxes, it has input and output. The number of inputs and outputs can be modified.

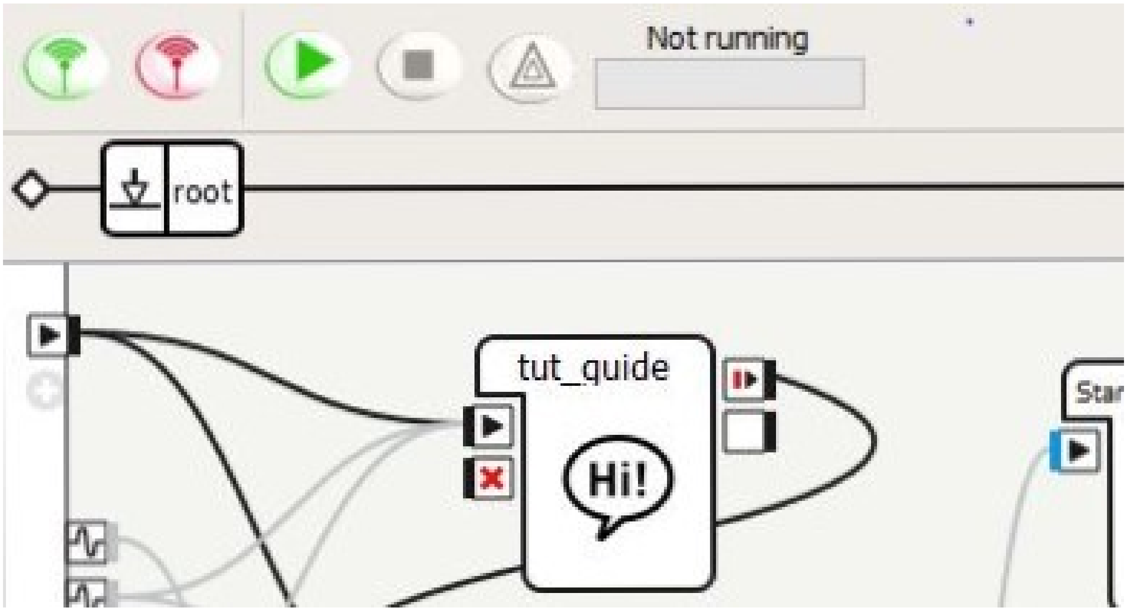

Figure 4.6. The dialog box on Choregraphe GUI used to formulate scripts for the guidance robot

We set Pepper’s speech and gesture interaction in the dialogue script. The script has a topic and a defined language. The script had keywords and rules that we needed to consider while programming the dialog.

```
topic: ~friend()
language: enu
concept:(correct) \pau=500\ ^rand[^start(animations/Stand/Emotions/Positive/Confident_1) ^start(animations/Stand/Emotions/Positive/Optimi
u:(e:onStart) $html="en/friend_start.html" ^gotoReactivate(intro)

proposal: %intro I've been meeting many people during my stay at T U T. \pau=500\ Would you like to meet them as well? \pau=500\ Let's st
    u1:(e:orientation/answerContinue) Lets start ^gotoReactivate(start)
    u1:(e:orientation/answerStop) $onStopped=1
proposal: %start \pau=500\ The first person is ^gotoReactivate(friend1)

#Q1
proposal: %friend1 $html="en/friend_1.html" He is a local student \Pau=100\ and knows a lot about the city \Pau=100\ He seemed to be fun
    u1:(e:orientation/answerRight) ^startTag(excited)~correct \RSPD=100\ I will ask this person to contact you with your email address ^g
    u1:(e:orientation/answerContinue)  Let's move on ^gotoReactivate(friend2)


#Q2
proposal: %friend2 $html="en/friend_5.html" She seemed very nice and jolly \Pau=100\ when I met her. \Pau=100\ There is one thing common
    u1:(e:orientation/answerRight) ~correct  \RSPD=100\ I will ask this person to contact you with your email address ^gotoReactivate(fri
    u1:(e:orientation/answerContinue)  Let's see who is next ^gotoReactivate(friend3)
```

Figure 4.7. The dialog script prepared on Choregraphe GUI for the guidance robot

Below we are defining the keywords that we used while programming the dialogue for Pepper:

1. Concept keyword was used when we needed to establish a list of phrase. In figure 15, the concept "correct" contains a list of animations. Thus, whenever the concept "correct" is called, the robot recognizes the list of animations defined in that concept.

2. Rand is a keyword that is used to randomly choose any one word or animation defined in a set of word or animations. In figure 15, the ^rand was used to randomly execute any one of the animations when the concept "correct" was called.

3. u(e:onStart) keyword is used when we wanted Pepper to begin the conversa-tion when the application is run.

4. ^start keyword is used to initiate animations or gestures for Pepper. ^startTag, on the other hand, allows us to launch animations, which have mentioned tags. If there is more than one animation specified in the same tags, the program randomly generates one animation for the robot.

5. RSPD and PAU determine the flow of the speech for Pepper. RSPD tag is used to control the speaking speech of the robot. PAU, on the other hand, decides if the robot needs to pause between the sentences.

6. ^gotoReactive() is the keyword to jump between proposals if required. In fig-ure 15, we jumped between different proposals depending on the user's input.

Since it is possible to edit the number of inputs and outputs of the box, it is also possible to pass parameters through those. $html in Figure 15, demonstrates that it is possible to pass strings through the html output port. In this particular case, we are passing the link of the webpage we want to display to the "show web view" box.

4.1.4 Programming Functionalities for Pepper

As mentioned previously, we programmed seven functionalities for the robot mentor Pepper. The participants would navigate between the features from the landing page, which was described in one of the previous sections. Below is the description of how each functionality was designed for the students.

1. **Show Me the Way**: This functionality was designed for the participants for easier navigation between the buildings in the university. We the help of HTML CSS and JavaScript, we programmed a webpage we created buttons that displayed the options for different buildings and prominent places in that building. When the users click one of the buttons with their preferred building's name, a signal would be sent from the webpage to the Choregraphe app via ALMemory events. Choregraphe would process the information and display an interactive map for a particular building on Pepper's tablet. This interactive map was google indoor map of the Tampere University of Technology that presented the participant's current position, destination building and the route. Moreover, it would display some salient points like restaurants and cafes. It also provided a QR code if the participants wanted to have the map while they were walking. Scanova.io created the QR codes.

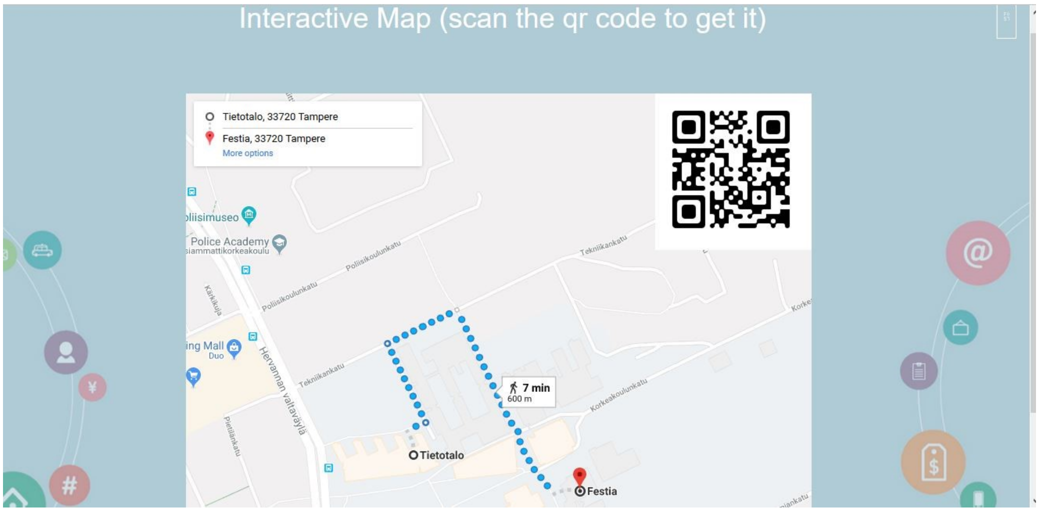

Figure 4.8. Interactive map display in Pepper's Tablet from Tietotalo to Festia

2. **Restaurant Services**: In this functionality, Pepper would display the restaurant menu and let the user navigate through the web pages. We managed to present a pre-existing website with all the restaurants' menu in it. When the participant clicks on the "restaurant services" button, JavaScript sends a signal to the AlMemory orientation/startapp event of Choregraphe. Choregraphe then displays the website on Pepper's Tablet. The participants were requested to touch the head of Pepper to exit the application. When Pepper's head is touched, ALMemory

event middleTactileTouched was raised which led Choregraphe to return to the landing page.

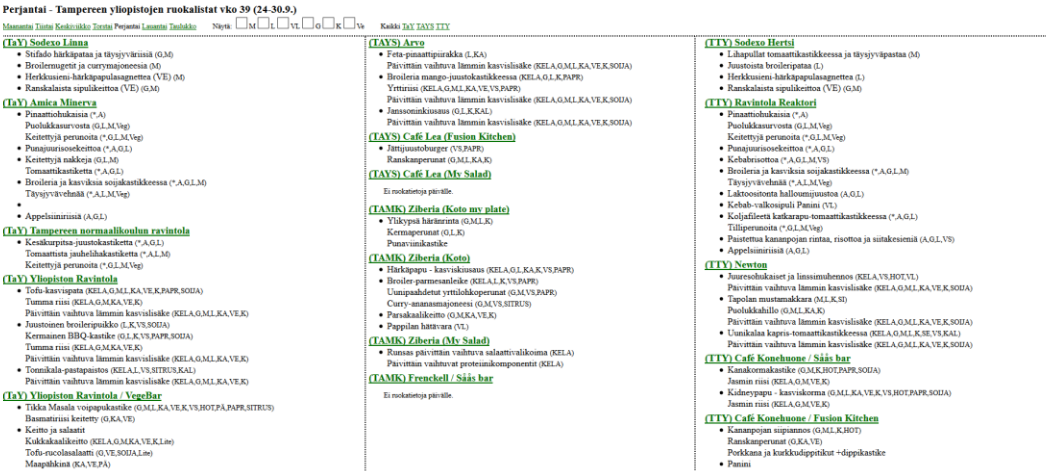

Figure 4.9. Restaurant Services website displayed on the guidance robot's tablet. This website displays the list of restaurants in all universities and their menus.

3. **Events and Places to Visit:** This functionality aims to advertise different events that are happening around the university and Tampere. Pepper displays 4 options for the students to explore. When the students select their preferred option, it raises the ALMemory event and redirects to the corresponding webpage. The webpage is programmed in HTML, CSS and Javascript. The events are displayed as swipe cards, so that, the participants can swipe the cards for more details.

Figure 4.10. Displaying the activities and events on the guidance robot's tablet. These cards display places to visit in Tampere City

We designed self-made events for the participants to create their events. These events are displayed under "Made by Others" section. When participants click on the "self-made" event button, Pepper explains the rules for creating own activity and takes them to a form where they can create their activities. These activities are later added to "made by others" section.

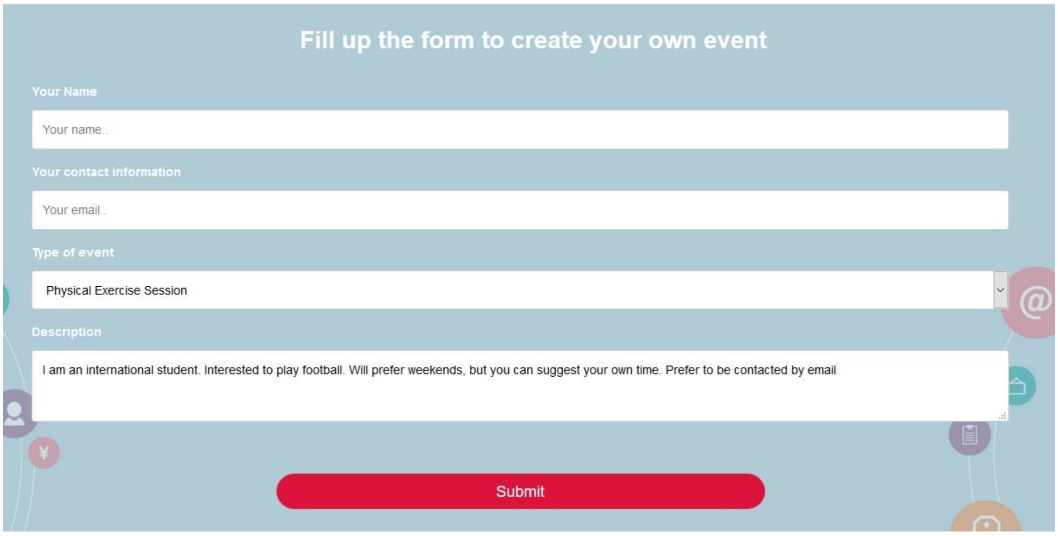

Figure 4.11. Filling up forms for making customized events on the guidance robot's tablet. The new students were asked to create customized events with this form.

4. **Find a Friend:** When participants click on the "Find a friend" option, it first asks the participants to enter their preferred contact information. The purpose of asking their contact information is to send their chosen friend a customized email with the provided contact information. It will help them to contact in future. After the participant fills up the details, Pepper introduces the profile of people he met and asks if the participants are eager to contact them. If the participants were eager to contact them, they would write a customized email and press "contact" button. Pepper verbally gives feedback that he emailed the participant's chosen friend with the email and contact details. Pepper then moves forward and introduces other profiles to the participants. After Pepper has introduced all the people he met, he would ask the participant if they want to give their details to be introduced to other people and provides a form to fill.
5. **Random Contacts:** When the participants click on the "Random Contact" button, it provides a list of probable necessary contact information for students. Information were displayed as cards and the students could tap the cards to scan a QR code. The QR code leads them to the website of the services.

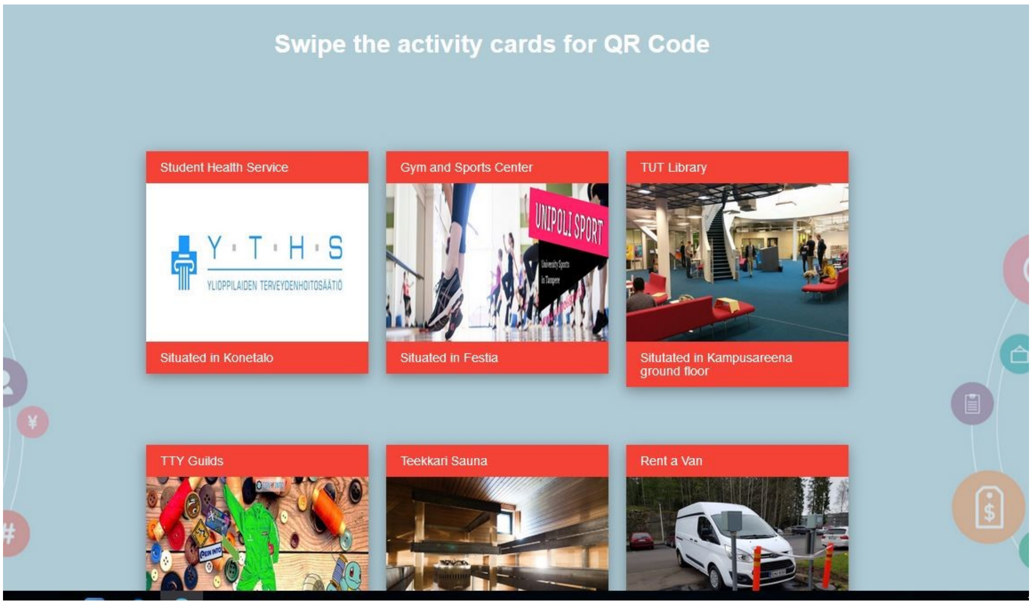

Figure 4.12. "Random Contact" webpage on the guidance robot's tablet that displays some important contact information for the new students.

6. **Fun and Entertainment:** This section is a combination of three functionalities. We adopted two of Pepper's already existing functionalities; "Fresh and pretty dance" and "tickle me". However, there was a third functionality under this section, which is "the language quiz". The purpose of this quiz was to gamify the process of learning Finnish words with Pepper. Once the participant taps on the language quiz, Pepper asks them if they want to learn some Finnish words. If the participant taps on "Continue", Pepper randomly generates eight series of questions. These questions were usually answering the Finnish words for the English words. Pepper would display the questions on the tablet, and the participant needs to select the correct answer from three options. At the end of the quiz, Pepper displayed their score. Furthermore, Pepper congratulates them with speech and gesture.
7. **TUT Freshman Quiz:** This quiz was similar to the language quiz. However, this quiz was designed to ask fundamental questions about TUT. The layout and structure of this quiz were same as language quiz, but the set of questions were different.

4.1.5 Implementation Limitations

There were some restrictions that we applied while designing the robot. We imposed the following limitation:

1. Movement of Pepper around the campus.
2. The speech interaction
3. The number of robot mentors.

We decided to restrict Pepper's movement to one particular area because according to Joose et al. [3] users might be sensitive to how the robots approach their personal space. On the other hand, people might consider Pepper rude if it walks away when someone tries to interact with it. We also limited the speech interaction to some extent because of some voice recognition issues in public.

Regarding the number of robot mentors, we decided to restrict it to one, since only one moderator was available to conduct the trial.

Since this was a prototype, many functionalities were not entirely implemented. Furthermore, due to the university's privacy policy, we could not access university database or use original data about students.

5 EVALUATION OF THE UNIVERSITY GUIDANCE ROBOT

In this section, we report how we conducted the evaluation phase and how we observed and collected the experience of the participants. We conducted pilot tests and field trial to gather participants' insight with 30 participants in the field trial. We used observations and questionnaires to deduce the participant's experience and preferred tasks in the context of university guidance robot. We also conducted short interviews with the participants based on their filled questionnaires. The responses of the questionnaires were recorded and analyzed which are also presented in this section.

5.1 Study Design

We conducted a pilot study and a final trial to evaluate the implemented functionalities. The purpose of the pilot study was to test trial set up.

We conducted the final trial in the Tampere University of Technology during the orientation week (20th and 21st August 2018) with the new students for two days. The tests were undertaken mainly in the Main Building and Tietotalo lobby. The tests were usually 15 to 20 minutes long. The students, who were willing to participate, were given two sets of questionnaire. Initially, they were given one set of the questionnaire before the start of the interaction. This set of the questionnaire (See Appendix B.1) included questions about their background information, for example, nationality, gender, the field of study and age range they belong. In addition to that, we asked them to mark the emotions they feel before interacting with Pepper (See Appendix B.1).

We then asked them to select the functionalities they would like to try out with Pepper's tablet. Based on their choice, they were given related tasks (see Appendix B). After the interaction, we gave them second set of questionnaire, which included questions about their emotions after the interaction, and the functionalities they tried out and found effective (See Appendix B.1). Two of my colleagues were making observation notes to understand the passerby's reactions and the data was analyzed by means of content analysis. Content analysis is a process to analyze qualitative data by identifying similar themes within the data [50]. These findings from observations are reported in 5.4.5.

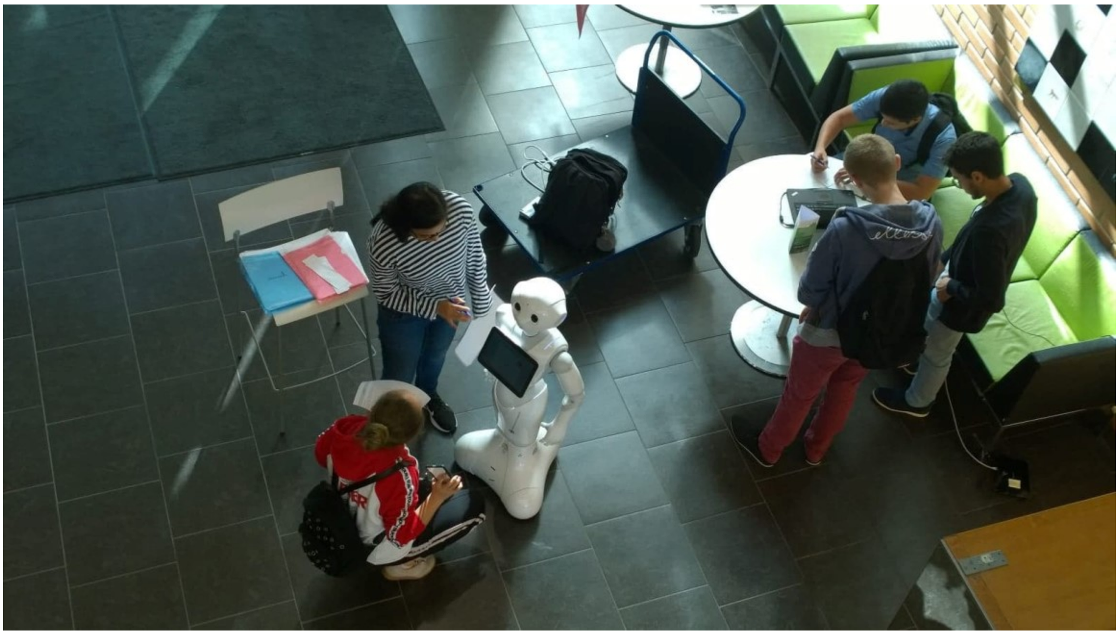

Figure 5.1. The trial environment during the orientation week. The participants interact with the guidance robot and fill the provided questionnaires

5.2 Participants

For the final trial, we recruited the participants randomly in the orientation week, if they agreed to interact with Pepper. We would generally approach curious people and ask if they want to interact with Pepper and take part in the user test. In total, we gathered 33 participants, where 18 participants were male, and 15 were female. We had participants from Morocco, China, Finland, Spain, Italy, Mexico, Tunisia, Chile and Iraq and the average age range was 23-27 years.

5.3 Data Analysis Methods

To analyze the collected data, we adopted two data analysis methods. We examined the quantitative data obtained from the questionnaire by conducting statistical analysis. To visualize the difference of evoked emotions before and after the interaction, we calculated the average and standard deviation for the collected data. We also ran P-tests to analyze if there was any significant difference between the two datasets. We performed content analysis for the observation notes and interview data.

5.4 Findings

In this section, we report the findings from the questionnaires that were collected during the trial sessions. Initially we interviewed 33 participants. Due to incomplete questionnaires of 3 participants, we decided to analyse the data of 30 participants who took part in the trial.

5.4.1 Evoked Pragmatic Experiences

We asked the participants about the usability and operability of the guidance robot, asking the questions displayed on Figure 24.

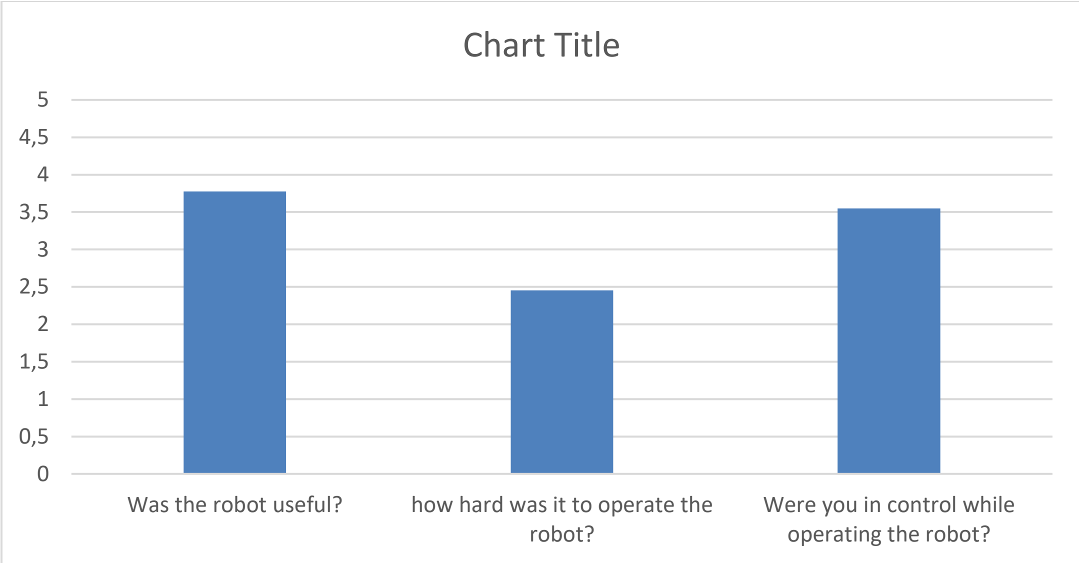

Figure 5.2. Mean value of usability, operability and usefulness of the robot

We conducted t-tests among these data, and we found out that the difference between "how hard was it to operate the robot" was extremely low when compared with other categories. This referred to the fact that participants did not find it hard to operate the robot. For example, we conducted a t-test between "how hard was it to operate the robot" and "were you in control while operating the robot" since these two had the least mean value. The two-tailed P value equals 0.0003, and the difference by conventional criteria is considered statistically significant. Thus, we can say that it was **not** hard for the participants to *operate* the robot and they were in *control* when operating the robot. It helped us achieve one of our set pragmatic goals, which was operability. The other hedonic goals achieved were *usability* and *control.* Thus, we can say that the guidance robot could fulfil the needs of the participants, satisfying the pragmatic goals.

5.4.2 Evoked Hedonic Experiences

To understand the hedonic experience evoked during the trial, we asked the participants about the role of the guidance robot according to them. We predefined specific roles, such as guide (representing nurture), friend (serving fellowship), a classmate (serving fellowship and natural/humanlike interaction), staff member (representing natural/humanlike interaction) and caretaker (representing nurture). We also provided an option for them to suggest other roles. These roles would reflect what kind of experience the guidance robot evokes among the students, thus indicating the evoked hedonic experience.

According to the participant's input, the highest number of people considered Pepper as a "friend" (14 people). It seems to reflect our target experience of fellowship. Participants also voted for "classmate" (2 participants), which was also a reflection of fellowship. Moreover, participants gave statements like "*Can I take him to the club with me?"* (Male, Finnish) and "He is so nice and friendly" (Female, USA), which also referred to the fact that the guidance robot successfully evoked fellowship among the participants.

The second highest vote came for "guide" (10 people). Since guides should have nurture quality in them [25], we can say that our guidance robot satisfied the target experience nurture. Participants mentioned, "I think Pepper is just like my tutor" (Male, Tunisian), where tutors are assigned to take care of the new students.

Participants also selected other roles such as, a classmate (2 participants), staff member (2 participants) and caretaker (1 participant), which also reflected the natural experience. A strong evidence of fellowship and humanlike hedonic experience could be observed from Figure 18. The mean score for friendliness of the robot was slightly above 4.5. This score is significantly high on a Likert Scale 5. Friendliness in this scenario refers to that the natural behavior and compassion of the robot towards the participants. In addition to that, the participants' vote for Pepper being a friend or guide was also a definite proof that the guidance robot evoked the natural/humanlike experience. Hence, we could deduce that participants enjoyed a natural/humanlike interaction, satisfying the target experience. 20 participants referred to Pepper as he or she, which reflected that participants assigned a gender to the robot. Based on the observation it seems that the participants considered Pepper behaving naturally. Moreover, one participant said, "I would say he is amazing and I said "he" because he was almost human" (Male, Iraqi). These statements verify our claim of Pepper evoking the natural experience.

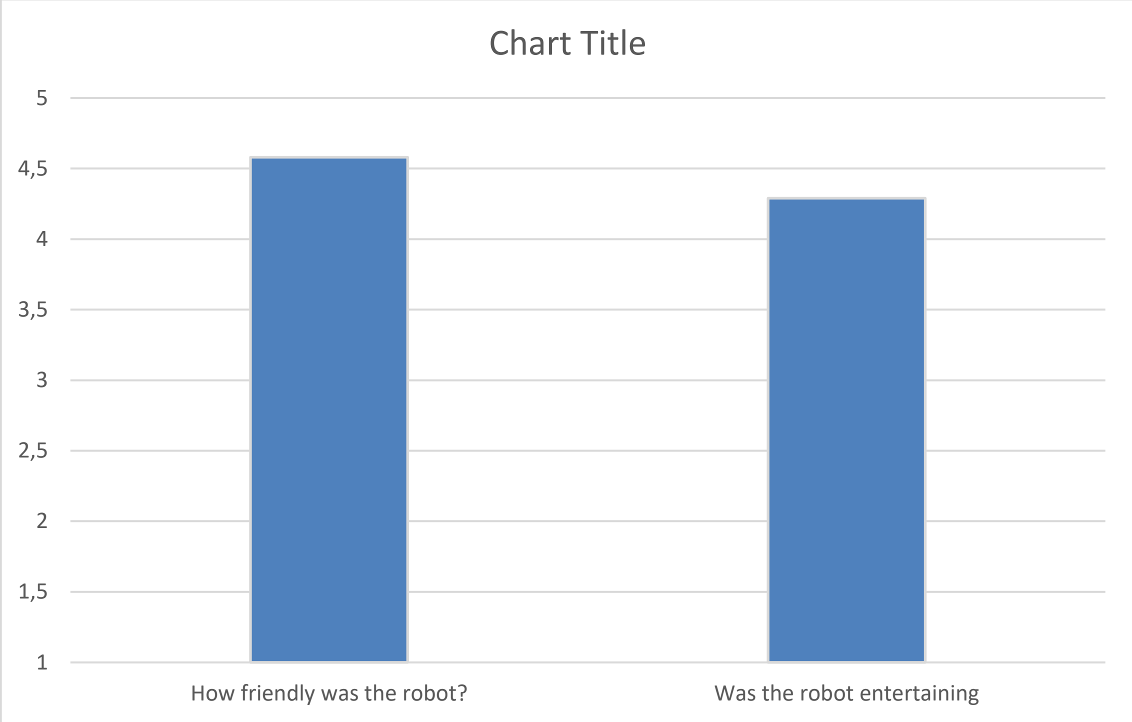

Figure 5.3. Mean value of the participants' attitude towards the robot.

Other extracted hedonic attributes from pre-study, which was also mentioned in 3.4.1, were playfulness, machine-like, and adaptive. From the figure 18, it could be observed that the mean score for the entertainment factor was between 4 and 4.5. This value is considered high when considering a Likert Scale 5. Thus, this high score reflects playfulness of the robot. When we asked participants what the most entertaining factor about the robot was, 14 people mentioned sing and dance. On the contrary, eight people indicated that the language quiz was useful for them. Moreover, some participants would challenge their peers to try it out and compare their scores. There were also participants who were recalling the words they have seen in grocery stores.

The experience machine like was not achieved during this phase. As most of the participants felt Pepper as almost humanlike, we can assume that the machine-like experience is missing. There are also attributes like adaptive. However, the technology itself is still developing to achieve this. The guidance robot yet cannot understand every context and answer autonomously. We will report how the pragmatic needs usability and operability were achieved, which were mentioned in section 1.3.2.

5.4.3 Comparison of Emotions Before and After Interaction

As mentioned before we asked the participants to fill a questionnaire for us. This questionnaire was divided into two parts. In the first part, the participants filled up some necessary information about themselves and marked their emotions before interacting with Pepper. These emotions were excited, scared, amused, shy, anxious, happy and proud. These emotions were collected during pre-study and reported in section 3.4.2, as the participants often mentioned such emotions if they were to interact with the robot. In the second part of the questionnaire, we asked them to mark their experience after the interaction. Furthermore, we evaluated these emotions on a Likert scale 5.

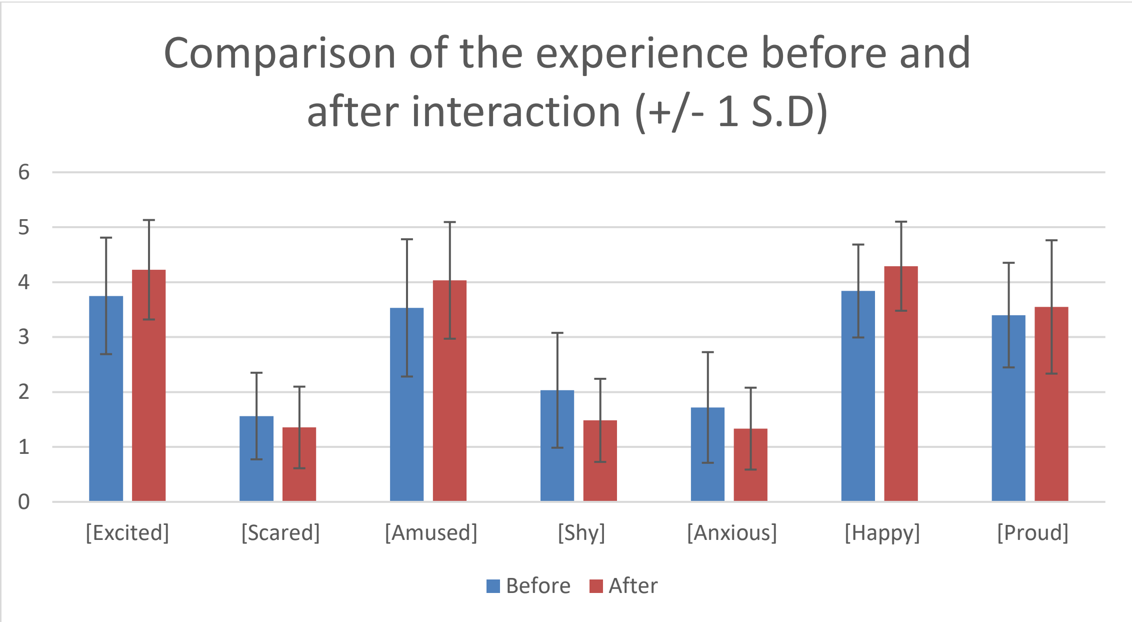

Figure 5.4 Comparison of the gathered data about emotions before and after interaction

The data presented in the graph shows the comparison of mean values between two datasets, before and after the interaction. We also calculated the standard deviation and the graph displays the error bars in comparison with the mean value. According to the graph, most of the error bars overlap following the y-axis, when the before and after emotions are compared. It means that there is no extreme difference between the compared emotions. The error bars also indicate the highest and the lowest bound for the responses.

We also ran unpaired t-test with each pair of data to confirm our previous finding. According to the t-tests, there was a significant mean difference between the emotions shy (Two-tailed P value 0.0237) and happy (Two-tailed P value 0.0391) post and prior to interaction. There were no other significant difference for other emotions. These refers to the fact that the emotions of the participants did not change before and after interaction. One reason for this could be the novelty effect of the robot due to short and one-time trials. The aroused emotion might differ if the trials were carried for longer period.

5.4.4 Observations

Overall, Pepper was considered as a friendly guidance robot that would entertain them as well as provide relevant information. We gathered and analyzed observational data and the following themes emerged:

Peer Pressure

According to the observations, *peer pressure* influenced many participants to interact with Pepper. We observed that students would mostly notice Pepper when someone else is interacting with it. Moreover, they got interested when other participants would take pictures of Pepper or hug Pepper. It was also noticed that, if students were walking in a group they would stop and ask what was Pepper doing there. On the other hand, students who were alone would stand at a distance observing other people. It was interesting to note that, if there were anyone alone who was observing Pepper, the observer would only approach Pepper if a friend joined him/her. It implies that students are usually hesitant to interact with a robot alone. In groups, they were braver. When we asked a participant why she was hesitant in the beginning, she replied, "At first it looked creepy, but he has such cute manga eyes" (Female, 25). Therefore, we can conclude that people are reluctant to interact with Pepper alone because they might be scared to see Pepper for the first time. However, when two or more people tried to interact with the robot at the same time, the guidance robot got confused, which as a result, made the participants confused.

Participants' Gestures and attitude

Pepper would not recognize when two or more people tried to interact with it, due to its speech recognition limitations. One participant decided to shout to Pepper's loudspeakers, as it was placed like Pepper's ears. Some participants even came up with their gestures and interaction methods, for example, tapping shoulder. We observed many participants preferred touch-based interaction rather than tablet based. On the other hand, there were people, who expected Pepper to have a conversation with them, rather than operating the tablet to perform specified tasks. Mostly, students loved it when Pepper danced or performed gestural behavior like hugging, handshaking, fist bumping etc. A group of students was imitating Pepper's dance moves. One of the participants mentioned, "I am so going to steal his dance moves" (Male, 27). On the other hand, some students expected Pepper to be decidedly advance to detect them using facial recognition. Some students also expected that Pepper would register them to the university system.

Limitation with height

We noticed that Pepper was too short for students. Students often crouched to interact with Pepper. One participant mentioned, "Why don't you put him on a table or something higher?" (Male, 26). Some students kept on complaining that the tablet is placed very low. One student also mentioned that the tablet's brightness was low.

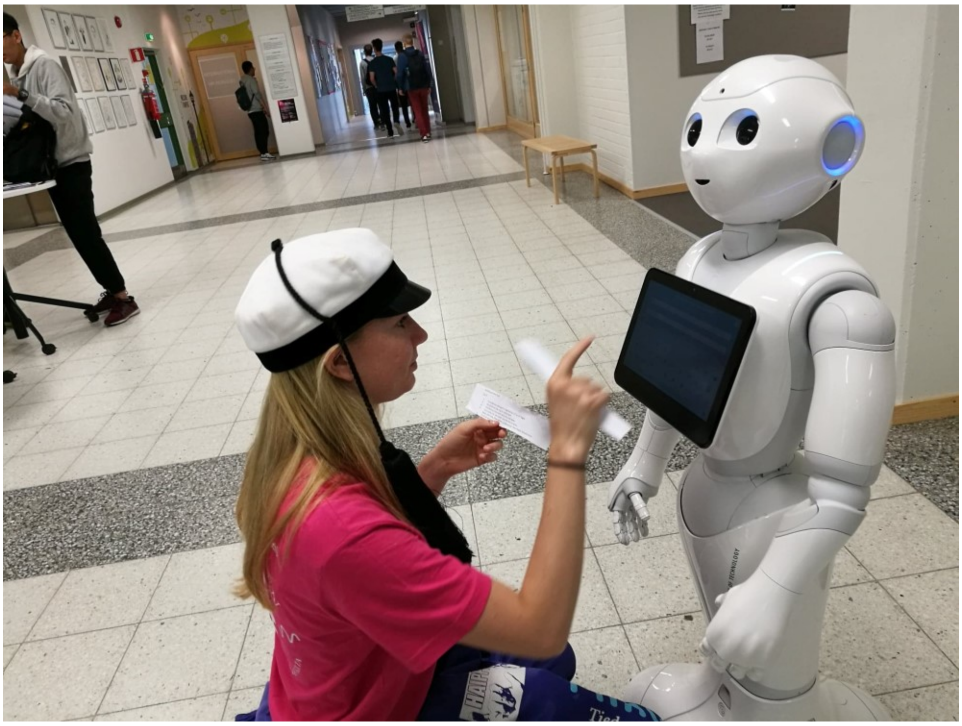

Figure 5.5. Students crouch or bend down when interacting with Pepper

Usually, international students were more enthusiastic than Finnish students were. Some students would pass by without even noticing Pepper. We asked them why they were not interested in interacting with Pepper. Some of them replied that they were very busy because it was the first week at the university, some would hesitantly agree to communicate. Interestingly, some participants would make funny comments like “I have a more advanced version of this at home” (Male, 28). However, few participants were eager to know if Pepper would interact in Finnish or other languages.

Our overall observation concludes that most of the people were eager and curious to see a robot in the university campus. Since the student mentor robot is a novel approach, most of the students seem to be curious about the robot.

6 DISCUSSION

In this section, we discuss our findings and limitations. Furthermore, we will discuss the results in the light of our research questions,

6.1 Discussion of the Research Questions

In this section, we discuss the research questions in light of the related works.

1. *What are the expectations of students for the university guidance robot?*

To extract users' expectations, we utilized the method of Leong et al. [33] to walk the participants down the memory lane. In our case, it was very efficient as the participants almost forgot about their orientation week. We asked them about their different experience during the orientation week, which helped them refresh their memories. In the researches mentioned in section 2.2, the participants were already aware of the robot, or they were directly introduced with the robot without addressing their expectations. [27] [24] [17] [30]. On the other hand, in our case, the participants were asked about their expectation from a guidance robot with physically introducing it to the participants. Therefore, their expectations were very futuristic. However, none of their expectations seemed to be inspired by science fiction movies as mentioned by Breazeal et al. [8]. They expected Pepper to be more like a *human* or a *friend*. As reported earlier, participants expected the guidance robot to *nurture* them and interact *naturally*, which was a sign that they were ready to accept robots in their life. According to Onchi et al. [42], people did not like their guidance robot when compared to a human due to efficiency. During our interview, it reflected that Indian and Chinese participants had very high expectations from the robot for showing the way. Some participants even expected Pepper to lead them to the desired destination. Therefore, both the studies' results reflected that the robot should be extremely efficient to be equally accepted as human help. On the contrary, the Finnish participants expected Pepper to serve the purpose of "just a device". In other words, they expected *machine-like* experience. According to Kanda et al. [29], participants often form an emotional bond with the robot, which motivates them to return to interact. Although the Finnish participants did not expect to form any bond with the robot, the Indian and Chinese participants often insisted that Pepper should be around them, indicating their attachment to it.

During our research, we expected that, there would be slight difference in expectations with pre study participants and trial participants. We assumed several factors, such as staying in abroad for a period, might affect pre study participants' way of thinking. We assumed it might be different from how newly arrived participants would think. However, we found that, these factors did not affect the expectations or thought process of the students. Both pre study and trial participants expected similar interaction experience. In this case, we can conclude that, the participants' expectations were based on student culture. Both pre study and trial participants expected the guidance robot to interact in a friendly and human like manner. Moreover, they expected the robot to take care of them as a guide or human tutor would.

2. What is the experience of the students with the robot?

In most of the previous researches, participants considered the robots as friendly [26] [27]. In our case, participants experienced fellowship, which reflected friendliness. However, other experiences emerged during the trial phase. We discovered that participants were nurtured and thought it was humanlike. It proved the statement of Kaipainen et al. [28] that many hedonic needs related to basic needs could be addressed in human-robot interaction. Kanda et al. [29] mentioned that entertainment was the critical factor to attract participants, which was not different in our case. We observed participants gather around when Pepper would entertain or be playful.

We also realized during the trial that social robots are more popular than any other existing technology. Kanda et al. [29] compared robots with displays and found out robots were more popular. Similarly, in our study participants valued the presentation of information through a robot. For example, one participant mentioned that she finds screen very dull, but robots are more fun, and it can be personalized. However, during our research, we received many comments about Pepper's appearance. Some people wanted to change its color; some participants wanted to put hair on it. This one factor influenced the experience with Pepper. Many participants thought that Pepper looked very dull and it does not behave according to their wish. It implies that a robot can evoke a positive experience if the user can design them on their own.

We could not find any paper that mentioned peer influence in human-robot interaction. However, in our study, it was a prominent observation. As discussed in section 4.3.1, peer influence was an essential factor in the interaction process. People would approach Pepper only if someone else were interacting or with friends. Thus, it was clear that university students were dependent on their group. Furthermore, the group would respect the individual's interest and would wait until he/she has finished interacting. Some group would also give funny comments depending on Pepper's response. It induced the experience of humor among the group members.

From figure 20, we could see that there was a minimal difference among the positive emotions. Table 4.1 elaborates only two emotions, happy and shy, display significant statistical difference. As mentioned before, according to our related works, robots still have a very novel value in public place. Thus, we feel, this novelty feature affected the positive emotion of the new students. Students came from all over the world, and they were amused to see a robot waiting to help them. Thus, they were equally positive before and after the interaction. However, their shyness decreased significantly after the interaction. According to Connel et al. [10], people's emotion and experience are affected when they are continuously exposed to robots. Although the study was not long term, it still had some effect on the shyness factor. We also noticed people hesitated to approach Pepper robot initially. However, they got comfortable during the interaction. Many participants would touch the robot and try to ask different questions.

According to our observation, participants seemed to be happier when Pepper asked them to hug it. Thus, we could conclude that the warmth from the robot increased the pleasant experience of the participants. Users would usually have a pleasurable experience and would want to come back to interact if the robot is friendly and empathetic [32].

Previously in our related works, we mentioned that most of the participants treat social robots as friends. Our study validated this statement. Most of our participants thought Pepper was their friend. According to Tanaka et al. [45], when someone builds a friendly connection with a robot, they ought to take care of it. According to our observations, the participants were also eager to find out if Pepper was doing fine. Participants would comment, "Is he okay?" (Female, USA) and "I think he is tired" (Male, Mexican). We deduced from these comments that participants were caring and empathetic towards the robot.

3. *What are the preferred tasks for Pepper in the university guidance context?*

One exciting thing that we can notice from Figure 24 is that the Freshman Quiz has the highest mean value (4.4) among other functionalities, whereas only nine people tried this functionality out. Thus, we assumed that everybody who tried it found it useful. We realized that the word "quiz" might have been intimidating for the students. Komatsubara et al. [30] reported that the robot could not improve participants' knowledge but helped to build a better relationship. However, participants seemed to learn and recall words while trying out the language quiz. It indicated that gamified learning activities could help achieve the pragmatic need of learning and adapting for survival, which Chinese participants reported during pre-study. The participants mentioned that the quiz was informative and fun. One of the tutors of a participant, who was a bystander, suggested, "I was supposed to show you all these today. Now you can show others." While taking the quiz, participants frequently recalled where they noticed the Finnish words, "I remember seeing the word in the supermarket" (Male, 22). Participants also liked fun and entertainment, which had a mean score of 4.16. Participants mentioned that singing and dancing and the language quiz was entertaining. Show me the way had a mean score of 4.06 and participants mentioned that the map could be useful if it showed the route inside the campus which contradicts the conclusion of Onchi et al. [42]. Also, this contradicted the expectation extracted in the pre-study, as the participants wanted the guidance robot to hand guides them everywhere. However, students liked that it mentioned where the restaurant and important places were.

Find a friend had the least mean among all other functionalities. Participants mentioned that they did not understand the purpose of this functionality. One participant mentioned, “Are these people real?” (Male, 25). Some participants were also doubtful about signing up to find more friends. Participants would ask, “What is the purpose for this?” When we asked the participants why they did not sign up, they mentioned that the purpose for this was vague and they were not sure what will happen with their data.

4. *Are there any cultural differences in expectations, user experience and preferred tasks?*

We found differences in expectations during the pre-study phase in hedonic experiences. However, there was so evident difference related to user experience and preferred tasks when it comes to cultural differences. Since our pre-study and trial participants were different, we noticed few differences among pre-study and trial participants.

6.2 Comparison of the Expectation of Pre-Study Participants and Trial Participants

As described in section 3.1, we gathered data by interviewing participants who were already studying at Tampere University of Technology. For some participants, it was difficult to recall their experience from the orientations week. However, we helped them recollect their memories by making them go through the scenarios mentioned in 3.1.2. They tried to think about their requirements and connect it with Pepper. However, one crucial factor in this process was to understand Pepper’s capability. Most of the participants had never seen a robot before, whereas, some participants only had experience with industrial robots. The concept of the social robot was very new to them, and they were only familiar with the humanoid robot Sophia. Thus, most of the expectations and thoughts arose from their previous experience or fantasy. Participants expected Pepper to have all the capabilities and information. Some participants expected Pepper to have fluent interaction capabilities. They expected Pepper to understand human grammar and reply to their queries.

Most of the pre-study participants expected tablet based interaction. They felt that a robot was not required for this purpose, “You can just display the information on a screen or something, you don’t need a robot” (Male, 28). The reason behind this could be that students are usually shy to interact actively in an open space, especially on their first day of university. When participants were thinking about their first day at the university, they mentioned that they were anxious. In addition to that, if a robot were there, probably they would not approach it. As a reason, they indicated that they would not know if they were allowed to use it. Thus we decided to keep Pepper’s speech interaction limited so that the participants do not panic when Pepper do not understand their commands.

However, when we conducted the trial, we realized that students were most interested in having a conversation with Pepper. They were trying to ask Pepper various questions to get a response. It was one of the reasons for “sing and dance” to be a popular choice for new students. Moreover, they enjoyed how Pepper hugged, shook hands and make other gestures. They felt Pepper was actively involved in the interaction.

6.3 Limitations

In Section 1 and 2, we discussed how cultural factors influence personality, thus influencing the interaction with technology. In fact, in section 4, we mentioned different finding from different cultural context. However, this was not visible in the field trial, due to various reasons. Firstly, we could not interview much Chinese or Indian students during the trial, because most of them were busy with their orientation sessions. We tried to convince Indian students to come and interact with Pepper; however, they were too busy with their orientation and registration. Although we managed to interview a few Chinese participants, they too had a busy schedule to spare some time for the interview. However, since we created the design on the context of three different cultures, we somehow achieved the experience goals for international students. According to our results, most of the students had a positive experience as mentioned in section 4.3. One possible explanation for this could be that all participants belonged to the “student culture” and they all had almost similar expectations. We also believe that this could be due to the novelty feature of social robots being guidance robot.

Another limitation of this trial was that most of the functionalities were a prototype only. This concept was unknown to many participants. Most participants felt that the features were fully implemented. Participants were skeptical about finding a friend because they anticipated that their personal information would be displayed for other people. There were people we created their events and tried to look for it in the list of events. When we explained to them that it was a prototype, the concept seemed to be unclear for them. One participant mentioned, “So that means it doesn’t work?” Thus, it was difficult for us to explain the whole situation for them. Furthermore, due to data security issues, we did not use authentic information of any person.

6.4 Influential External Factors

While conducting this research, we noticed that social robots have a novelty effect. Pepper robot attracted many participants instantly. Even if the students did not take part in the trial, most students at least stared at the robot for a couple of minutes. In addition, if many students were interested in taking part in the trial, they had to skip it due to their tight orientation schedule. However, we convince 33 participants to interact with Pepper, out of which 30 participants filled the questionnaire correctly. The tight orientation schedule is one of the main reasons why we could not collect enough qualitative data for the trial occasion. Furthermore, it was one of the reasons not to get feedback from target cultures. However, we convinced the participants to fill a questionnaire from which we collected quantitative data.

From the Findings of Section 5, it could be observed that, participants had a positive experience and felt positive emotions while interacting with the robot. Kheng et al. [31] concluded in their study that participants' excitement might fade away if they get habituated with the robot. Due to short and one-time trial, the novelty value persisted among the participants. Longer-term studies might lead to different emotions and experiences as the users might get used to a robot in the university.

One factor, which influenced the interaction to some extent, was the tablet applications. Some participants started judging the tablet interface rather than focusing on the interaction with Pepper. They were mostly involved with the interface design of the tablet, rather than focusing on the interaction with Pepper. We had to ask some participants what was the value for Pepper displaying particular information. However, they would still focus on how the data was displayed on the tablet, rather than the value of Pepper displaying it.

At least 2 participants felt that they were not in control, because they would need help from the moderator. They would ask from the moderator "*What am I supposed to do?*" (Female, 23) and "Does it recognize my voice, or I just use the tablet?" (Female, 25). On the other hand, some participants would observe other participants and then interact with Pepper.

7 CONCLUSION

This thesis presents three main outcomes based on a university guidance robot designed for the new students of the Tampere University of Technology. In this thesis, we introduced the expectation of students towards a social robot, their experience with the robot and their preferred tasks. In the pre study phase, we collected expectations from the 30 students who already faced the orientation week. We asked them about their difficulties and the help they sought during the orientation phase. Based on the pre study data, we developed the design implications and functionalities for the robot and conducted 2 trials during the orientation week to understand their experience with guidance robot and the preferred tasks they want to perform. Although there were limitations in this thesis, it proved to be successful and achieved the targeted goals. The guidance robot should be friendly and natural, and it should take care of the students whenever they need help. However, one reason to accept the robot with enthusiasm in the university environment could be the novelty value of robots. It would be interesting to see people's feedback if it was used for the long term. Moreover, the study was conducted with only one robot. In future, it could be an option to use several robots for this purpose and analyze participant's feedback according to that. Another topic which raises during this phase was customizable robots. Many participants suggested coloring Pepper or putting on some clothes. It would be interesting to see in future how could people customize their robots according to their choice and how could this enhance their experience.

Overall, robots are yet to be commonly used by ordinary people. In this study, we found out that the young generation is eager to accept robots, but they have to be advanced and should know more than human. Students treated Pepper just as a normal human, but they expected Pepper to know much more than a normal human. In future, it is important to make the robot adaptive to human behavior, nurturing, friendly and natural in university guidance context, so that students from different background accept guidance robots in their student culture.

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8 REFERENCES

1. *Affinity diagram – kawakita jiro or KJ method*. . (2017). Retrieved June 25, 2018, from https://project-management.com/affinity-diagram-kawakita-jiro-or-kj-method/

2. *About us, gallery; softbank robotics*. . Retrieved June 25, 2018, from https://www.softbankrobotics.com/emea/en/press/gallery/pepper

3. Ahtinen, A., Poutanen, J., Vuolle, M., Väänänen, K., & Peltoniemi, S. (2015). (2015). Experience-driven design of ambiences for future pop up workspaces. Paper presented at the *European Conference on Ambient Intelligence,* 296-312.

4. Alenljung, B., Lindblom, J., Andreasson, R., & Ziemke, T. (2017). User experience in social human-robot interaction. *International Journal of Ambient Computing and Intelligence (IJACI), 8*(2), 12-31.

5. Arnold, L., Lee, K. J., & Yip, J. C. (2016). Co-designing with children: An approach to social robot design. *ACM Human-Robot Interaction (HRI),*

6. Arrasvuori, J., Boberg, M., Holopainen, J., Korhonen, H., Lucero, A., & Montola, M. (2011). (2011). Applying the PLEX framework in designing for playfulness. Paper presented at the *Proceedings of the 2011 Conference on Designing Pleasurable Products and Interfaces,* 24.

7. Berns, K., & Zafar, Z. (2018). Emotion based human-robot interaction. Paper presented at the *, 161* 01001. doi:10.1051/matecconf/201816101001

8. Breazeal, C. L. (2004). *Designing sociable robots* MIT press.

9. Burgard, W., Cremers, A. B., Fox, D., Hähnel, D., Lakemeyer, G., Schulz, D., . . . Thrun, S. (1998). (1998). The interactive museum tour-guide robot. Paper presented at the *Aaai/iaai,* 11-18.

10. Connell, J., & Viola, P. (1990). (1990). Cooperative control of a semi-autonomous mobile robot. Paper presented at the *Proceedings of the IEEE International Conference on Robotics and Automation, , 2* 1118-1121.

11. Costa, A., Martinez-Martin, E., Cazorla, M., & Julian, V. (2018). PHAROS—PHysical assistant RObot system. *Sensors, 18*(8), 2633.

12. Desmet, P., & Schifferstein, R. (2012). A collection of 35 experience-driven design projects.

13. DIS, I. (2009). 9241-210: 2010. ergonomics of human system interaction-part 210: Human-centred design for interactive systems. *International Standardization Organization (ISO).Switzerland,*

14. Doygun, O., & Gulec, S. (2012). The problems faced by university students and proposals for solution. *Procedia-Social and Behavioral Sciences, 47*, 1115-1123.

15. Duffy, B. R., Rooney, C., O'Hare, G. M., & O'Donoghue, R. (1999). (1999). What is a social robot? Paper presented at the *10th Irish Conference on Artificial Intelligence & Cognitive Science, University College Cork, Ireland, 1-3 September, 1999,*

16. Ferrer, G., Garrell, A., & Sanfeliu, A. (2013). (2013). Robot companion: A social-force based approach with human awareness-navigation in crowded environments. Paper presented at the *IEEE International Conference on Intelligent Robots and Systems,* 1688-1694. doi:10.1109/IROS.2013.6696576

17. Fischinger, D., Einramhof, P., Papoutsakis, K., Wohlkinger, W., Mayer, P., Panek, P., . . . Argyros, A. (2016). Hobbit, a care robot supporting independent living at home: First prototype and lessons learned. *Robotics and Autonomous Systems, 75*, 60-78.

18. Fong, T., Nourbakhsh, I., & Dautenhahn, K. (2003). A survey of socially interactive robots. *Robotics and Autonomous Systems, 42*(3-4), 143-166.

19. Hall, E. T. Beyond Culture, New York: DoubleDay, 1989

20. Hassenzahl, M. (2010). Experience design: Technology for all the right reasons. *Synthesis Lectures on Human-Centered Informatics, 3*(1), 1-95.

21. Hassenzahl, M. (2018). The thing and I: Understanding the relationship between user and product. *Funology 2* (pp. 301-313) Springer.

22. Hassenzahl, M., & Tractinsky, N. (2006). User experience-a research agenda. *Behaviour & Information Technology, 25*(2), 91-97.

23. Heerink, M., Kröse, B., Evers, V., & Wielinga, B. (2010). Assessing acceptance of assistive social agent technology by older adults: The almere model. *International Journal of Social Robotics, 2*(4), 361-375.

24. Hegel, F., Muhl, C., Wrede, B., Hielscher-Fastabend, M., & Sagerer, G. (2009). (2009). Understanding social robots. Paper presented at the *Advances in Computer-Human Interactions, 2009. ACHI'09. Second International Conferences on,* 169-174.

25. Hofstede, G. (2018). Hofstede insights. *Recuperado De Https://www.Hofstedeinsights.com/models/national-Culture,*

26. Joosse, M. P., Poppe, R. W., Lohse, M., & Evers, V. (2014). (2014). Cultural differences in how an engagement-seeking robot should approach a group of people. Paper presented at the *Proceedings of the 5th ACM International Conference on Collaboration Across Boundaries: Culture, Distance & Technology,* 121-130.

27. Joosse, M., & Evers, V. (2017). (2017). A guide robot at the airport: First impressions. Paper presented at the *Proceedings of the Companion of the 2017 ACM/IEEE International Conference on Human-Robot Interaction,* 149-150.

28. Kaipainen, K., Ahtinen, A., & Hiltunen, A. (2018). (2018). Nice surprise, more present than a machine: Experiences evoked by a social robot for guidance and edutainment at a city service point. Paper presented at the *Proceedings of the 22nd International Academic Mindtrek Conference,* 163-171.
29. Kanda, T., Shiomi, M., Miyashita, Z., Ishiguro, H., & Hagita, N. (2009). (2009). An affective guide robot in a shopping mall. Paper presented at the *Proceedings of the 4th ACM/IEEE International Conference on Human Robot Interaction,* 173-180.
30. Karvonen, H., Koskinen, H., & Haggrén, J. (2012). (2012). Defining user experience goals for future concepts. A case study. Paper presented at the *NordiCHI2012 UX Goals 2012 Workshop Proceedings, Tampere: TUT Publication Series,* 14-19.
31. Kheng, L. K., Syrdal, D. S., Walters, M. L., & Dautenhahn, K. (2007). (2007). Living with robots: Investigating the habituation effect in participants' preferences during a longitudinal human-robot interaction study. Paper presented at the *Proceedings - IEEE International Workshop on Robot and Human Interactive Communication,* 564-569. doi:10.1109/ROMAN.2007.4415149
32. Komatsubara, T., Shiomi, M., Kanda, T., Ishiguro, H., & Hagita, N. (2014). (2014). Can a social robot help children's understanding of science in classrooms? Paper presented at the *Proceedings of the Second International Conference on Human-Agent Interaction,* 83-90.
33. Law, E. L., Roto, V., Hassenzahl, M., Vermeeren, A. P., & Kort, J. (2009). (2009). Understanding, scoping and defining user experience: A survey approach. Paper presented at the *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems,* 719-728.

34. Lee, M. K., Forlizzi, J., Rybski, P. E., Crabbe, F., Chung, W., Finkle, J., . . . Kiesler, S. (2009). (2009). The snackbot: Documenting the design of a robot for long-term human-robot interaction. Paper presented at the *Proceedings of the 4th ACM/IEEE International Conference on Human Robot Interaction,* 7-14.

35. Leong, T. W., & Johnston, B. (2016). (2016). Co-design and robots: A case study of a robot dog for aging people. Paper presented at the *International Conference on Social Robotics,* 702-711.

36. Lubin, G. (2013). **The lewis model explains every culture in the world**. Retrieved 12/15, 2018, from https://www.businessinsider.com/the-lewis-model-2013-9?r=US&IR=T&IR=T

37. Maslow, A., & Lewis, K. J. (1987). Maslow's hierarchy of needs. *Salenger Incorporated, 14*, 987.

38. Meyns, P., van der Spank, J., Capiau, H., De Cock, L., Van Steirteghem, E., Van der Looven, R., & Van Waelvelde, H. (2019). Do a humanoid robot and music increase the motivation to perform physical activity? A quasi-experimental cohort in typical developing children and preliminary findings in hospitalized children in neutropenia. *International Journal of Human-Computer Studies, 122*, 90-102.

39. Mori, M. (1970). The uncanny valley. *Energy, 7*(4), 33-35.

40. Nishimura, S., Nevgi, A., & Tella, S. (2008). Communication style and cultural features in high/low context communication cultures: A case study of finland, japan and india. *Teoksessa A.Kallioniemi (Toim.), Uudistuva Ja Kehittyvä Ainedidaktiikka.Ainedidaktinen Symposiumi, 8*(2008), 783-796.

41. Nomura, T., Suzuki, T., Kanda, T., Han, J., Shin, N., Burke, J., & Kato, K. (2007). (2007). What people assume about robots: Cross-cultural analysis between japan, korea, and the USA. Paper presented at the *Human Robot Interaction,*

42. Onchi, E., Lucho, C., Sigüenza, M., Trovato, G., & Cuellar, F. (2016). (2016). Introducing IOmi-A female robot hostess for guidance in a university environment. Paper presented at the *International Conference on Social Robotics,* 764-773.

43. Šabanović, S., Bennett, C. C., & Lee, H. R. (2014). (2014). Towards culturally robust robots: A critical social perspective on robotics and culture. Paper presented at the *Proc. HRI Workshop on Culture-Aware Robotics, , 2014*

44. Šabanović, S., Reeder, S. M., & Kechavarzi, B. (2014). Designing robots in the wild: In situ prototype evaluation for a break management robot. *Journal of Human-Robot Interaction, 3*(1), 70-88.

45. Tanaka, F., Cicourel, A., & Movellan, J. R. (2007). Socialization between toddlers and robots at an early childhood education center. *Proceedings of the National Academy of Sciences of the United States of America, 104*(46), 17954-17958. doi:0707769104 [pii]

46. Triebel, R., Arras, K., Alami, R., Beyer, L., Breuers, S., Chatila, R., . . . Fiore, M. (2016). (2016). Spencer: A socially aware service robot for passenger guidance and help in busy airports. Paper presented at the *Field and Service Robotics,* 607-622.

47. **User experience (UX) design**. Retrieved June 25, 2018, from https://www.interaction-design.org/literature/topics/ux-design

48. Väätäjä, H., Savioja, P., Roto, V., Olsson, T., & Varsaluoma, J. (2015). User experience goals as a guiding light in design and development–Early findings. *INTERACT 2015 Adjunct Proceedings,* 521-527.

49. Väätäjä, H., Olsson, T., Savioja, P., & Roto, V. (2012). UX goals 2012 workshop–how to utilize user experience goals in design?

50. Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & Health Sciences, 15*(3), 398-405. doi:10.1111/nhs.12048

51. Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly,* 425-478.

52. Wang, L., Rau, P. P., Evers, V., Robinson, B. K., & Hinds, P. (2010). When in rome: The role of culture & context in adherence to robot recommendations. Paper presented at the *Proceedings of the 5th ACM/IEEE International Conference on Human-Robot Interaction,* 359-366.

53. Who is pepper. Retrieved June 20, 2018, from https://www.softbankrobotics.com/emea/en/robots/pepper

54. Willemse, C. J. A. M., Toet, A., & van Erp, J. B. F. (2017). Affective and behavioral responses to robot-initiated social touch: Toward understanding the opportunities and limitations of physical contact in Human–Robot interaction. *Frontiers in ICT, 4* doi:10.3389/fict.2017.00012

APPENDIX A: PRE INTERVIEW QUESTIONS

A.1 Initial expectation Question

- Some basic information (name, nationality, gender, which university, degree, did you interact with a robot earlier? how many times (or how much); what kinds of robots?)
- How often do you create and share content publicly in social media?
- On a scale of 1 to 5, rate how much technology makes your life enjoyable.
- How many different mobile services do you use?
- How often do you take part in online discussions? (Maybe add the scale 1-5 also in these questions)
- How often do people ask you to help with IT related tasks?
- Do you consider yourself a skilled user of IT? (Maybe add the scale 1-5 also in these questions)
- How adaptive are you to new technology and services? (Maybe add the scale 1-5 also in these questions)
- How long have you been studying in TUT? Is this your first time studying abroad?
- Was there any difficulty during the orientation phase?

Imagine your initial 2 weeks in TUT:

- How easy was it to find the places around your university? How helpful was the map? If no, what was the difficulty? If yes do you know someone who faced these difficulty? What made it easy/difficult?
- Did you come with friends in Finland? (Don't ask this to Finns) How easy was it to make new friends? Why was it difficult? What was difficult, meeting new people or ice breaking?
- Did you meet your tutors? How helpful were they? Were they around when needed? If not, how did you manage? If yes, what help did you ask for.
- How easy was it to cope up with your studies? Was help always around? Did you try asking help from fellow students? If not, what could help? How did you manage? If yes, what rules did you follow to cope up?
- How did you reach the teachers? Was it easier to send email or just drop by? How did you manage if the teacher was not responding?
- If you decided to just drop by, was the teacher available at that moment? If not, what was your next step? Were you aware of their schedule beforehand?
- How easy was it to get information, for example, hospital opening hours? How did you find them? Was the information on their website enough? What else would have been helpful?
- Was it easy to track the restaurants around your university? Did you know where to look for the menu? Did you have any special preference during lunch? Any ingredient you are allergic to? Did the website provide enough information for you?
- Do you select the restaurant depending on menu or location?

- How do you get the information about student events? Do you prefer to go alone or with friends?
- Do you go to the university gym? Have you ever considered activities arranged by Unipoli sports?
- During lecture breaks, do you perform any exercise? If not, why? Would it be better to arrange an exercise session during the lecture break?
- What was the most difficult phase for you? What other initial help would you need in the university?

Show Pepper's Image: Imagine that you are a new student in TUT:

- Imagine it is your first day in the university and you managed to reach TUT, and you came across this robot. What would you expect it to do? Is there something that you would like to ask from it?
- You could not contact your tutor, and you do not know where to submit your documents. How will you ask help from the robot? How would you expect it to help you?
- Now you have submitted your documents and registered as a student. It has been a long day and you are hungry, but you have no idea about the restaurants in TUT. You have some certain food preferences. How do you think Pepper can help you?
- You finally found a perfect restaurant. You helped yourself with the food but you do not want to eat alone. Since you are new you do not know anyone. How do you expect Pepper to help you in this situation? What would you do with Pepper to get that information?
- Now you have a friend who also does not have a tutor and you guys want to do some activity. What information can Pepper provide in this situation?
- Party week is over. It is now time to study. The first deadline is already next week and the teaching assistant is engaged with other students. You do not know anyone else from the course to help you. How do you expect Pepper to help you? and how?
- All deadlines are now over. You and your friend decide to do some physical activity together. You have heard about Unipoli sports during the orientation week and look up in the internet about it. But there is no information about the location of the activity. How can Pepper help you in this scenario?
- It's time to go back to the lectures. You have been attending lectures the whole day, and your back hurts. Now you got a 15 minute break, and you want to do some exercise for the back. You are shy to do it alone. How do you expect Pepper to help you here?
- How do you expect Pepper to entertain you? Can you think of any activity that Pepper can moderate?
- Finally, will you give Pepper a nickname? What will be that? Why did you choose this nickname?

- Would you be willing to interact with Pepper just by yourself or more preferably with someone or in group?
- what would be the best location in university for Pepper?
- any other expectations or ideas concerning Pepper?

A.2 Consent form

Study on Social Robotics in University Guiding context: Information regarding participation

Invitation to participate in research project

You are invited to participate in a study to collect information for designing a social robot for guidance in the university for newcomers. This study is a part of a thesis of Aparajita Chowdhury in Tampere University of Technology

We would like to collect the following material from you in order to develop a concept for using social or service robots at this location:

1. Audio-recorded interview
2. Photographs

Participation is completely voluntary.

About the research

The purpose of the study is to gather data from university students in order to design and implement functionalities for new students, based on the gathered data. The interview is conducted face to face and the data is gathered during the process. The data will then be analyzed to determine functionalities for the robot. For the purpose of data analysis, the interview needs to be recorded and photographs might be taken during the process.

Confidentiality and data security

All data will be treated as confidential. Recordings, written notes and photographs will not contain any identifying information about you. All collected data will be anonymized. The collected data will be stored for 2 years.

Results of the research

The results of this research may be written up for conference papers or peer-reviewed journal articles. We may show parts of the results in scientific papers, conferences and events.

Consent

Based on the information expressed above, I provide consent for using my data in the study.

Name .... Date ....

Signature ....

Contact information

If you have any further questions regarding this study, please do not hesitate to contact the responsible person of the research:

Aino Ahtinen	**Aparajita Chowdhury**
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Tampere University of Technology	Tampere University of Technology
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Appendix B: Trial materials

B.1 Trial Questionnaires

TAMPERE UNIVERSITY OF TECHNOLOGY

WHAT ARE WE DOING?

We are from Pervasive Computing department (Unit: User Experience). Our purpose is to test how the social robot Pepper can help to welcome new students. We also want to test how the new students interact with Pepper and their preferred tasks with the robot. Remember, we are not testing the tablet; we are testing how is it if the robot helps you with this tasks.

What is your Nationality

Gender

☐ Male ☐ Female ☐ Other ☐ I prefer not say

Field of Study

Age Range

☐18-22

☐23-27

☐28-32

☐33+

How much did you feel the following emotions (On a scale of 1-5 (1 is the least and 5 is the most))

During Interaction

Excited:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 Proud: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Scared:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Amused:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Shy:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Anxious:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Happy:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Which functionalities did you observe? How useful did they seem? (1 being least 5 is the most)

Show me the way:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Restaurant Services:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Activities and Events:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Find a Friend:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Random Contacts:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Fun and Entertainment:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Freshman TUT Quiz:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

After Interaction

Excited:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Scared:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Amused:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Shy:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Anxious:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Happy:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Proud:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Which functionalities did you try? How useful were they? (1 being least 5 is the most)

Show me the way:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Restaurant Services:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Activities and Events:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Find a Friend:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Random Contacts:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Fun and Entertainment:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Freshman TUT Quiz:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

What other things were you expecting from the robot?

What role(s) do you think pepper was playing today?

☐ Friend

☐ Staff Member

☐ Hero

☐ Caretaker

☐ Classmate

☐ Guide

Other roles:

Which method of interaction would you prefer?

☐ Touch ☐ Voice ☐ Gesture

How friendly was the robot?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Was the robot entertaining?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Was the robot useful?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

How hard was it to operate the robot?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Were you in control while operating the robot?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

B.2 Trial Tasks

Show me the way:

Task 1:

i) Try to find out where is Paula's Desk.
ii) Try to find out how to reach Festia and scan the QR code (You can try to say Festia)

Restaurant Menu:

Task 2:

i) Try to find out what was today's menu in Hertzi

Activities and where to go: (You can try to say the menu's name for this application)

Task 3:

i) Try to find out what event is organized by TUT on 21st August
ii) Try to find out how to go to Sarkanniemi
iii) Try to find out information about bus time tables.
iv) Try to create your own event. Input the fields as follows:
Name: Anik Dutta, Email Address: 123@gmail.com, Type of event: Physical Activity.
v) Try to find out your own event.

Find a Friend:

Task 4:

i) Try to make atleast one new friend. As contact information input one of the following:
123@gmail.com (if you prefer to be contacted by email) or 0123456 (if you prefer to be contacted by whatsapp). In customized email write: "Hey, I want to have a small chat with you".
ii) If you want Pepper to send an email to the person on behalf of you touch its right hand, otherwise touch left hand.

Random Contacts

Task 5:

i) Try to find out Unipoli Sport's website

Fun and Entertainment

Task 6:

Try out:

i) Tickle me (When you are done, wait for Pepper to say ”that was fun” and then touch its head)
ii) Sing and dance (Touch the head when you are done)
iii) Language quiz

TUT Freshman Quiz

Task 7:

Take the TUT Freshman’s Quiz.

Tips:

1) Pepper has some random interactions:
   a) If you want Pepper to hi5 you can say: hey, hi five,
   b) If you want pepper to handshake you can say: shake my hand, handshake, hello, greetings
   c) If you want pepper to fist bump you can say: fist bump it bro, fist pound it bro, fist knuckle it bro
   d) If you want pepper to give a hug you can say: Let’s give a hug, let’s give a squeeze, give me a squeeze, give me a hug.
2) If you feel you cannot exit some page, touch Pepper’s head
3) None of you data is saved, this is just a prototype (non functional design)
4) Type or click anything after Pepper finishes its sentences.