

Design Implications for a Virtual Language Learning Companion Robot: Considering the Appearance, Interaction and Rewarding Behavior

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Abstract

Second language learning has become very important because of globalization and as a result, many online language learning platforms have gained popularity. Despite their popularity and convenience, they still lack the human factor and meaningful interaction. Robot-assisted language learning (RALL) is a concept where social robots are employed to assist in language learning, adding meaningful and human-like interactions to the process. In the case of online learning platforms, a similar approach can be taken using virtual robots. Virtual robots are similar to social robots as they can have a visual appearance, communication capabilities as well as human-like features. This research aims to understand the potential users', i.e., university students' perceptions, and expectations of a virtual robot as a language learning companion. We are focusing on three major aspects of its design: appearance, interaction and rewarding behavior. This is a qualitative and explorative study, which employs a human-centered design (HCD) approach by conducting a co-design workshop with five groups of university-level language students ($n = 25$) and a theme interview with seven design students. This article presents the first phase of the HCD process. The participants were asked questions about the appearance, behavior, movements, motivational factors, sound and rewarding features of the potential virtual language companion robot. The findings show that the idea of having an interactive virtual robot to assist online language learning was accepted and appreciated by all the participants but their expectations about the robot's design varied. The potential users preferred a robot-like appearance rather than a human-like one for the virtual language learning companion, however, different robot-like appearances were mentioned in terms of their body parts, hands, head, shapes etc. Human-like gestures and movements were appreciated by the participants. Finally, seven design implications were formulated to support the further design of a virtual robot that can act as a virtual language learning companion as part of an online learning platform for university students.

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CCS Concepts

• **Human-centered computing** → **Human computer interaction (HCI)**; **Interaction paradigms**; • **Applied computing** → **Interactive learning environments**.

Keywords

Social robots, Virtual robots, Embodied agents, Robot-Assisted Language Learning (RALL)

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1 Introduction

Learning a second language is nowadays more of a necessity due to globalization. To add convenience, flexibility and effectiveness to the learning process, many online learning platforms have been created, such as Babbel [1], Mondly [2], Duolingo [3] etc. These online learning platforms are becoming more popular because of their convenience and specific learning targets, gaining the trust and appreciation of learners all over the world [4]. Most of these platforms offer text or video-based lessons, sometimes both. While these platforms are considered useful, they lack proper interaction with the learners [5]. It has been reported that social presence or the sensation of being part of the platform makes it easier to make good use of the lessons. The importance of interaction was emphasized in the research conducted by Salmi [6] where the participating students expressed that they expect a teacher or instructor should always be available to interact with them, giving feedback and available to answer questions [7]. The presence of an educator as well as the interaction between the learners and with the educator plays a vital role in achieving the learning outcome. Studies have suggested that learning can be much more effective with the help of proper interaction as it can increase motivation and improve learning strategies [8]. Studies also suggest that social interaction between learners and peers in online virtual platforms results in a high level of satisfaction and learning experience [9][10]. The popularity of online learning platforms has led to many additions being made to them to make them more effective. One of the concepts is Robot-assisted language learning (RALL), which is a concept of employing robots in language learning assistance [11]. This concept includes robots being involved in language education

to create an interactive environment. So far, physical robots have been widely used in education and learning [12], especially social robots. Social robots are robots that can communicate with humans in a way that is understandable to humans. They can also have abilities to relate to human's way of communication and react in a way that resembles human behavior [13]. These types of robots have been developed to have social skills which allow them to operate close to humans in their day-to-day lives by adding meaningful interactions such as conversation, helping with chores, teaching as well as providing entertainment [14][15]. In addition to having human-like communication capabilities, a social robot needs to have an embodiment that is close to a human being or at least resembles humans in a natural way. This embodiment should include movements, facial expressions, gestures etc. to make the interactions more natural [16]. The embodiment can be either physical or virtual. The physical embodiment of a robot means that the robot has a physical appearance and shape, while the virtual embodiment means that the robot would have an appearance in a digital form, such as an avatar [17]. The concept of RALL has been experimented in many studies with social robots with a physical embodiment. However, online language learning platforms have not introduced embodied virtual robots yet. Several online language learning platforms have chatbots, such as Duolingo [3], Mondly [2], Memrise [18] etc. These are mainly conversational robots without proper appearance or social features.

While RALL-based studies have investigated how social robots can aid in language learning [11], online language learning platforms have been out of this scope. The objective of this study would be to introduce human-like interactions and seamless feedback, not just text-based conversational agents. Interactions in online learning platforms can be introduced in several ways such as voice-based interactions or sounds. However, voice coming out of a webpage cannot create a proper interactive engagement [19] and this leads us to the concept of embodied agents [20], more specifically embodied virtual agents (EVA). Embodied agents are agents that have an embodiment. Embodied agents can be either virtual or physical. The embodied virtual agents, EVAs, are animated objects that can move, talk, and look like human beings [21]. The embodiment of a virtual agent ensures that it has an appearance as well as human-like features, such as face, body, movements, gestures, and expressions. Several research studies have concluded that conversations are much more meaningful and effective if the communication agent has a face as well as gestures and expressions [22][23], which in the case of online learning platforms can be designed in the form of embodied agents.

A related study by Grivokostopoulou [20] has shown that embodied agents such as physical social robots can play a very important role in improving the learning experience as well as enhancing the way they engage in learning. In addition to that, it can improve the construction of their knowledge, resulting in improved performance. Many aspects are needed to be considered while designing such an agent. Firstly, we need to consider the embodiment and appearance of the virtual agents. The degree of learning and engagement can be directly linked to the appearance of the agent [24] and if not done right, it can even be the factor that pushes away potential learners [25]. Studies have reported that different user groups based on age differences have different preferences for the appearance

of an embodied virtual agent [26]. In addition to the appearance of these agents, interactional behavior is also regarded as a very important factor in online learning environments [27]. It has also been reported that social components in interaction affect the learning outcome positively [28]. When it comes to affecting learning outcomes positively, rewards can also play a very significant role. Reward-based education increases playfulness and creates interest in a learner's mind, inspiring them to keep going and achieve more [29][30].

For this study, we consider embodied virtual agents as virtual robots who have all characteristics of embodied agents such as appearance, expressions, movements as well as gestures. The virtual robot concept also includes social features such as human-like communication capabilities, the ability to relate to human situations as well as human-like behavior.

Related works show that there are no existing proper guidelines for designing a virtual language learning companion robot. This study aims to address this research gap and attempts to start from the very beginning of the design process. The goal of this paper is to understand the potential users' expectations about virtual robots as a learning companion and create solid design implications for designing a virtual language learning companion robot, which reflects the users' needs. This study presents the first phase of the human-centered design (HCD) process of a virtual language learning companion robot, i.e. empathy phase [31]. Our study includes potential users, i.e. university students as language learners, at the beginning of the human-centered design (HCD) process. The design implications focus on three major aspects, the physical appearance of the virtual robot, its behavior while interacting with the user and the rewarding system. Our study focuses on Elias [32], which is an online language learning platform. The research questions of this article are as follows:

1. What type of physical appearance should a virtual language learning companion robot have?
2. How should a virtual language learning robot react and behave to create meaningful and engaging interaction? What type of movements and gestures should be included?
3. What type of rewards can motivate the users for learning in an online language learning platform?

The research has been conducted in several phases. The first phase was to conduct an online co-design workshop with university-level language students who are the primary target group of this study. They had little or no experience in interacting with robots. Next, theme interviews were done with university-level design students who had previous experience in human-centered design of social robots. Data from both the co-design workshop and the theme interviews were then analyzed qualitatively to find out specific design implications for a virtual language learning companion robot.

2 Related Work

2.1 Online Education and its Effectiveness

Online learning platforms are getting more and more popular every day and as a result, it is important to maintain quality and effectiveness. Especially, due to the remote learning nature of education nowadays, online learning platforms have become a necessity.

However, the quality and effectiveness of this type of education remain questionable. Studies have suggested that multiple aspects influence the learning quality and experience in virtual learning platforms. Such as content design, interactivity, trust and demographics [8][33]. The content can engage better if they are attractive and well structured. Also, there needs to be continuity through the lessons so that it does not feel scattered and there should be an incremental addition to the level of knowledge to the lessons. Interactivity is one of the major requirements for creating a meaningful learning environment [34]. Interactivity mainly encourages the engagement of the users to the platforms. Trust is another very important parameter when it comes to adopting online learning as it affects the commitment of the learner to the platform as well as reducing the sense of uncertainty. The increase in trust factor can increase seamless engagement on online platforms and at the same time reduce drop-out rates [35]. Demographics also play a significant role as people from different age groups, professions and cultures perceive things differently. To be effective and successful, these platforms either need to focus on specific demographics such as specific age groups or specific cultures or should try to be culture neutral to some extent. The level of expertise in using technology-related products is another important demographic [36].

Several previous studies have investigated the factors influencing virtual learning and learners' satisfaction. According to [37], the students' perception of the instructor's credibility in subject matter defined their level of confidence in the course and resulted in better learning satisfaction. Their qualitative study findings suggest that the presence of the instructors and the interaction with them can create a sense of satisfaction among the students. Also, the social interaction between learner and peers increases motivation and question answering between peers and instructors makes the learning more spontaneous [34][10][38]. This increases the option to ask and answer questions to resolve confusion and conflicts to achieve a common learning goal [39].

Reward-based learning on virtual platforms is another way of engaging students. In [40], the effect of virtual achievements such as online badges based on learning performance was investigated. The findings suggest significantly higher quantity of students engaging and contributing on the platform being motivated by the badges and achievements. In addition to that, the quality of learning stayed on an expected level. Students reported that they enjoyed having these kinds of online badges and it motivates them to keep working to earn them.

Positive learning outcomes in online learning platforms can differ based on the expectations from the courses. However, several factors can influence this such as engagement, virtual competency and collaboration between peers [19]. Engagement with the platform as well as meaningful interaction plays a strong role in motivating the students to keep up and keep going. Here, meaningful interaction can be defined as the types of interactions that can create experiences. Almost all the platforms have some type of interaction, such as clicking, tapping, voice feedback etc. However, these interactions do not necessarily mean anything other than navigating through the platform. A meaningful interaction could be created by adding real-life contextual relations with the study materials, introducing social factors in conversations as well as variable feedback based on context [41].

2.2 Robots in Language Learning

Social robots have been widely used in language learning [42][30][43]. This significant adaptation has been the result of these robots having social features such as human-like communication, context-based feedback as well as the ability to relate with humane circumstances [13]. They also have human-like appearances to a great extent, resulting in more natural-feeling interactions. Social robots these days have become significantly advanced in terms of understanding context as well as human language. They can recognize and understand the language and provide feedback accordingly. This helps them create meaningful interactions with the users [15]. There are several studies that investigate language learning with social robots, which fall under the concept of robot-assisted language learning (RALL). RALL is an area of human-robot interaction (HRI) which promotes the use of robots in teaching language expression or comprehension skills [43]. It includes speaking, writing, reading, or listening in both native and non-native language instruction as well as in both spoken and non-verbal languages. In a RALL-based study by Belpaeme [44], major aspects of the design have been discussed, such as the context of learning from a robot, the embodiment of the robot as well as social behavior. Significant issues like age effect, meaningful interaction, verbal, and non-verbal behavior have also been discussed. There have been several studies where robot-assisted learning was investigated with social robots [42][30][43], however, the usage of virtual robots with embodiment has not been reported. In a study by Aparicio [45], a virtual robot solution has been presented to aid programming learning. The solution helps a novice student to understand basic programming concepts through simulations. According to the results, the virtual robot has introduced a significant amount of tangibility to the outcomes. In a study by Song [46], learners' participation in online courses educational multimedia and research methodology were investigated with and without a virtual conversational agent. The results showed significant positive differences in participation behavior and achievements of the learners. Another study [47] investigated the embodiment and gender preference for a virtual instructor in terms of social presence, perceived learning effectiveness and performance of students. Results show that both gender and embodiment of virtual instructor affect the learning experience. Also, embodied female virtual instructor was preferred to a disembodied and male instructor.

2.3 Virtual Robot Design

To understand users' preference for online learning companion agents, several studies have made user-centered evaluations. In a study by Ramachandiran [48], six different virtual robot designs were presented to students and they were asked to evaluate the agents considering seven key aspects. The keywords were attractiveness, expertness, effective, intellectual, enjoyable, pleasant, and intelligent. Each agent was employed to narrate study-related materials and later were evaluated by the students. A similar study by Bergmann [49] employed 2 different virtual robot designs, one robotic and one human-like, both having different behavioral attributes. The study tried to understand, which design can better connect with the user with their appearance and non-verbal behavior to create feelings of warmth and competence. They found out

that the robot-like agent was better to create a feeling of warmth initially which decreased over time, while it remained constant for the human-like agent. Also, agents with gestures were perceived as more competent compared to agents with no gestures.

There are several aspects of virtual robot design that can increase its effectiveness and acceptability. Physical embodiment is one such aspect. A study by Thellmann [17] which focused on investigating the physical and social presence of robots found that social features of a virtual robot are vital for interaction with people. Another study [50] explored the attitude of humans and their decision-making scenarios with different embodiments for robots. Their results show that embodiment of a robot creates faith in the users' minds, making it easy for them to trust the robot [51][52]. On the contrary, lack of appearance resulted in less trust among users.

Another important aspect of robot design is the interactional behavior of robots such as non-verbal cues, gestures and body movements significantly affect the overall user experience [53][54]. However, it needs to be investigated if these factors differ when it comes to virtual robots. Studies have found that virtual learning companions raise students' motivation and engagement [24]. Another study [49] has reported that robot-like appearance and movements are preferred by users when it comes to virtual learning agents.

In any learning platform, it is very important to motivate the users to stick to the learning. Most of these platforms use different types of rewarding schemes to keep the users motivated. Digital badges, reward points, ranking systems are some of the rewarding schemes implemented by many online learning platforms [55][56]. In terms of robot-specific rewards, there are gestures, voice-based appraisals and visual cues, for example, candy eyes [30].

3 Overview of Research Process

3.1 Research Approach

The human-centered design (HCD) [57] approach has been used in this study. HCD is a process of creating design solutions by including humans and their perspectives in decision-making. Human involvement in such cases can be co-designing, observation, brainstorming, discussions, interviews and so on. There are several phases of the HCD process such as empathy, define, ideate, and prototype. This study employs the empathy phase for which, the idea is to collect an empathic understanding of the potential users about the problem at hand. The main element of this design study is a co-design workshop [58] with 25 language students, which focused on understanding the perception of potential users for the appearance, interactional behavior and rewarding of a virtual language learning companion robot. Later, theme interviews [59] were done with seven students who specialized in design and user experience (UX) to understand the problem from a designer's perspective. These two methods were primarily chosen as they can easily incorporate potential users in the design process. The participation in the co-design workshop and the theme interviews were voluntary and data consent was asked from all the participants. The target group of the study was university students and the study was built upon the Elias Language Learning Platform [32]. All the collected data were treated as confidential, and all the identification data from the participants was removed in the analysis phase. Data collected

from the co-design workshop and theme interview sessions were then analyzed and design implications were formulated.

3.2 Co-design Workshop

We conducted one co-design workshop where the participants were university-level language students. The workshop focused on understanding the perception of language students for a virtual language learning companion robot, specifically the robot's appearance, interactional behavior, and its rewarding behavior. The workshop was conducted online because of the covid-19 restrictions. Zoom online meeting tool was used to facilitate the workshop and the session was recorded. An online collaboration tool Mural was used for proper documentation, idea generation and discussion tracking. The participants were given three major tasks to complete, related to 1) the appearance 2) interactional behavior and 3) rewarding behavior of the virtual robot. Each task contained four questions to trigger discussions and insightful thinking. The total duration of the co-design workshop was 2 hours and 30 minutes.

A total of 25 participants took part in the co-design workshop. They were studying different languages at the university level. The name, gender and age of the participants were not tracked. Among the participants, only one participant reported having some previous experience of interacting with robots while the others had never interacted with robots despite strong interest. At the beginning of the workshop, the participants were given a short demonstration of the current Elias learning platform [32] to give them an idea about how it works without a virtual robot. Then, the participants were divided into five groups where each group consisted of five participants. The breakout rooms feature of Zoom was used here to create virtual rooms where each group was assigned to a room. The Mural canvas was constructed with questions, which were designed to ignite critical thinking among participants, leading to discussions in the group. Some of the questions were as follows: "What kind of behavior/interaction with the virtual robot can keep up your interest and motivation?", "What bodily or visual features of a robot can make you think that it's useful or fun?", "How do you think a virtual robot can appreciate your efforts? What things can a robot do that will make you feel good and motivate you to keep on interacting with it?". Based on the questions on the Mural canvas, each group discussed and documented their thoughts and discussion summaries on the Mural canvas. The participants were encouraged to speak their minds and document every idea even if it seemed unreasonable. Figure 1 is a screenshot of a small part of the Mural canvas where group members documented their ideas by answering specific questions related to the design of the virtual robot.

3.3 Theme Interviews

As the language students did not have a design background and almost none of them had previous experience with robots let alone human-centered design of robots, we decided to conduct one on one theme interviews with design students having previous experience with robots and user experience. These participants were considered competent in design and as a result, their insights and opinions added a designer's perspective to the data. For these interviews, the questions were kept the same to keep the data aligned. The same tools, Zoom and Mural were used for these interviews

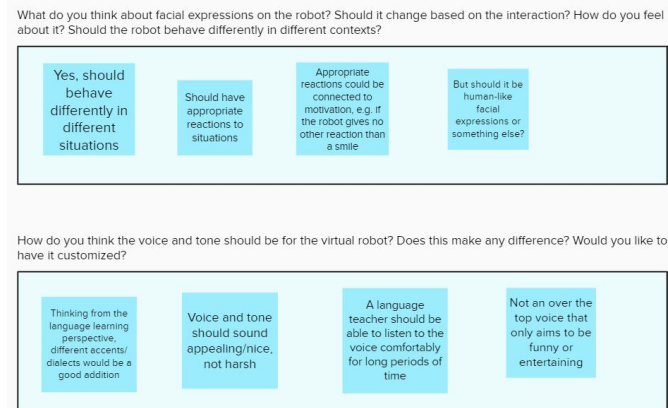


Figure 1: A section of Mural canvas where the groups have documented their ideas based on the questions asked.

and each session took around 1 hour and 30 minutes.

There was a total of seven participants for the theme interviews, among them five were second-year master’s students from design and user experience backgrounds. They also had previous experience in human-centered design of robots. The other two students were first-year master’s students of Human Technology-Interaction (HTI) with substantial experience in user experience in robotics.

3.4 Data Analysis

Data from both the co-design workshop and theme interview sessions were discussion notes triggered by the same questions and discussion cues. For this reason, all the data was collected to a common repository for analysis. At first, all the data fragments were copied into an Excel sheet under task categories. After collecting all the data into one sheet, thematic coding [60] was done. Based on the task fragments (1 task each for robot’s appearance, interaction behavior and rewarding schemes), the data was already automatically divided into 3 themes (appearance, interactional behavior, and rewards). However, as there were multiple questions for each major task fragment, there were multi-themed data under each category. As a result, we divided the data further by identifying multiple themes from 1 major task. Finally, the data was distributed into 5 major themes where each thematic category represented a major part of the virtual robot’s design. The categories are 1) appearance and visual features, 2) gestures and movements, 3) feedback, 4) sound, voice, and tones, and 5) rewards and motivation. Furthermore, the data were analyzed under each theme to devise design implications.

4 Findings

This section will explain the results and findings from the co-design workshop and theme interviews. There were five groups in the co-design workshop, and we refer to them as G1, G2, G3, G4 and G5. All the co-design workshop participants were university-level language students and had little to no previous experience with robotics and design. There were seven participants in the one-on-one theme interview sessions, and they are referred to as P1, P2, P3 etc. These participants were design students with significant

previous experience in robotics and user experience. The following section is the theme-based reporting of findings.

4.1 Appearance and Visual Features

In the co-design workshop, all the groups (5/5) said that they would prefer the appearance should not fully resemble a human, rather it should have a robot-like appearance. Some groups (2/5) said that it should be anything but human-like. One of the groups documented that it could be scary if there’s too much resemblance with a human: “It could resemble a human, but not in an uncanny way” (G4). four out of the five groups suggested that the robot could be more impactful if it resembles an animal: “An animal or something other than human could be less scary and more interesting for smaller kids” (G2). When asked about gender or colors, two out of five groups reported that it can be gender neutral with neutral colors while other groups did not report anything. From the theme interviews, some (3/7) participants reported that the appearance should be robot-like, not human-like: “NOT A HUMAN, human-like virtual robots or agents are creepy and unnecessary” (P3). “To reduce the human expectations on what the robot can do.” (P4). “I would have robot-like form as a basis since it makes clear for the user that the function behind the agent is based on the robot.” (P3). two participants said that they would prefer humanoid robots. two out of seven participants wanted the robot to be either a human-like cartoon or a superhero. The other participant said that a female avatar would be preferred.

When asked about more specific visual features, three out of five groups reported that the robot should have body parts like humans such as eyes, mouth, hands and legs: “It should have humanlike features like eyes, mouth but not necessarily human” (G1). One group said that they would prefer a bigger head than usual and big friendly eyes that can express emotions. two out of five groups said that they would like something that looks soft and fluffy. One group said that round shapes make the robot more likable. Some (3/7) of the participants in the theme interviews said that the robot should have human-like body parts and ratio while others did not report anything in this regard. two out of seven participants thought that the appearance should be based on specific cultures of the user so that they can connect to it better. One participant suggested that the virtual robot can have only an upper-body form (no legs) and should float while two other participants said that it should have legs as humans: “no need of legs. not necessary to have legs can have wheels or float in air” (P4).

To summarize, majority of the participants preferred more of a robot-like appearance rather than a human-like one. However, they think that the robot should have human-like body parts. Some of them thought that the eyes or the head could be a bit bigger than normal while round-shaped body parts were preferred. Some of the participants mentioned they would like to have the appearance customizable as well. They mentioned that it can look different for different age groups such as soft looking and cartoonish for kids while adults can choose from multiple options.

4.2 Gestures and Movements

Three out of five groups suggested that human-like gestures are more relatable when it comes to interaction. One of these groups delved more into it and said that there should be some robotic twist

to the gestures: “still there could be a robotic twist to the human-like gestures; some fun attached to it” (G3). Another group said that they would prefer smooth movements: “Smooth movements preferred, contrasted to “traditional” jolting robotic movement” (G2). One of the groups said that human-like gestures might be distracting and partial movement of the body would work. There were some suggested gestures such as thumbs up (G3, G4), high fives (G4) and head tilt (G4). One of the participants (P1) of themed interviews said that changing gestures, expressions and movement can highly impact the success of such a robot. Four out of seven participants said that the virtual robot should have human-like gestures or behave partly like a human. They think gestures are a very integral part of the robot: “gestures are important to stand as a feedback from the performance or as a support for verbal message. They make the robot more interesting.” (P3). Three participants suggested that there should be visual movements and the robot should not be static all the time, they should react to every action of the users, gaze at the users and other elements on the screen, point to objects when teaching about them and make facial and hand gestures while talking: “Body movements like moving hands while communication, verbal or physical gestures, sense of humor while talking can make the interaction robot more fun and attractive.” (P6). One participant (P7) thought that gestures and movements should be related to the topic of teaching as well as the cultural context.

When asked about facial features, two of the groups suggested that it needs to be done very carefully as there is a very fine line between proper expressions and creepy ones: “Facial impressions combined to glassy eyes might be creepy. So, I’d go for visual effects and not facial expressions.” (G1). “There’s a thin line between facial expression feedback and ‘getting it wrong’ or creepy” (G3). Two of the seven participants think that there should be some kind of facial expression but not negative expressions like anger or disgust, rather happiness and surprise. One other participant (P5) thought it should not smile too much and should behave according to the situation, such as be neutral or caring when the user is not doing well with the learning.

To summarize, all the participants wanted either partial or human-like movement from the virtual robot, however, human-like facial expressions did not seem to be a good idea. Participants had divided opinions into types of movement as some preferred smooth human-like movements while others preferred robot-like movements. The Majority of the participants thought that the robot can perform some well-known gestures like hi-five or thumbs up.

4.3 Behavior and Feedback

All the groups in the co-design workshop (5/5) thought that the virtual robot should have varied reactions and behavior depending on the situation. “Varying expressions depending on how to tasks are going can make it more interesting to interact with” (G1). One of the five groups mentioned that the behavior should never be on an extreme level: “Affects motivation negatively if the robot is always over-positive” (G2). “It can change its voice a bit when the performance is not up to the mark, but not so rudely, or maybe can use different color in eyes” (P2). “it should show the difference in behavior but not negative and not extreme positive.” (P4). Two out of seven participants from the theme interviews thought that the

robot should have a short or medium length of speech so that the user does not have any problem understanding and following the instructions: “short interaction so that the users know when they can start speaking, no long lectures, turn-taking” (P5).

Two out of the 5 groups (G1, G3) mentioned that there should be visual feedback as well as voice feedback for every interaction. All the groups (5/5) have said that the robot should have positive feedback for doing well but neutral or constructive feedback for bad performance. One of the groups mentioned that negative feedback can be explored as long as they are constructive and not too extreme. Also, if everything is positive and neutral, the robot should be able to point out what went wrong. “positive feedback when doing well and positive encouragement when not doing well” (G1). “Too much positivity and unnatural laughter and smiling might become annoying. Kindness, neutral approach would work instead.” (G1). “Affects motivation negatively if the robot is always over-positive” (G2). One of the groups (1/5) thought that the type of feedback should be customizable. All seven out of seven participants from the theme interviews thought that positive feedback is the way to go but it should not be over positive. Five out of seven mentioned constructive feedback while the other two mentioned that it should have a proper way to point out the lacking in a humble way: “It is good to let learner know that they need to improve or try again. In some very clear way. Still, it should not be done so that person feels humiliated.” (P3). Three out of seven participants strongly opposed having negative emotions while the others did not mention it explicitly. One of the participants mentioned surprise moves: “It could also have some surprise moments, for example, different varying funny moves or ways of giving feedback” (P3).

To summarize, majority of participants thought they should be able to visualize their progress and there should be feedback about the stage-by-stage progress of the learning. There should be variable reactions to different activities of users while the reaction should not be negative or over-positive. The feedback should be neutral or constructive for unsatisfactory learning performance. Some of the participants have mentioned that the robot could change its shape or color as a form of feedback.

4.4 Sound, Voice and Tones

All five out of five groups thought that having voice interaction along with text can make the understanding process easier and make the interaction better as a result. Three out of five groups mentioned that the voice of the robot should be human-like with varying tones for different situations while the one group (G4) said that the voice should not mimic a human voice. Three out of five groups said that different accents to choose from would be good, for example, for people from different parts of the world, adults, kids etc. Two of the groups said that the voice should sound appealing, not harsh: “Not an over-the-top voice that only aims to be funny or entertaining” (G2). Two out of seven participants mentioned that the robot could have different tones for different types of words: “Using a tone of joy for achievement, sad tone for sad words as an example” (P1). One of the participants said that the voice should represent the appearance of the robot, for example, if the robot looks like a male person, the voice should complement that. Adding voices of celebrities or known characters were also suggested: “The idea of putting the voice of some known people or celebrities can

be great. or the robot looks like some animal then we can use our favorite cartoon voice.” (P2). Four out of seven participants thought that voice should be changed depending on the user: “motivative voice for children might be a bit different than for adults. At least, I get irritated by voices in children’s tv shows.” (P3). Three out of seven participants thought that there should be multiple voice options to choose from.

To summarize, all the participants thought that the virtual robot should have voice features and it should vary according to context, such as funny, or happy voice for task completions or achievements while neutral voice for the opposite. Some of the participants think that the voice should be customizable, and the users should be able to choose from multiple options.

4.5 Motivation and Rewards

Three out of five groups mentioned that seeing a proper progress map and traceability of the learning process can play a very important role in keeping the users motivated. “might motivate by telling me facts about my learning like how I am doing, how do people do it averagely, what helps, what does not” (G1). Appropriate and precise reactions to the activities can improve motivation. Four out of five groups and five out of seven theme interview participants said that positive and constructive feedback is very important and some of them mentioned specific feedback types: “positive sounds: hands clapping, positive words” (G3). “the robot could change its color when you advance, use different light effects while communicating” (G4). “Audio-visual feedback, pretty lights and sounds” (G5). Two out of five groups and two out of seven participants mentioned competition as a motivation to keep going: “Competition, being able to see how other users are doing.” (G2). One of the groups said that it would be more fun and motivational if they can connect and use what they have learned with the real world through the platform and the robot. Another group (G4) mentioned, if the robot can recognize the user in some way and call the user by their name, this will give a more personalized experience, hence increasing motivation. Three out of the seven participants mentioned that learning progress needs to be available which might include some statistical analysis of the users’ performance. Varying the type and degree of feedback has also been mentioned: “some simple reaction for every action e.g., happy face when finished one sentence, important actions can get a longer reaction e.g., “well done” when we finish one lesson of 20 minutes” (P5).

As for more tangible rewards, two out of five groups and four out of seven participants mentioned game-like rewards, such as achievements, emblems, trophies, diamonds, points, new levels unlocking, robot look upgrades etc.: “games: gaining “coins” etc. when you do well and when you do, you can unlock new levels / upgrade the robot looks” (G3). Two out of five groups mentioned something surprising and crazy such as fireworks or the robot turning into a disco ball. Two out of seven participants mentioned a cool robot dance in the event of a good performance. Rewards can also be related to the lesson and very specific: “if the user finishes fruit exercise, the robot gets a fruit in its hands” (P5). Unlocking new robot avatars and new accessories have been mentioned by three participants.

For maintaining motivation, majority of the participants mentioned traceability of the learning process as well as competition between

users. As rewards, participants suggested game-like rewards such as coins, emblems, level unlocks etc. while clapping or other appreciative gestures were also mentioned. Surprising the users by changing shapes and color of the robot was also mentioned by some of the participants.

5 Discussion

5.1 Design of Virtual Robot as a Language Learning Companion

Previous studies [17][50][52] emphasized the importance of embodiment for a virtual agent. Our research study findings suggest that the embodiment of a virtual robot is a very important design element. While asked about embodiment, all the participants from either the co-design workshop or the theme interviews mentioned that the virtual robot needs to have an appearance and they delved into more detail such as, if it should be human-like or robot-like or animal-like, making the necessity of embodiment very clear. However, previous studies did not go into detail about the embodiment of virtual robots and there is a knowledge gap here.

Previous research [24][53] suggests that gestures and movements play a very important role in making the interaction more interesting and engaging. Gestures work as a feedback mechanism to all the activities by the user which creates a feeling that all the input from the users is recognized and accounted for. Based on these, the gestures and movements of the virtual robot have been explored in this study to make more precise design suggestions and implications. The results show that users prefer human-like movements and gestures such as hand movements, nodding, waving etc. It was found that these gestures and movements can add liveliness to the robot and make the interaction more contextual and meaningful. However, facial features and expressions should be handled with care.

Previous research [55][56] on rewards and motivation in virtual learning platforms suggests that digital badges, reward points, ranking systems etc. can create motivation in users which is in line with our findings. The results of this research support this statement as the participants have suggested digital rewards to be effective and competitiveness make learning more fun and appealing. In addition to the similarities found in the findings with previous research, there also additional findings that add new knowledge. We found that rewards should be incremental to keep the users motivated. Instead of giving the users some stars after they complete every lesson, the volume of value of the reward should be varied, increased for continuous betterment in performance and might be decreased in case of worsened performance. For example, initial rewards can be simple stars or badges and after more learning, the reward could be bigger like paid lesson unlocking etc. Then after a continuous good performance, there could be bigger rewards. Also, it was mentioned that rewards related to the lesson topics can be more interesting and motivating.

5.2 Design of Virtual Robot as a Language Learning Companion

Based on the related work, there are no existing design guidelines for a virtual language learning companion robot. Based on our findings and previous research, we have formulated seven design

implications, which can help designers who work with language learning companion robots. Based on our findings, the design implications for a virtual language learning companion robot are:

- (1) **The appearance of the virtual robot should not fully resemble a human.** Too much similarity with a human could create several problems, such as increased expectation from the robot as well as the risk of getting it wrong and making it creepy as a result. Also, human features like facial expressions are very challenging to mimic fully in a robot, making it a risk factor. A robot-like or even an animal-like appearance should work better. Similar findings were made in [26].
- (2) **Human-like movements and gestures are preferable.** While the robot should not exactly look like a human, it can sure move like one. Human gestures such as hand movements, nodding, waving can add to the interaction and make it more engaging. This implication is also mentioned in [31].
- (3) **Facial features should be handled very carefully.** Eye movements as well as other moving parts of the face such as jaws and mouth can be done wrong very easily, making it creepy as a result.
- (4) **Positive feedback with constructive criticism is effective.** For keeping the motivation up for learning positive feedback is necessary while negative feedback is not desirable. However, for poor performance, there should not always be positive feedback, rather constructive criticism along with suggestions to improve.
- (5) **Voice-based interaction in line with movements and gestures has a positive effect.** The Voice of the virtual robot should not be over the top and should sync with its physical movements. Also, voice and tone should be different for different situations such as a happy tone for positive feedback and neutral for criticism. [33] has reported similar findings.
- (6) **The robot should have some reaction to every action of the user.** There should always be some kind of feedback from the robot for everything the user does. A simple nod, sparkling eyes, sounds or hand movement etc. can create a proper interactive environment.
- (7) **The robot can turn into funny attractive characters as a reward.** As it is a virtual robot, it can turn into a disco ball, or create fireworks for the user when performing well. The element of surprise works very well in this regard.

5.3 Limitations and Challenges

Due to the Covid-19 pandemic and distant working regulations we had to move to online platforms like Zoom for conducting the co-design workshops as well as the theme interviews. This might have created some complications in collecting data and communicating with the participants overall.

The online workshop meetings had been recorded; however, the transcription was challenging as there was a mixture of English and Finnish languages. To compensate for this, participants were requested to document every idea they had as well as everything they talked about. This approach has made the data richer, however, it cannot be stated for certain that no data was lost or not

documented.

Another limitation would be the cultural aspect as this study was conducted in Finland with either Finnish or English-speaking participants only. The data and findings could be more diverse if the study was done in different cultural contexts such as somewhere robots are very common or somewhere robots are very rare in general.

The number of language students in the co-design workshop was adequate, however, we feel that more theme interviews could have made the data richer and more balanced. Design students think more related to design principles, and it provides a new dimension to the data. A future study with data collected from more design-focused participants can create a significant improvement to the design implications.

The current study lacks the evaluation of the design implications provided which is already being planned as a future work. A full design of the virtual language learning companion robot needs to be done based on the findings and design implications presented in this study. Furthermore, a proper evaluation with a target group (language students) needs to be done as future work to ensure credibility.

6 Conclusion

Online learning platforms are becoming more and more important these days and they are contributing significant knowledge for the learners. As a result, making these platforms more effective and interactive has become a need. Previous research has suggested that interactive virtual agents can improve their effectiveness by introducing meaningful interaction and raising motivation. In this qualitative and explorative study, we wanted to understand how potential users of a language learning platform expect a virtual robot to assist with their learning. We employed the first phase of the HCD process i.e., the empathy phase in this study to understand user expectations. We conducted a co-design workshop with language students and theme interviews with design students. These workshops and interviews provided users' preferences and expectations for a virtual language learning companion robot focusing on its major characteristics, such as appearance, interactional behavior, feedback styles, movements, gestures and rewarding. Based on the co-design workshop and theme interview findings, seven design implications for a virtual language learning companion robot were formulated. The design implications can be used to design a virtual robot that assists with online education. However, these design implications need to be further validated by applying to actual designs and evaluation studies which are expected to be an upcoming future work of this study.

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