



RESEARCH PAPER

# The Teacher's Role in Robot-assisted Language Learning and its Impact on Classroom Ecology

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## Abstract

In recent years, social robots have emerged as a new teaching aid in foreign language (FL) classrooms. Interaction in FL classrooms usually takes place between teachers and learners or among learners. However, this constellation of interactions changes when a robot enters the classroom. The robot's role in the classroom has been studied previously, however, in this article we examine how initial encounters between a social robot and learners occur, focusing on the teacher's role during these encounters. Additionally, we examine how children seek help or assurance from their teacher when interacting with the robot. Research data consists of video recorded in FL classrooms in primary schools in Finland in 2019. The primary school learners ( $N = 22$ ) who participated in this study ranged in age from 10 to 13 years. The results show that during the robot-assisted language learning (RALL) interaction, the teacher had several roles: she validated children's contributions, guided or mediated the discussion, encouraged the children to speak with the robot, and provided technical support. The results also suggest that the teacher's role in RALL classrooms, while not necessarily central, is essential to ensure smooth interactions between the robot and learners.

## **Keywords**

Classroom ecology; Primary school children; Robot-assisted language learning; Teacher role

## **1. Introduction**

The development of language teaching and learning has usually been guided by technological innovations that have produced new teaching materials and learning aids, such as video and, especially in recent decades, computer-assisted language learning (CALL) (see e.g., Tudor 2003). Practically all technologies used for language learning purposes extend the physical limits of the traditional classroom (see e.g., Mroz, 2014). For instance, computer-mediated digital games (Cornillie, Thorne & Desmet, 2012), virtual worlds, such as Second Life (Deutschmann & Panichi, 2009), and the use of mobile technology (Kukulska-Hulme, 2009) are already established as virtual environments in language learning. More recently, video-mediated interactions with a telepresence robot have been implemented (Jakonen & Jauni, 2021). In the last few years, the social robot has entered FL classrooms and it has had an impact on classroom ecology. From the perspective of FL learning, an interesting question is whether children interact and learn languages differently when they play digital games in virtual environments or communicate face-to-face with robots during classroom-based instruction (see e.g., Kim, Han & Ju, 2014). Moreover, the question of balance in classroom ecology arises, as there are more factors and/or actors affecting the complexity of the classroom environment (cf. Guerrettaz & Johnston, 2013; van Lier, 1997). This environment changes when a new teaching element, in this case a robot, enters the classroom. Its utterances, embodied behaviour, posture, gestures, and gazes have an influence on interaction in the classroom. At the present developmental stage, the type of robot used in FL classrooms is often an embodied human-like figure. It presents as a playful and intelligent smart toy (Mubin, Shahid, & Bartneck, 2013) whose contributions are usually based on pre-scripted utterances and dialogues. FL learning is seen as a mediated activity (Vygotsky, 1978) that occurs amongst the participants in a certain environment, which can be regarded as an ecosystem (van Lier, 1997, 2004). Therefore, a learning environment enriched by a robot poses questions about social interaction in FL classrooms. Apart from pedagogical materials (Guerrettaz & Johnston, 2013), the role of the teacher is crucial both in the traditional classroom and in robot-assisted language learning (RALL). In the FL learning context, the use of robots is interesting because teachers tend to dominate communication in the FL classroom (see e.g., Newton & Newton, 2019).

Against this background, the present article focuses on the role of the teacher in RALL classrooms and aims to fill a gap that exists in classroom ecology studies. We examine how the presence of a robot in the classroom affects classroom ecology, especially with regard to the teacher's role in this special learning environment. Furthermore, attention is paid to how children seek help or assurance from the teacher when they interact with a robot. We use data taken from video recordings made in FL classrooms in primary schools in Finland in 2019. The learners that participated in the study were aged from 10 to 13 years. Based on our findings, we aim to shed light on new realities of FL classroom interactions when children encounter a robot in their English class for the first time. Firstly, we discuss previous studies on the concept of language classroom ecology, this serves as the theoretical framework for our study. Secondly, previous studies on participants' roles in RALL are examined. Finally, we present our study and its findings before offering a final discussion and conclusions.

## **2. Theoretical framework of classroom ecology**

Language classrooms are complex places (Tudor, 2001, 2003), and hence they are difficult to describe and analyse. They function like small ecosystems with their own rules or inner logic (Dörnyei, 2014). Exploring language teaching and learning from an ecological viewpoint means looking at "the totality of the lives of the various participants involved, and not as one sub-part of their lives which can be examined in isolation"

(Tudor, 2003, p. 4). When looking at CALL/RALL from an ecological perspective, we rely on the work of educational and language researchers who have brought the notion of classroom ecology (Bronfenbrenner, 1976; Tudor, 2001) and ecological-semiotic perspectives on educational linguistics into use (van Lier, 1997, 2004, 2011). In the field of education, Bronfenbrenner's (1976) nested ecological research model divides the educational environment into micro-systems, meso-systems, exo-systems, and macro-systems. In this model, the classroom setting is defined as "a place in which the occupants engage in particular roles (parent, teacher, pupil, etc.) for particular periods of time" (Bronfenbrenner, 1976, p. 5). According to this system, the language classroom can be regarded as a micro-system that is linked to other systems at the macro level as well. The factors of place, time, activities, and participant roles constitute the *elements* of this setting.

Classroom ecology provides a framework to study the relationships between these elements. It encompasses the interplay between and amongst participants, processes or activities, structures, and artefacts (van Lier, 2004; similarly, Guerrettaz & Johnston, 2013). Teachers and learners represent *participants*, *processes* are actions or activities that take place in the classroom, and *structures* refer to the curriculum that guides the teaching. The fourth element in this complex, *artefacts*, refers to physical objects that are available in the classroom such as textbooks, blackboards, computers, online materials, and robots (see below).

The role of the teacher in this ecosystem "is shaped by the attitudes and expectations of students, of parents, of school administrators, of materials writers and many others including, of course, each teacher as an individual in his or her own right" (Tudor, 2003, pp. 5–6). The concept of classroom ecology comprises "the totality of interrelationships between elements in the language classroom" (Guerrettaz & Johnston, 2013, p. 783). Despite the encouragement of learner-centred approaches in language education, it is usually still the teacher who dominates the interaction and plays the main role in the classroom. Many studies have shown that the teacher-led interaction model IRE (Initiation–Response–Evaluation) is still used predominantly in classroom discussions (see, e.g., Lyle, 2008). Compared to a traditional language classroom with teachers and learners as participants, the ecology of the classroom in our study is complemented with a new participant, the social robot. When the robot enters the classroom, the classroom as an ecosystem is reorganised. The emergence (van Lier 2004, p. 82) of a new element in the classroom transforms the system into a more complex one. The interaction in the classroom may also be indirect, that is, where teaching materials guide the structure and content of the lessons and bring the perspectives of the material writers to the classroom ecology (Tudor, 2001, p. 26). Accordingly, the programmes installed in the robot have an indirect influence on interaction in the classroom.

Ideally, language learning takes place in a context of "purposeful action" (van Lier, 2008, p. 600). The participants have certain goals, and to reach them learners are given affordances. The role of the robot in this complex environment is an interesting one, as its role lies somewhere between a participant (Kanda, Hirano, Eaton & Ishiguro, 2004) and an artefact or affordance. In the context of classroom ecology, van Lier (2004, p. 91, 96) defines affordances as 'relationships that provide a 'match' between something in the environment [...] and the learner'. In other words, they refer to what is available in the classroom for the learner to do something. Accordingly, affordances refer not only to materials (cf. Guerrettaz & Johnston, 2013) or teacher reformulations (Thoms, 2014) but also to the relations between participants and the environment (van Lier, 2004). These active relationships create the classroom ecology. According to van Lier (2008, p. 598), reciprocity between the perceiver and perceived belongs to the ecological perspective, according to which they can take different roles. Given that it is the teacher who decides how the RALL activity is programmed and/or which pre-programmed lessons and teaching materials are used, the robot can be defined as an artefact (cf. Guerrettaz & Johnston, 2013). However, in the RALL classroom, the robot can also function as an assistant to the teacher (Alemi, Meghdari & Ghazisaedy, 2015) or as a peer learner, who is taught by learners (Tanaka & Matzuhoe, 2012; for an overview of robot roles, see Engwall & Lopes, 2020).

To this point, the concept of classroom ecology has been used as a theoretical framework, for instance, analysing the role of teaching materials in language classroom ecology (Guerrettaz & Johnston, 2013) or teachers' reformulations as affordances for learning (Thoms, 2014). According to the concept of classroom ecology, the language classroom is an ecosystem in which different elements or artefacts (space, materials, and robots) interact with human participants (teacher and learners). In the present study, we focus on what happens in the ecosystem when the robot is involved in classroom interaction. In our case, the robot did not function as an autonomous actor, and hence it needed the teacher to control the child-robot interaction (CRI). She initiated the programme and decided about the content of the lesson<sup>1</sup>.

### 3. Previous studies on RALL

As robots are a novelty in language classrooms, the RALL research field is still in its early stages (for an overview, see Randall, 2019). Many studies have reported on the positive impact of robots on language learning, especially on learners' anxiety and willingness to learn languages (see e.g., Alemi *et al.*, 2015; Lee *et al.*, 2011). In a recent review article on social robot use in language learning, van den Berghe *et al.* (2019) discussed the results of 33 RALL studies dealing with learning outcomes and motivation, focusing on studies that used a physically present robot. Many of the reviewed studies reported higher student motivation in RALL classrooms compared to traditional classrooms in all age groups. The use of a robot also seemed to reduce anxiety and create more positive attitudes towards learning (e.g., Alemi *et al.*, 2014). Although children in most studies enjoyed language learning with a social robot (Gordon *et al.*, 2016), learned without anxiety (Alemi *et al.*, 2015), and learned more words with a robot than without one (Tanaka & Matsuzoe, 2012), their learning outcomes were often modest (Gordon *et al.*, 2016; Kanda *et al.*, 2004). In fact, Randall (2019, p. 2) concluded from previous studies that the benefits of robots in learning are unclear, yet they seem to increase learners' motivation, decrease anxiety, and enhance language use in interaction.

The behaviour of robots seems to have an influence on language learning outcomes. Randall (2019, pp. 7-8) listed the roles of robots: teacher, teacher's assistant, peer/tutor, and learner. In these roles, knowledge transfer can be uni- or bidirectional, and the level of authority varies. For instance, when working as a teacher, the robot represents the authority in the interaction, and as a peer or a learner the robot is closely connected to other learners. Zaga *et al.* (2015) examined the effect of two robots with a different social character (peer vs. tutor) on 20 children between 6 and 9 years of age who were solving puzzles with the help of the robots in a Dutch Montessori school. They found that in interactions with a peer-like robot, children paid more attention to the robot and to the puzzle. Children also solved the puzzles quicker with a peer-like robot. Similar findings have been found in other related studies, with the results indicating that children performed better in interactions with peer-like robots that displayed emphatic behaviour (e.g., Belpaeme *et al.*, 2013).

There are some studies that have examined computer-assisted language learning (CALL) and/or RALL from an ecological perspective, showing the significance of the role of the teacher in the language classroom. For example, in the Taiwanese context, Liu and Chao (2018) examined CALL from an ecological perspective. Their data included field notes, transcripts, and online discussion files collected from classroom observations (30 hours) and subsequent interviews with 10 teachers. The focus was on classroom interactions between the students and the technology and on how the teacher participated in the interactions and encouraged learners. The role of the teacher was found to be decisive in guiding the learners to find the right solutions in online dictionaries. In a more recent study on adult second language (L2) students, Jakonen and Jauni (2021) studied a telepresence robot in university-level foreign language classrooms, where a remote student moved the robot around to gain access to classroom learning materials. In this

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<sup>1</sup> The English teacher in our study was a female, and therefore we use the pronoun *she* when referring to her directly in our study.

study, the videoconferencing application (developed by Double Robotics) allowed the remote learner to have a relatively wide view of the classroom, but the other learners only saw his or her “talking head” (Licoppe & Morel, 2012). Jakonen and Jauni (2021) showed that this kind of hybrid learning environment renders distance education more accessible, but it also requires new classroom interactional competences on the part of the teacher.

Engwall, Lopes and Åhlund (2020) surveyed adult language learners and recorded language café conversation sessions in pairs, hosted by a Furhat robot, to determine how four different interaction styles influenced the interactions. These were based on the interaction styles of human language café moderators. Factors such as the learners’ language levels and familiarity were studied. The anthropomorphic Furhat robot used in the study has a human-like appearance and can display human facial expressions, such as smiles or eyebrow movements. Engwall et al. (2020) observed that learners were willing to exchange personal information with robots and that they found the interaction with robots to be less intimidating than with a human teacher. The anthropomorphic appearance seemed to blend the robot’s multiple roles. Due to its size, for instance, it resembled a peer more than an authority (cf. van den Berghe *et. al.*, 2021; Randall, 2019; for robot types, see e.g., Engwall & Lopes, 2020). Although the robot was well suited for conversational practice, they concluded that the robot’s non-verbal displays, such as eye contact or gazes, should be improved. In another study in a Swedish context involving 33 adult L2 learners, Engwall and Lopes (2020) observed that learners were most active in situations in which the robot took an encouraging role. Newton and Newton (2019) studied the use of robots as teachers and proposed a “code of practice” for teachers working with robots. They argued for the usefulness of humanoid robots in teaching but raised some concerns about using robots as teachers. For example, they recommended that a human teacher should be present when a robot teacher is used and that the human teacher should ensure that children interact adequately with the robot.

#### 4. Research aims and questions

As previously discussed, when a robot enters the classroom, the classroom ecology changes. However, RALL is still in its early stages, and thus the role of the teacher in the RALL classroom is crucial in classroom ecology. Hence, classroom interaction is still quite teacher-centred. In this paper, we are interested in the teacher’s role in RALL situations where there are four participants and/or artefacts present in the classroom: (a) teacher, (b) learners, (c) robot, and (d) computer. We used an Elias robot (NAO 6), which is suitable for different age groups (Engwall & Lopes, 2020), with a pre-programmed lesson controlled by a computer. The Elias robot is not an independently functioning robot, it requires a support device (here a computer) to direct the exercises (see Participants and Data Collection section for further details). Mainly, the teaching and learning happens in the CRI context, but the teacher is present due to technical limitations.

As we aimed to examine the teacher’s role and the relationship between the teacher and learners in a classroom in which the robot was used as a teaching assistant, the research questions of our study were as follows:

RQ1. How does the presence of the robot affect the classroom ecology, especially from the perspective of the teacher?

RQ2. What role(s) does the teacher play in the ecology of a language classroom in which a robot is used as a teaching assistant?

#### 5. Method

##### 5.1. Participants and Data Collection

Research data consisted of video recorded in English language classrooms in a primary school in Finland in 2019. A total of 22 primary school learners (10 girls and 12 boys), ranging in age from 10 to 13 years, participated in our study. As the data were collected in a Swedish-speaking primary school in Southern Finland, the participants included both

monolingual (Finnish or Swedish) and bilingual children (Swedish–Finnish). This data set was part of a larger data set collected for the RoboLang research project at the University of Turku (RoboLang). As mentioned above, the robot used in the present study can be defined as a non-autonomous social robot designed to interact and communicate with learners based on predefined scripts. In doing so, the robot is only able to respond when the learner reacts as expected (van den Berghe *et al.*, 2019). However, the peer-like robot in this study has a cute physical body and can use movements and gestures (cf. Engwall & Lopes 2020; van den Berghe *et al.*, 2021; see Figure 1). It demands eye contact when learners talk to it and rewards learners' correct answers with colourful candy eyes and supporting sound. Its voice is nice and cannot be clearly identified as a girl or a boy, but on the recordings the teacher calls the robot "he" (Swe. *han*). From the perspective of children, the human-like robot in this study may seem more like a peer or friend than solely a machine. At the time of the recordings, the children were working with the robot for the first time during the English lessons on the topic of family.

As in many previous studies (see Randall, 2019; van den Berghe *et al.*, 2019), the data for the present study were gathered in a single session and consisted of video recordings (90 minutes) of robot-assisted language learning in the classroom for one day. To provide all the children with the possibility to interact, they were divided into small groups (2–4 children per group, henceforth C1–C4). The same teacher was present in all group discussions. She was a visiting language teacher and not the group's regular teacher. Altogether, six group discussions were analysed for this article, with an approximate duration of 15 minutes each (see Figure 1).

### Figure 1

*The Setup of the Group Discussions with the Robot.*



RALL classes were video recorded and transcribed according to standard conventions used in discourse analysis. Transcripts of the recordings amounted to about 80 pages. The code of ethics and the privacy rights of human subjects were observed throughout the project. The data contain no personal or personally identifiable information. In conducting the analysis, we focused on turns-at-talk (Schegloff, 2007, Ch. 1) in the RALL classroom discourse. According to Schegloff (2007, p. 3), each turn can "be inspected by co-participants to see what action(s) may be being done through it", and they are not topical, saying something about the same subject. Hence, turns are changes in who talks in the respective situation. We paid attention to the turns in which the teacher was involved, that is, if the turn was prompted by the teacher or if she was addressed during the turn. The transcripts of the recordings were organised in sequences and interaction frames (*robot–child–teacher*) to obtain an overview of and to understand the interactions. We focused especially on the interaction frames *robot–child* and *teacher–child*. Besides the learners (in the examples C1–C4), the human teacher (T in the extracts) was present during the session, and the robot (R in the extracts) was used as a teaching assistant. For example, in Extract 1, learner C2 asks the teacher for a clarification of the situation in Swedish (i.e. the language of the school) (01), and the teacher encourages him or her to say the target word (02).

### Extract 1

*Question addressed to the teacher.*

- 01 C2 va  
what  
02 T nu så säger du där öh  
now you say this eh  
03 C2 grandad  
04 T jo  
yes

### 5.2. Data Analysis

Data analysis was conducted by using both qualitative and descriptive, quantitative methods, especially content analysis (cf. Kuckartz 2014, 38-41). The researchers read the data several times and noted the most salient topics that emerged from the recordings. Besides the primarily qualitative analysis, we conducted a rough quantitative analysis of the recorded data. We wanted to determine the preliminary proportion of turns-at-talk in the RALL classroom discourse (Guerrettaz & Johnston, 2013; Schegloff, 2007). If the turn was related to the teacher, it included cases that were prompted by the teacher or addressed to the teacher.

## 6. Teacher roles in RALL classroom ecology

As previously discussed, in the context of our study, the participants in the classroom interaction are the human teacher, the robot, and the learners. However, the teacher stayed on the sideline and tried to give the children the opportunity to interact independently with the robot. As it was their first encounter with the robot, the teacher had to facilitate the situation by rotating the robot toward the children. Even though the teacher was in the background in the actual CRI, the classroom discourse was strongly dependent on the teacher. The teacher began the lesson with the robot by presenting the topic (family) and ended the lesson by thanking the children and asking them how they felt about talking with the robot (cf. Han, 2012). The interaction mostly followed the IRE model (Lyle, 2008). The robot took the role of the teacher, for instance, by saying single family words, such as "sister" (initiation). One child repeated it at a time (response), and then the robot accepted the word, using a special sound effect to confirm the response of the learners (evaluation). A typical discussion is presented in Extract 2.

### Extract 2

*Example of the IRE model.*

- 01 R no I don't  
02 C2 no I don't  
03 R \*emits the sound of success\*  
04 R no I don't  
05 T good

As can be seen from Extract 2, after the response and/or evaluation by the robot (03–04), the teacher usually made short confirmations, such as *good* (05), to the robot's responses, usually in the target language (English). However, these affirmations were mainly given in Swedish, as Swedish was the language of instruction in the classroom. The direction of the interaction in this RALL classroom was mutual between all

participants, but there was practically no interaction between the human teacher and the robot. This means that, between the teacher and the robot, no reciprocity of interaction occurred.

In response to the first research question, the following teacher roles emerged from the quantitative analysis of the turns: (a) a validator of interaction, (b) a guide or a mediator, (c) a motivator/emotional supporter, and (d) a technical supporter. Table 1 shows the distribution of the turns initiated by the teacher in the RALL classroom interaction. These will be analysed qualitatively below using examples from the data.

**Table 1**

*Distribution and Examples of the Turns Related to Teachers' Roles in the RALL Classroom Interaction.*

Turns (N = 384)	N	%	Examples
(a) The teacher affirms or provides a brief validation. → <i>The teacher evaluating and validating children's contributions.</i>	160	41.67	01 T mh bra <i>mh good</i>
			01 C2 jag ska säga do you have any <i>I am going to say do you have any</i> 02 T mh <i>mh</i>
(b) The teacher guides the child-robot-interaction. → <i>The teacher as a guide or mediator.</i>	103	26.82	01 T säga till exempel I have one sister <i>say for example I have one sister</i> 02 C2 I have one sister 03 R I have ten thousand brothers and sisters
			01 C2 mm do you have a mom 02 R *nods* 03 C2 do you have a mom 04 R no I don't 05 C2 ja <i>yes</i> 06 T something else 07 C2 (to C1) säg nånting <i>say something</i>
(c) The teacher encourages or gives positive feedback. → <i>The teacher as a motivator.</i>	83	21.61	01 C1 brother 02 R brother 03 T en gång till <i>once more</i> 04 C1 brother 05 R *nods* 06 R okay
			01 R yes I do 02 C2 yes I do 03 R *emits the sound of success* 04 R yes I do 05 T fint <i>great</i> 06 T *nods toward C2*
(d) The teacher gives technical instructions. → <i>The teacher as</i>	38	9.90	01 T (to C1) sköter du den här <i>do you take care of this one</i> 02 T och när ni är färdiga så så klickar du vidare

a technical support.			<i>and when you are ready then then click on</i>
			01 R *emits the error-sound*
			02 R error 600 I'm not safe like this please help me
			03 R *crouches and sighs*
			04 T nå <i>well now</i>
			05 T han vill ingenting nu <i>he does not want anything now</i>
			06 T *laughs gently and clicks robot's button again*
			07 R *emits the error sound*
			08 R error 600 I'm not safe like this please help me
			09 R *crouches*
		10 T nå nu måste vi stänga av nu helt då <i>well now we have to turn off now completely</i>	

It could be observed that most of these turns were affirmations directed toward the children to support the interaction with the robot. The teacher guided the CRI mostly by giving advice about how to proceed, what the children could say to the robot, or how they could continue the interaction. As Table 1 shows, the teacher often gave a clue in the first language (L1). On many occasions, she asked the children if they remembered the word in English or had a question for the robot ((a), 01 and (b), 01). On several occasions the teacher told the children to speak up because the robot only understood the children when they were close enough and were making eye contact with it. The examples in Table 1 also illustrate how the teacher encouraged the children to repeat their answers or to try again if the robot did not understand them immediately. They often did this by giving positive feedback or using body language, such as smiling or nodding ((c), 06). The teacher was constantly monitoring the robot and its functions during the lesson. Occasionally, the teacher gave the children technical advice, for instance, telling them to click on the computer and continue the interaction with the robot ((d), 01–02).

In the following discussion, we will give more examples of teacher roles in RALL starting with category (a). The teacher evaluated and validated the children's contributions, as it was the teacher who affirmed to the children that they had said something correctly to the robot. The brief affirmations by the teacher seemed to be very important to enable the interaction between the children and the robot. With these, she encouraged children to continue talking with the robot. The teacher validated the children if they were saying something correctly, mostly by saying *mh, okej* "okay" or *bra* "good".

The second important role of the teacher in the RALL classroom ecology was as a guide or a *mediator*. The teacher mediated (Vygotsky, 1978) and guided the discussion. For example, she asked the children to pronounce the target words again or to speak up so that the robot could understand it. The teacher gave clues in the mother tongue (e.g., *har du mamma* 'do you have a mother') or indicated that the robot did not understand what the child said (e.g., *nu uppfattar han inte* "now he did not understand"). In this way, the teacher tried to build an "active relationship" (van Lier 2004, p. 92) between the participants. Examples of the teacher's guiding and mediating utterances are summarised in Table 2.

**Table 2**

*Examples of ways in which the teacher guided children's interaction with the robot.*

T sen tar du vidare <i>try again</i>
T säg till exempel I have one sister <i>say for instance I have one sister</i>
T nu får ni fråga något (för)han <i>now you can ask him something</i>
T fråga nånting om familjen till exempel <i>ask for example something about family</i>
T prova fast har du mamma har du pappa har du mamma eller förkortning av mamma <i>try for instance do you have mother or father do have you mother or [use] abbreviation of mother</i>
T vill du fråga nån om familjen eller <i>would you like to ask. something about family or</i>
T säg bara den där syster på engelska <i>just say that [word] sister in English</i>

The teacher intervened many times in the interaction and gave the children instructions about what to do or say (*han frågade dig* "he asked yo"). As it was their first encounter with the robot, the teacher often told the children to come closer to it (*du behöver komma närmare* "you need to come closer") or told them to speak up. The teacher mostly guided the CRI in the mother tongue of the learners, as Extract 3 shows. This passage is prompted by a child (C1).

**Extract 3**

*Instruction in the L1.*

01 C1 \_\_hmm

02 C1 \_\_så jag kan typ säga jag kan säga typ I have one  
\_\_\_\_ brother eller sådant

*so I can say something like I can say something like I have one brother or something like that*

03 T \_\_eller du frågar åt honom  
\_\_\_\_ *or you ask him*

04 C2 \_do you have a brother

05 C1 \_\_do you have a brother

06 R \_\_no I don't have any siblings but I've two cool buddies  
\_\_\_\_ Pepper and Romeo

In this extract, another learner (C2) enters the dialogue to provide help to find the correct way to ask the question they had rehearsed earlier (04). In some cases, the teacher

instructed the children about correct pronunciation; for instance, by saying *man måste säga mera som aunt* “you have to say it more like aunt” (with the US pronunciation). In these passages, the teacher’s utterances served as affordances for the whole group, affecting the on-going discussion with the robot (cf. Thoms, 2014).

Furthermore, the teacher’s questions encouraged the children to maintain interaction with the robot, as Extract 4 illustrates. Note that when the robot just nods, it does not mean that the answer is correct, it means that you have to try again. The robot repeats the sentence or makes a specific sound when it accepts the answer.

#### **Extract 4**

##### *Supporting questions.*

01 C2 no I don't

02 R okay you don't have any hobbies

03 T mh han fattar fel

*mh he misunderstood*

04 T (to C1)

do you have a question for him

05 C1 mm do you have any sisters

06 R \*nods\*

07 T \*rotates the robot toward C1\*

08 C1 do you have any sisters

09 R do you have any sisters

10 T mh

The Extract 4 illustrates the fact that teacher roles can intertwine. Here, she comments on the robots’ incorrect reaction (technical support) (03, 07) but also support and encourage the learners to continue the interaction with the robot (04). The teacher guided the interaction with words (Extract 4, 10) but also only with non-verbal actions (e.g., smiling or nodding), or even by supporting verbal actions with non-verbal ones (see Extract 5, 01–02, 11–12). The latter created reciprocity between the perceiver (i.e. the self, which in our case is the children) and the perceived (i.e. the affordance, in our case the robot) (see van Lier, 2008). Gestures, movements, and speech holistically contributed to these activities to convey meaning and support interaction.

### Extract 5

*Verbal and non-verbal support.*

01 T \*nods to C2\*

02 T prova säga

*try to say*

03 C1 (to C2)

prova säga

*try to say*

04 C2 dad

05 R dad

06 T okej nu valde den XX

*okay now choose the XX*

07 R grandmother granny

08 C1 grandmother

09 R \*nods\*

10 R grandmother

11 T mh

12 T \*nods\*

In Extract 5, another learner (C1) encourages their schoolmate after the teacher to try to pronounce the word again in an appropriate way (03, similarly Extract 3). On some occasions, the teacher interrupted the CRI if she noticed that there was a misunderstanding on the part of the robot, as in Extract 6 (03–04).

### Extract 6

*Misunderstanding.*

01 C2 father [/ð/ missing from the pronunciation]

02 R butter

- 03 T \*shakes head\*
- 04 T nu fattade han inte rätt  
*now he did not understand correctly*
- 05 C2 father
- 06 R \*nods\*
- 07 C1 ah jag klickade nånting  
*oh I clicked something*
- 08 T inte gör det nån  
*it does not matter*
- 09 T (to C2)  
  
du kan sä- försöka säga  
  
*you can sa- try to say*
- 10 C2 grandmom
- 11 R grandma
- 12 T okej  
  
*okay*

During this interaction, the target word changes as the second learner (C1) clicks on the laptop, which is used to administer the pre-scripted lesson (07). Here, the teacher encourages the children to continue the lesson and not to stop despite the technical problems. By doing so, she also encourages the learner in Swedish to continue the activity (09). The recognition threshold of pronunciation was around 42%. In fact, most of the misunderstandings between the robot and the children concerned pronunciation. In these situations, the teacher encouraged the learners to correct their pronunciations and try again (Extract 7, 06).

**Extract 7**

*Pronunciation challenges.*

01 R \_\_\_uncle uncle

02 C2 \_\_uncle

03 R \_\_\_ uncle

04 C2 \_\_\_ uncle [wrong pronunciation ankle]

05 C1 (to C2)

\_\_\_ närmare

\_\_\_ closer

06 T \_\_\_ ju han uppfattade just säg nu bara en gång till

\_\_\_ *he just understood say once again*

Extract 7 illustrates the teacher's role as a motivator. The teacher encouraged the children to say the English words to the robot. This happened mostly by nodding or saying something in the L1, Swedish, for example, "(prova) en gång till" "try once again" or "äg på nytt bara" "please say again", "säg bara det där samma" "say that again" or "[...] om han säger inte nånting så måste man prova bara på nytt" "if he does not say something you have to try again". The teacher evaluated and validated the learners' answers by giving them positive feedback during the interaction — here several of the teacher's roles again overlap. The encouraging words were mostly given in the children's L1 (*Bra!*, *Säg det bara* "Good!", "Just say it"). In addition to providing verbal support by telling the children to pronounce the target word again (*en gång till* "once again", as mentioned earlier, the teacher encouraged them by nodding, smiling, or laughing if the communication with the robot failed.

Moreover, in Extract 7, the other learner also supports the interaction (05) as in earlier extracts. In general, the agency of the learners was otherwise limited in the classroom interaction (cf. Guerrettaz & Johnston, 2013) in these pre-scripted lessons. In most cases, the CRI consisted of the pronunciation of the target word by the learner and the repetition of it by the robot. Sometimes the robot took the role of the teacher, for instance, when giving instructions on how to continue the lesson according to the pre-scripted structure. For example, the robot said, "Great, let's practice asking questions about family. I'll show you some pictures. Repeat after me". In these situations, in which the robot was interacting with the learners, the robot could be regarded as a real participant (van Lier, 2004) in the ecology of this classroom. However, in most turns from child to teacher, the children asked the teacher for clarification or for further instructions. The children sometimes expressed their need for help by simply glancing at the teacher.

Finally, the teacher served as a technical support, as mentioned in previous examples. When something went wrong during the interaction, for instance, if the robot did not react or answered unexpectedly, the children looked at the teacher for help and support. If the interaction was interrupted for some reason, the children asked the teacher how they could proceed. The teacher turned the robot towards the children's faces if they could not meet its gaze (see Extract 4, 07). She creatively found solutions when technical problems appeared so that the interaction between the children and the robot did not stop. The children's moments of success were shared with the teacher and peers. To conclude, the teacher nudged the learners toward interaction with the robot. The emotional support of the teacher had a positive effect on the learning atmosphere in the class.

However, when there were problems regarding understanding or technique, the learners usually asked the human teacher for help. When the children were surprised or confused by the robot's answer, they looked at the teacher. During the interaction, the children often expressed their uncertainty by asking for further instructions or help or by glancing at the teacher. The content of the interaction between the teacher and children mostly

consisted of the robot's utterances, the children's pronunciation problems, and instructions related to the pre-scripted lesson.

## 7. Discussion

The results of the present study showed that during the first encounter with the robot, the RALL classroom ecology was predominantly dependent on the teacher, although she acted in the background. The teacher influenced the classroom interaction by being present and observing and controlling the interaction between the children and the robot. Although the teacher was in the background, the success of the interaction was strongly dependent on their actions and affordances for learning (cf. Thoms, 2014). However, it could be observed that the robot served as a model and sometimes replaced the human teacher, especially in providing linguistic knowledge (i.e., about pronunciation) and giving some task instructions to the children. Moreover, due to the activity design there was practically no interaction between the human teacher and the robot, although the teacher commented on the robot's actions to the learners in the event of technical problems. From time to time, the children looked to the teacher for help, but the teacher mostly acted as a facilitator and a motivator in the background. Based on our findings, it seems that during the first encounter with the robot the children conceived the robot as a new element or visitor from the target culture who had entered the classroom. Hence, they did not necessarily consider the robot to be a peer with whom they could chat or a real teacher, probably due in part to the fact that the lesson was pre-scripted. We noticed that the teacher enabled the interaction between learners and the robot in the following ways: i) by evaluating and validating children's contributions, ii) by guiding and mediating the CRI, iii) by encouraging and giving positive feedback to the children, and iv) by giving the children technical advice. It is also important to keep in mind that the teacher initiated the programme and decided on the content of the lesson. The teacher's turns could be interpreted as affordances for learning (Thoms, 2014; van Lier, 2004).

Regarding the limitations of the present study, all findings are tentative and were obtained in a specific classroom context in a single session during the first encounter with the robot. These RALL contexts might seem artificial settings, and therefore more longitudinal studies are needed to examine how the teacher's role will change in the long run. The research on classroom discourse is never static, generalisable, or complete. In our case, the robot had newly arrived in the classroom. The excitement of the children could be explained by the novelty effect (van den Berghe *et al.*, 2019). For instance, in the study of Kanda *et al.* (2004) the children lost interest in the robot after two weeks. Our data did not reveal how the children would work in general in the classroom when the robot was not present. Moreover, the pre-scripted activity for the lesson had an influence on the interaction in this RALL classroom. In future research, longitudinal studies are needed to determine what happens when the robot loses its novelty effect and becomes an everyday phenomenon in a FL classroom (cf. Randall, 2019). Further studies could provide information on how the RALL technology could be developed to maintain the interest and motivation of learners after the novelty effect is gone as well as on what happens when the children work with the robot for a longer time period (cf. van den Berghe *et al.*, 2019).

Keeping these limitations in mind, the technology did not replace the teacher in the classroom. Our findings show that the role of the teacher was even more important when the robot was in the classroom. Specifically, the presence of a human teacher was needed to ensure that the children interacted adequately with the robot (cf. Newton & Newton, 2019). The robot was able to handle mechanical classroom talk, such as asking questions, affirming correct answers, and giving feedback. However, its deficits were related to creative thinking and thinking processes involving values, beliefs, and decision-making (Newton & Newton, 2019).

The RALL classroom discourse could eventually profit from dividing roles between the human teacher and the robot. The robot could be used as a classroom assistant (cf. Jakonen & Jauni, 2021), with whom learners could practice the language with less anxiety and pressure from the presence of others (cf. Alemi *et al.*, 2014). Based on our study, it could be observed that the robot also enhanced negotiations between children who then

helped each other. Therefore, the use of robots in language classrooms might be justified by their role as facilitator and motivator. From the teacher's point of view, when the robot is in the classroom, it might allow differentiation and the teacher can give more time to learners, who need it.

## 8. Conclusion

The RALL classroom ecology provided an overall framework for the present study. It seemed that the robot was a participant, that is, providing more than the usual affordances, such as textbooks and other teaching materials. It took the role of the teacher, for instance, by repeating the words and helping the children to pronounce the words correctly. In general, the RALL classroom discourse did not differ from the usual language classroom discourse based on the teacher-led IRE patterns. Due to pre-programmed lessons, the responses of the children to the robot consisted mostly of one or two words and repetitions of utterances by the robot. Thus, learners' agency in the RALL classroom discourse was quite limited during these sessions. The content of the children's utterances was also restricted to the robot's behaviour. The RALL classroom discourse appeared to be mechanical, the opposite of what is expected in the ecological perspective on language learning. Because the teachers have a great influence on what content and which technology is used in the classroom, further studies are needed on teachers' beliefs and attitudes toward the use of robots in language learning. The use of robots and artificial intelligence has the potential to enrich language teaching if it is used in a pedagogically meaningful way while considering ethical guidelines. The role of the human teacher is dynamic, and it is about to change as social robots enter the classroom.

## Ethical statement

The study was conducted in accordance with ethical approval practices at the researchers' institution. The anonymity of participants was ensured. There are no conflicts of interest to declare.

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