

Software Agents Supporting Second Language Learning as a Personalized, Collaborative and Lifelong Activity

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Abstract

Second language learning is as a personalized, collaborative and lifelong activity. In this paper we present a model of a second language learning environment based on software agents, integrating speech technologies and natural language processing from this perspective. We have developed this model based on previous research concerning technologies for the development of software agents supporting second language learning from the perspective of collaborative learning (Ayala & Yano, 1998) personalization (Ayala & Yano, 1996) and lifelong learning (Ayala, 1999; Ayala 2003).

1. Introduction

The development of new educational technologies requires to be based on sound learning theories, and to be implemented on the currently available information technologies.

The objective of this work is to present our approach for the integration of natural language and speech technologies, in the context of language learning theories and the current information technologies for the development of second language learning environments.

1.1 Second language learning is based on communication and situations

An emphasis in *communication* has been proposed as a guiding principle for speech technology research, producing emotional, immersive and personal experiences (Cole, 2003).

According to Carrol, language acquisition based on the communicative responses in the respective situations is considered to produce more permanent learning. A communicative approach to second language learning makes it more *subconscious*, informal, and implicit (Carrol, 86).

1.2 Grammar learning has a predictable order

Kraschen's *natural approach* is based on an empirical theory of second language acquisition, supported by scientific studies (Krashen & Terrel, 1983). According to the natural-order hypothesis, grammatical structures are acquired in a *predictable order*. Certain structures tend to be acquired early, while others tend to be acquired late. We acquire language structures by understanding input that is little beyond our current level of acquired competence. If there is enough input, the frontier knowledge structures will be covered *automatically* (Krashen & Terrel, 1983).

1.4 Second language learning is social

For second language acquisition, collaborative learning is considered the most appropriate method, because *language learning is a social activity* (Vygotsky, 78).

Together with the *individual knowledge frontier* based on the predictable learning order of grammar structures, there is a *social knowledge frontier*, based on the domain knowledge elements already acquired by other learners in the community. Both knowledge frontiers can be interpreted as Vygotsky's zone of proximal development of the learner in a group, which must be generated in order to maintain learning opportunities to the individual.

1.5 Second language learning is a lifelong activity

We are responsible of our own learning. Throughout our lives, we continue learning a second language in order to become more functional in a foreign society and its culture, which are in continuous change.

The desire for self-improvement in Japan presents major business opportunities, where 5% among all lifelong learning activities in 1999 was second language learning (Hall, 2000).

1.6 Second language learning and software agents

The current trend in the area of computer supported collaborative learning (CSCL) is the use of software agents. *Pedagogical agents* and *learning companions* manipulate the domain knowledge and are designed as interface agents that interact directly with the learner (Kirschning, 2001). *Mediator agents* are designed to mediate the interaction between learners and *information agents* find resources in the internet (Ayala, 1999).

2. Collaborative Learning

There have been some discussions on the application of Vygotsky's ideas in collaborative learning for second language (Renié & Chanier, 1995).

In the GRACILE project, we have designed our framework for collaborative second language learning based on Vygotsky's theory of social learning (Ayala & Yano, 1996; Ayala & Yano, 1998). We consider computer supported collaborative learning as: *"the use of the computer as a mediational device that helps the learners to communicate and collaborate in joint activities through a network, providing assistance in their coordination and application of knowledge in certain domain"* (Ayala & Yano, 1998).

In a collaborative learning environment, software agents are personalized components that assist the individual learner in her/his communication and collaborative interaction in a group, finding learners, configuring groups, and searching for domain knowledge resources.

3. Lifelong Learning

Lifelong learning market can be expected to increase in the near future. There has been an increment of learning activities independent of any institution or distance education program. Learning communities are emerging in the Internet, bringing together people who have *real and genuine learning interests*.

The use of information technologies in second language learning provides a powerful tool for lifelong learning (ISBE, 2004). We have defined a lifelong learning environment as: *"an Internet based environment that supports self-directed, generative and intentional learning, where software elements assist the learner in planning her/his learning activities, in order to meet changing society demands, supporting her/him to collaborate in the social construction of knowledge in a community"* (Ayala, 2003).

Supporting *self-directed learning*, a software agent keeps the learner aware of second language knowledge resources believed to be relevant for her/him.

Supporting *generative learning*, a software agent supports the social construction of knowledge in a virtual community, providing assistance to the learner in the organization and presentation of knowledge of the second language use of vocabulary, grammar rules and expressions.

Supporting *intentional learning*, a software agent helps the learner in the maintenance of a personalized learning plan and assistance in the configuration of discussion groups, based on the learning interests of the other members in the community.

Following this model, we have proposed an agent based lifelong learning environment for Japanese language learning (Ayala, 1999).

4. Personalization

Motivation in collaborative or lifelong learning environment depends on personalization, and this requires a *learner model*. A learner model is considered as *a set of beliefs held by the system about the learner* (Self, 1994).

The role of the learner model in a collaborative learning environments should not be to support tutoring or diagnosis, but to *enhance awareness and the relevant collaboration between learners*. In GRACILE, we propose to model the learner as an agent, in terms of her/his *mental state*, which refers to their capabilities, commitments and goals (Ayala, 1996):

- a) *capabilities*: both actual and potential capabilities, considering both, the structural and the social knowledge frontiers.
- b) *learning goals*: in terms of situations or speech acts.
- c) *constructions*, as examples of correct and incorrect application of second language domain knowledge elements (grammar structures, expressions and vocabulary).
- d) *commitments* to assist other learners in constructing a sentence for a specific situation or speech act.

A necessary task for the lifelong learner is to construct her/his personal *learning plan*. Learner model for a lifelong learning environment is used to maintain a learning plan, based on the capabilities and the *interests* of the individual learner and her/his peers in the community (Ayala, 2003).

5. Software agents for second language learning

Our model is based on the previous assumptions and on our research concerning the modelling of software agents for second language learning, based on artificial intelligence technologies (Ayala & Yano, 1998; Ayala, 1999). It provides a context for the integration of speech technologies and natural language processing.

5.1 Domain agent

Message production in a *input-rich natural environment* begins with single word utterances or short phrases (Krashen & Terrel, 1983). In a comprehensive input environment there will always be a correct model to imitate, because advanced learners can check the actions of the others, correct them when necessary and self-correct their own.

In our model, a domain agent assists the learner in both, recognizing a sentence given by the learner presenting a grammar analysis of it, and helping her/him in constructing a valid sentence, for an specific situation or speech act. It works based on a knowledge base in Prolog representing grammar structures and expressions, being able of natural language processing for short sentences in a limited domain. The sentences constructed and analyzed by the domain agent are provided to the *interface agent* (see below) for the generation of speech synthesis of them.

We have organized second language domain knowledge in *situations*, corresponding to speech acts, that appear in dialogs, for Japanese language (Ayala & Yano, 1998).

The structural organization of language patterns (grammar and expressions) in the domain knowledge, grouped in situations representing speech acts, gives a partial reference in the construction of the individual learner's structural knowledge frontier, considering that grammar learning has a predictable order.

Generative learning is supported when the learner, assisted by the domain agent, constructs short sentences and expressions, in order to communicate with others.

5.2 Mediator agent

For the collaborative approach of the model, the mediator agent assists the learner in finding other learners in the community, proposing the configuration of groups of interests, based on the learner models of the users of the learning environment.

Using the information contained in the learner model, the mediator agent can support the awareness in the group allowing the communication of the individual learners' goals, commitments and capabilities. Based on this representation the mediator agent is able to propose to the learner a set of *learning tasks* which imply the application of knowledge elements considered acquired by other learners, as well as *feasible, relevant, popular and frequently used* in the group. This results in an increment of the collaboration and assistance possibilities between learners, which implies the creation of *zones of proximal development* and therefore more learning possibilities (Ayala & Yano, 1998).

The mediator agent generates the personalized syllabus, as a proposal of learning tasks corresponding the application of knowledge elements in a given situation or speech act. Using a learner model, the syllabus can be generated based on an assessment of student needs (structural knowledge frontier) considering also her/his social context (social knowledge frontier).

In this way, the mediator agent generates zones of proximal development that correspond to those knowledge elements that can be acquired by the learner when s/he interacts with other members in the group.

Learner modelling implies a pedagogically structured domain knowledge, provided by the domain agent, as well as the application of belief revision techniques, in order to update the learner model through the changes in the capabilities and interests of the user.

Intentional learning is supported when the learner has a learning plan, maintained with the assistance of the mediator agent.

5.3 Information agent

During second language learning the learner is continuously processing linguistic information, noticing *regularities* in the structure of the second language. A language regularity may be a new vocabulary item or a new expression or grammatical construction that appears in a sentence which is understood and occurs in a particular situation (Carrol, 86).

An *information agent* travels into the Internet recovering sentences to be analyzed and registered as a valid examples to the domain agent, visiting those web sites believed of the interest of the particular learner, based on her/his interests registered in the learner model.. In this way, we provide awareness of knowledge resources

considered relevant for the learner, guiding her/him towards a self-directed lifelong learning attitude.

With the system SALLE (Software Agents for a Life-long Learning Environment in Japanese) we modelled an information agent, that works in order to determine real, relevant and truly useful material in web sites, motivating the discovery, use and sharing of language patterns, vocabulary and expressions by the learners in a learning community in the Internet (Ayala, 1999).

5.4 Interface agent

Second language learning is based on communication and situations. Language acquisition occurs only by understanding messages, obtaining comprehensible input. Language is better acquired when it is being used to transmit messages, not when it is explicitly taught for conscious learning (Krashen & Terrel, 1983). Acquisition takes place when people understand messages, real ideas, in natural, communicative situations.

An *interface agent*, as an animated talking head, applies speech technologies in the interaction with the learner. It allows immersive, emotional and personal interaction, anytime. The learner can practice the pronunciation of words and sentences constructed based on the domain agent's knowledge base or obtained in the Internet by the information agent. This interface agent is based on speech technologies adapted to Mexican Spanish by the TLATOA Speech Processing Group of our University (Kirschning, 2001).

6. Conclusion

We have presented our experiences in the modelling of software agents for second language learning, considering it a personalized, collaborative and lifelong activity. By developing educational technologies for second language learning, our final objective must not be just to improve human-computer interaction techniques, but to provide technologies that support communication between humans.

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