ELEna. An interdisciplinary research[1]

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This paper focuses on the description of the controversies that arise from the interdisciplinary work necessary for the creation of an on-line platform for learning Spanish as a foreign language, which we call ELEna. The platform develops the learning of written expression skills, thus promoting written production and interaction, the most demanded areas for the students of foreign languages nowadays. In this way, it has been necessary to create an interdisciplinary team made up of linguists and computer scientists who are specialized in the fields of Spanish language teaching and in the creation of interactive on-line platforms. This fact has led to a series of challenges that we present below with their respective solutions in pursuit of scientific progress.

Keywords: technology, language learning, on-line platforms, interaction

1. Introduction and motivation

The following interdisciplinary research try to explore the technological framework as well as the linguistic guidelines that are being applied on an ongoing project for the development of a dialogue system for language learning. This environment imposes critical requirements to the whole architecture and the design of the different modules and departments involved. On one hand, computer researchers and, on the other hand,

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researchers on linguistics. This interdisciplinary situation causes several controversies.

The study on the relations between linguistics and technology provides us with a considerable repertoire of theoretical and normative discourses, objective register of the state of the discussions in the last decades on this interaction, with important practical repercussions about efficiency levels and language learning organization (Gómez Fernández, 2013; Moral, 2006; Fernández, 2005).

In addition, the emergence of technology in everyday life has modified training habits. In particular, e-learning has not only grown exponentially, but also been the central topic of research (Cabero, 2010; Barberá, 2008; Trujillo, 2005), as it has been shown to be functional and because it generates a lot of learning experiences. (Donnelly, Kirk and Benson, 2012: 5).

The application of language technologies in non-native environments still represents a major research challenge. In addition, if this non-native environment must integrate a solid and comprehensive learning orientation, we are facing one of the most demanding environments for the application of Language Technologies.

However, this scenario represents a significant industrial and commercial opportunity. Moreover, in the context of the goals specified for a Multilingual Europe and a Multilingual Digital Single Market, the application of language technologies for language learning represents a key intersection between a research challenge and an industrial opportunity. This item has been a main controversy. We were crossing borderlines between computer and linguistic sciences with an economy and marketing point of view.

More than 1.5 billion people are currently learning a second language world wide. The estimated market size for 2013 just on digital English reached $1.8 billion. The compound annual growth rate for the period 2013–2018 exceeds 11%, with a forecast of more than $3 billion by 2018 (Adkins, 2014).

Moreover, only 5% of the Language Learning Industry relies on digital components. Accordingly, language learning products in general are becoming the largest business opportunity in the international language learning market.

During the last few years, a significant number of key improvements have appeared on the field of Language Technology. Speech recognition, multimodal interfaces, machine translation or dialogue systems constitute some of the key technological platforms. Its integration with convergent areas like robotics, big data, cloud computing, machine learning, and so on, will determine the immediate future. Learning environments and platforms constitute an additional convergent area.

In fact, using technology to improve the educational process and outcomes has been a classical and persistent goal during the last decades. However, regarding the use of technology for language learning, it is important to take into account that language itself is one of the most pervasive and complex processes, as it involves many knowledge levels and skills. Therefore, the application of technological developments and methodologies for language learning has been and it is still a critical research challenge.

The value added to the idea stands in the computer-aided learning, much more affordable than face-to-face teaching, and the ease for the platform access in terms of time and resources, in other words, we provide the possibility of accessing through any mobile device with internet access without schedule restrictions.

There are currently lots of apps for language learning but a shared feature among all of them is that they offer a completely guided process for the language itself that may be useful for reviewing previously acquired concepts and skills.

In our case, we are looking for a more advanced step in learning through a free conversation simulating dialogues with a native speaker that could provide needed capabilities for the improvement of target language.

One of the long-term goals of the project that it's in mind should be the possibility of certifying his/her studies by means of some official institution. Moreover, this can be a source of motivation for the student.

Adkins report is published by Ambient Insight, a company that pretends to produce market studies and predictions about business opportunities based on learning technologies. In this report some five years in the future projections are made, from 2013 to 2018, and collect consumption data from more than a thousand providers of products related with language learning abroad more than 98 countries all over the world.

It's predicted a growth in the in the learning of English language through digital media over 20% in Africa and almost 15% in Asia, Latin America and Eastern Europe among other regions. Countries of emerging economies such as Mexico, Turkey, Brazil and Saudi Arabia also stand out in growth for this period of time. Although the crucial point here is the trend to a greater digitalization of language learning worldwide. This trend has currently a very low market share so it can ve conceived as a great opportunity for business development in mid or long term.

Nowadays, as stated previously, the language learning relies on traditional learning, let's say, a combination of face-to-face classroom classes and printed material. So only 5% uses digital media, so this fact allows a big growth potential at least in the next 5 or 10 years.

At global level, the following key factors are considered for a reconversion of the sector towards the digital era:

- Large-scale initiatives in academic segments.
- New government policies to increase a foreign language acquisition.
- High demand of customers in digital products and software, especially in the mobile application sector.

The current products related with digital language learning base its money income in a subscription model directly marketed to potential client in internet, social networks and content providers. Curiously, most of current companies are subsidized by national and regional governments and by non-governmental organizations.

1.1 The context

In this area of opportunity and relevance, our research focuses on the teaching of Spanish as a foreign language. The increasing demand of Spanish is leading to an equally growing interest about how to improve its teaching (Martínez, 2007; Robles, 2006). We present an international and transversal project characterized by a high degree of interdisciplinarity which improves research but also increases complexity. To deal with this inconvenient, each team (linguistic and computer) works in its own field with a member specialized in intermediate tasks who connects both groups with the ultimate goal of improving student performance and motivation thanks to the creation of ELEna. This e-learning platform aims to provide a conversational system to facilitate natural interaction through speech between the person and the computer (Llisterri, 2006).

ELEna emerges as a business initiative within the so-called start up companies with the previous experience of Milao Language Inc. (Jiménez Palmero, 2015; Quesada, Nunez & Suárez, 2013)

It was in 2016 when a group of researchers from the Department of Computer Science and Artificial Intelligence and the Department of Language, Linguistics and Theory of Literature (University of Seville) started to work. In 2017 another team of the department of philosophy joined in the context of an international project with a team from the University of Malaga. In addition, we worked together with a specialized member in economics and marketing who offers the point of view in order to the viability of the project as a company in the context of the pre-incubation and coworking project of the University of Seville. All of them put together their efforts to come up with a platform that allows students to practice conversation skills outside the class.

The oral skill is one of the most complicated abilities for students, especially for those who do not have a cultural immersion experience. In addition, other companies in the sector have created a void because they have not tested it yet because they chose a more comprehensive and global learning system, so they do not focus specifically on this skill. For example, in the case of Duolingo or Babbel they contemplate learning based on e-learning target that cannot be used in face-to-face classes. Radically on the contrary side is the bet made by ELEna since it is intended to be a complement of the classroom with the objective of encouraging conversation exercises outside the classroom.

In short, ELEna has been conceived as a comprehensive system which integrates different technologies and approaches. In addition, the platform is based on an implementation of gamification strategies on CALL (Computer Assisted Language Learning) environments.

The organization of the human resources has two well differentiated teams in its practices and objectives. On the one hand, a group focused on designing the pedagogical and linguistic model in charge of methodological planning. On the other hand, a second team work in translate the methodological specifications proposed by the first group to the computer program and also focusing its efforts on the infrastructure and systems management.

Currently, the project is in the testing phase. It has already been tested with students from the University of Iceland (Háskóli Íslands) in Reykjavík and is currently operating at the University of Lisbon. A third and last test in France is planned to confirm the positive results obtained in Iceland.

Undoubtedly, the main challenge is to make a fully open and flexible dialogue with the students. As a consequence, students are encouraged to engage in conversation, not just doing homework like other similar platforms.

At the moment, the platform has the possibility of having conversations in Spanish with an initial level dealing with understanding spoken and written expressions. However, it has been designed in order to allow the incremental incorporation of additional learning levels and languages. Furthermore, we will not only use writing skills. In the future oral conversation will be implemented.

To sum up, ELEna is a platform for an educational virtual environment of Spanish as a foreign language (ELE) which enables students to interact in diverse dialogue scenarios designed on the latest developments in the field of Natural Processing Language (NPL).

Taking into account that learning a human or natural language requires the acquisition of a lexical and grammatical background, but a human language is mainly a communication tool; and therefore, an operative learning requires an interactive use. Undeniably, linguistic immersion is the

most effective strategy for language learning. However, a big percentage of the world population does not have the required resources to allow such strategy. Even classical teaching strategies are not able to cover the whole market.

As a consequence, a systematic and coherent approach for the application of language technologies to the generic market of language learning will become a relevant industry in the next few years.

Conversational Interaction Technologies will play a crucial role in this process. However, specific constraints conditionate the possibilities as well as the right approach to be effective. In particular, it will be necessary to integrate the technological environment over a sound methodological framework.

2. The technological, methodological and linguistic framework

We are working towards one of the main goals in the current trends in the research and development around Computer-Assisted Language Learning environments: the creation of interactive interchanges where the learners can improve their linguistic skills by engaging themselves in natural conversations or even mimic real life scenarios.

The use of Language Technologies as a tool for the development and deployment of Language Learning platforms is a relatively unknown area of research and innovation. In a review about the application of language technologies to education, Eskenazi (2009) concluded that “appealing systems that incorporate spoken dialogue and games are at the leading edge of the field, (...) they will soon be central, providing not only tutoring, but also testbeds for the development of new algorithms and strategies.”

The SLS group at the MIT plays a crucial position among the main precedents in this research strategy (Xu & Seneff, 2011). The motivation of its research project is quite significative to understand the technological approach: “It is widely recognized that one of the best ways to learn a foreign language is through spoken dialogue with a native speaker. However, this is not a practical method in the classroom due to one-to-one student/teacher ratio it implies. A potential solution to this problem is to rely on computer spoken dialogue systems to role play a conversational partner.”

A perfect simulation of these scenarios is a great technological challenge at the moment. Nevertheless, we are working on the creation of the tools required to chase the aforementioned global goal.

About linguistic framework, we have consulted the main books of learning Spanish as a foreign language (A level) and we have combined the

similar contents to give the student the possibility of practicing that knowledge seen in class.

- Nuevo avance (Moreno, Moreno & Zurita, 2010):

  • Thematic contents: Spanish speaking countries. Classroom. Public places, famous people and their professions. The family tree and family relationships. Personal photos.

  • Lexical contents: similar words in several languages. Communication in the classroom. Days of the week, the time, places and public spaces, most usual regular verbs. Family members. Civil state. Jobs. To know and to meet: differences in use. To go and to come: differences in use. Phrases with the verb to have.

  • Functional and sociocultural contents: spelling. Formal and informal greetings. Courtesy. Basic resources to communicate in the classroom. Spanish proper names. Names of the countries of Latin America. To ask and to answer about the time, about the date, personal questions, about habitual actions, about schedules, to request and to give information in general. To express the relationship or possession. To express more habitual actions. To describe personal photographs. The Spanish schedules. The independence of children in Spain.

  • Grammatical contents: the numbers from 1 to 10. Present of the regular verbs in -ar, -er, -ir. The interrogative pronouns. Contractions to and from. Prepositions: in, of, a. The numbers from 11 to 30. Present of the irregular verbs to do, to leave, to put, to bring, to give, to be, to know, to offer, to lead, to translate, to have, to say, to hear, to be and to go. Adverbs, expressions and locutions to express the frequency. The possessives. The cause: because + verb. Some prepositions that indicate time.

  • Spelling content: b / v – c / qu / k – c / z – g / gu g / j – h – r / rr

  • Phonetic contents: phonemes of Spanish.

- Nuevo español en marcha (Castro Viúdez, Díaz Ballesteros, Rodero Díez & Sardinero Francos, 2010):

  • To say hello and to introduce yourself in class and someone else. Gender of nationality adjectives. To give personal information. Plural of the names. To talk about daily routines. Reflexive verbs: getting up, going to bed. Present of irregular verbs: to start, to go back, to go and to go out. Prepositions of time: to, from, by, at.

  • Alphabet. Spelling. Resources for the class. Jobs: gender. Present of regular verbs. Present of irregular verbs: to be and to have. Pronunciation: interrogative intonation. Place markers: below, above, to

the side, in front, behind, in, in, to the right and to the left. Possessive adjectives. Demonstrative pronouns. The days of the week. To talk about work: place, job and schedule.

• To give the phone number and address. Numbers from 0 to 20. To ask and to tell the time. World hours. Numbers from 21 to 5000. Pronunciation and spelling: stress. To talk about breakfast. Breakfast of the world. Pronunciation and spelling: g.

• Treatment greetings. Habits and schedules of the Spanish people.

○ Nuevo prisma (Gelabert & Menéndez, 2013):

• Functional contents: To say goodbye. To ask for confirmation and confirm previous information. To ask how something is said in another language. To ask for clarifications and repetitions. Spelling. To ask for and to give personal information: name, age, origin, place of residence, profession, to talk about the profession and the place of work. To talk and to ask about personal relationships. To ask and to give personal information. To express possession. To describe people: physical description, character, clothing.

• Grammatical contents: subject personal pronouns. Verb to be. Interrogative pronoun: how? The determined article. The gender and the number of the name. Concordance of the determined article and the adjective with the name. Interrogative pronouns: which? what? how many? Possessive adjectives. Adjectives of physical description and character. To be, to have and to carry.

• Types of text and lexicon: brief dialogues. Nationalities Lexicon of survival in class. Names of countries and continents. Descriptive text of personal information: form. Lexicon of the class. The colors. Jobs and places of work. Journalistic text Lexicon related to family and social relationships. The physical aspect, the character. Clothes.

• The strategic component: to relate information through the images. Strategies for lexical acquisition through images. Resources to use the dictionary

• Cultural content: courtesy treatments in Spain and Latin America. Spanish names and surnames. General information about Spain and its autonomous communities. Some famous people with Hispanic origin. The family: concept and structure. Famous people in the Hispanic world.

• Spelling / phonetics: Question marks and exclamation marks. The alphabet. Abbreviations. The syllable. contrast g, x, k. The graphs g / j.

○ Sueña (Álvarez Martínez, Blanco Canales, Gómez Sacristán & Pérez de la Cruz, 2000):

• Functions: greeting, spelling, introducing oneself, to ask and to say the name and surnames, the origin, the languages spoken, age and job or studies, to request and to give information about the meaning and form of the words. To say hello and goodbye. To introduce someone and to respond when asked. To ask and to say the address and the phone number. To answer the phone and to ask for someone. To express family relationships and to talk about family members. To express habitual actions and how often we do things.

• Grammar: Subject pronouns. Being + nationality adjective; to be + name of city or country. Gender and number in nationality adjectives. Interrogative pronouns: how?, from where?, how many (years), what?, what? Numbers from 0 to 100. Forms of treatment. Demonstrative pronouns. Contract forms. Concordance in gender and article number and demonstrative. Interrogatives: what?, where?, when?, how many?, how?, what? Gender and number of family names. Present indicative of the most frequent regular and irregular verbs. Reflexive verbs. Possessive: unstressed forms. Interrogatives: who?, what?, how many?, how?, where?, presence of the article with the days of the week. Frequency expressions: always, normally, often, sometimes, never.

• Writing: spelling. Alphabet. Types of writing. Personal and professional information (passport, student card). Abbreviations. Diary. Date and address in an envelope.

• Phonetics: first approach to the pronunciation of the letters. Intonation of enunciative and interrogative sentences.

• Lexicon: greetings. Name and surname. Countries, nationalities and languages. Studies and jobs. Greetings and farewells. Parts of the day. Presentations. Addresses and telephones Fundamental public places. Jobs. Work places. The family. Civil status. Days of the week. Usual actions.

• Culture: famous people of the world.

○ Vuela (Álvarez Martínez, Blanco Canales, Torrens Álvarez & Alarcón Pérez, 2005):

• Functions: to say hello and goodbye. To present oneself. Personal information. To ask and to give personal information: first and last name; age and date of birth; home; email; languages to be spoken. To express tastes and interests. To talk about habitual actions and customs. To talk about actions that are carried out not frequently. To ask and to talk about how often we do things. To express kinship relationships. To describe people by their physical characteristics.

• Grammar: Nationality adjectives: gender and number. Interrogatives: how?, what?, where?, how many?, why? Present of indicative of want and like + infinitive. Good, bad and regular adverbs. Present of indicative of verbs of habitual actions. Irregular verbs. Reflexive and pronominal verbs. Prepositions by and of for the parts of the day / absence of preposition for the days of the week. Frequency markers: never, sometimes, often, normally, always. Gender in kinship nouns. Concordance. To be / to have / to carry for the description of people. Demonstratives.

• Lexicon: greetings and farewells. Countries and nationalities. Numbers from 0 to 50. Sports. Parts of the day. Days of the week. Habitual and daily actions. The family. Adjectives for the physical description.

• Structure / Phonetics: the vowels of Spanish. Registration form. Personal files. Representation of r and rr.

○ ¿Sabes? (Ding, De Prada Segovia, De Juan Ballester, Couto Frías & Salazar Lorenzo, 2010):

• Communicative functions: to say hello and goodbye. To introduce yourself and someone. To ask and to answer for the identity, for the nationality and for the name. To talk about languages, jobs and places of work. To ask and to answer for contact information. To describe people. To ask and to answer about age.

• Grammatical contents: Spanish alphabet. Subject personal pronouns (three persons of the singular), nationality adjectives. Demonstrative. Possessives. Interrogatives. Verbs: present to be called, to be and to speak. Subject pronouns (three persons of the plural). Singular and plural. Numbers from 0 to 20. Article determined and indeterminate. Colours. Gender concordance and number of adjectives with nouns. Verbs: to call, to be, to talk, to work and to dedicate. Possessive adjectives. Adjectives. Demonstrative adjectives in the plural. Numbers from 21 to 100. Present of indicative of the three conjugations: -ar, -er, -ir. Verb to have.

• Cultural differences: names and surnames. The greetings in Spain. Countries Nationalities Languages. About personal identification numbers. The Spanish family.

• Vocabulary: Jobs. Work places. Contact information. The members of the family.

2.1 Communicative competence and dialogues

Within the global area of language learning, our main focus and concern concentrates on Communicative Competence. Accordingly, we are working on a framework that has been designed to prioritize this linguistic factor during the learning process. The main strategic consequence of this approach is the requirement of a sophisticated and very advanced design of Dialogue Interactions. Therefore, the technological core is a Natural Language Processing tool specifically designed and tailored for Language Learning. Mainly, we have been working in this items:

- The logic of a dialogue interchange. Input and output.
- Feedback evaluation like spelling checker (the system must be able to detect any spell mistake. But checking the spelling is a real challenge in NLP in general even more so in its application to Language Learning in particular).
- The ability of the system to have both a proactive and a reactive attitude.
- The design of the system must allow a dynamic flow of the conversation incorporating new topics when needed or even replying accordingly to the topics introduced by the student.
- In order to effectively rate a learner communicative competence, it is often necessary an in-depth analysis of the semantic and even the pragmatic dimensions of the conversation.
- Accessing external information (A conversation cannot be reduced to a self-contained structure either).
- Language levels A1, A2, B1, B2, C1, C2 (Instituto Cervantes, 2006).
- Student's age and place of birth with special attention to intercultural aspects.
- The impact of gamification strategies (Jiménez, Quesada, Salguero & Quesada,
2017)

2.2 Open domain dialogue systems challenges and difficulties

The most thrilling feature of ELEna platform will be the offering to the final user of an open and free conversation with a simulated language teacher. The conversation topic can be driven by the system but it must be able to deal with open questions and even topic changes if user wants.

The main technological challenges that a dialogue system must face in order to achieve this requisite are (Glass, 1999):

Human dialogue modeling

Human conversations contain phenomena like disfluencies, interruptions (in spoken dialogue systems), confirmations, rejections, turn-management dialogue acts, anaphora and ellipsis (in both spoken and written dialogue systems). Many of the utterances simply can't be well understood without the context of the conversation in which they occurred. So context modeling for the dialogue should be implemented and used.

The study of the human-human interactions can drive us to implement such features in our system so we could make a system to have more natural dialogues with humans. But these features also have the potential to make things more complex and ambiguous.

Another key point here is that humans really apply pragmatic skills to handle the dialogues and its ambiguities. For example, "Do you know what time it is?" won't be answered by another human with (only) a "Yes" or a "No" because pragmatics (let's say also your personal experience) tells you to answer the current time although we have a propositional question that, at least in theory, should be answered with an agreement or a disagreement.

The pragmatics skill implementation is another research field in its own and there are some promising works that involve knowledge modeling and representation, machine reasoning and common sense implementation driven by experience and reinforcement learning.

Matching expectations with system skills

Expert users are familiar with the system capabilities, or at least to a subset of them, so they change their utterances according to the expected capabilities of the system. But novice users can have more difficulties to adapt their expectations. Typically, this issue can ve overtaken if the system drives the conversation with questions that are known to be answered with shot and not ambigous utterances (propositional or choice questions). But this can lead to lack of naturalness and of course it can't be used to improve the communicative skills of the user.

So, the model is changed to a mixed-initiative strategy which provide more freedom to the student. This total freedom can be dealt by the system by means of some kind of "help" capability that can be used to address the proper topic or domain. But this is not an easy-to-implement skill: Users are not really sure about how to ask for help and identifying those help requests by the system is a complex task on its own.

In addition to the lack of knowledge about the domain, the user even doesn't know about the range of that domain. For example, in the context of

a medical appointment booking lesson, system could ask about the city where the user wants the appointment but the machine has only a certain amount of cities or towns in its lexicon. So a mechanism that detects an out-of-vocabulary word is needed in order to offer the user what cities the system knows without having to list them all.

Another important issue comes from the wide variety of speaking styles that users can use. From isolated words (U: 'Seville'), to cryptographic utterances (U: 'Appointment, Seville'), to being extremely chatty (U: Yes, hello, ok, I would like to book an appointment for the doctor in Seville but tomorrow because the day after tomorrow I'm on holiday in Valencia).

Recovering from errors

Errors in dialogue system can come from a wide variety of sources, in written dialogue systems the main ones are lexicon missing words, parsing coverage and understanding failures and it's even difficult to detect that there has been an error, what was the reason of that error and to compose an appropriate answer for the user.

Many systems use a confidence scoring scheme that allows to refine the source of error and its correction but it seems that some more advanced grounding mechanism (in the sense of how to establish common knowledge between human and machine) is needed to improve the error handling of such systems.

Implementation Strategies

There are many ways dialogue managers can be designed and implemented but most of them use a scripting language to determine the flow through the dialogue. But this scripting mechanism can be faulty when we have an open domain conversation.

One useful technique is the dynamic activation/deactivation of some understanding features like lexicon or grammar rule sets accordingly with the topic or active question under discussion.

Anyway, the dialogue strategies are quite often hand-crafted so this can become a time consuming task whose can't be generalized to other domains so a good dialogue strategy modeling could be crucial for the reusability of the chosen implementation.

User student status

This challenge is specific of our platform due to the fact that it's going to be used for language learning so we face with users that:

- Are learning the target language: So there will be failures because the user is still learning that language.

- Will not understand partially or totally the system utterances.
- Will not follow accurately the grammar rule set of the target language.

These sources of failures can be dealt together if we provide the system with enough robustness that grounding and error handling schemes can help to achieve. In addition to this we should add to the platform some other features like:

- Spell corrector: minor changes in lexicon contained in user utterances can have a great impact on robustness so spell corrector that maps the incorrect word to the correct one is a must have.
- Grammatical noise system: We can have the possibility of ignoring some of the detected words if a grammar rule can be applied to the rest of the sentence. This will improve the parser robustness (and thus, the system language understanding phase will be improved its performance) so, we will have the opportunity to evaluate the student skills in order to provide some reports at the end of the dialogue.
- Machine learning module: Another fashionable area of researching is to include automatic learning methods into understanding stage. These systems are more robust than rule-based system and context free grammars. But they are based on the processing and learning algorithms that require a big annotated corpus. That corpus can be built only after great effort and time consumption, although we have another possibility in a research line that is called right now “user simulation” that tries to get the corpus automatically with some interesting results. Anyway, a hybrid approach, taking the advantages of rule-based models and machine learning models is a path to explore and evaluate.

Natural Language Generation

Once the dialogue manager composes the answer, formatted in an abstract representation, it must be passed to natural language generation (NLG) stage to send a grammatically correct sentence to the student. The most of NLG system tend to be very static because they use a fixed pattern response for every situation. But introducing some variation in the way system prompts user is effective in making the system appear less robotic and also becomes important in reducing monotony of responses.

Student evaluation

One of the major challenges when creating the platform was to decide how to evaluate student performance for every possible dialogue made in the platform. This is a crucial point because system should deal with student errors and system errors as well.

Some metrics have been accorded to inform the user if the dialogue was successful or not. For example, one of the metrics is called “Fluency” and its based in the time needed by the student to answer some question that the system asks. Other interesting metric is to evaluate proactivity in the user. For example, if system ask student name it would be desirable (as well as a communicative skill) that the student asked the system’s name.

3. Research challenges

Natural Language Processing is a very well known and established field of research and development, with many worth-noting and outstanding systems and applications created during the last few decades. Inside this field, Dialogue Modeling plays a crucial role, as it comprises all the main components and algorithms of Language Engineering.

At a high level of specification, a dialogue system should incorporate the following main modules:

- Natural Language Understanding (NLU): in charge of the lexical, morphological, grammatical and semantic analysis of the input received from the user. This module must generate a final representation of the meaning of the whole utterance.
- Dialogue Management (DM): different techniques and algorithms has been documented and applied to control the dialogue structure, from finite state automata till knowledge-based mechanisms, game-based strategies, statistical and machine learning frameworks, etc. The dialogue manager must organize the conversation as a set of tasks, and cooperate proactively with the user. This component must model the conversational scheme, receive the formal input generated by the NLU component and produce a formal representation of the corresponding output.
- Natural Language Generation (NLG): this module will receive the formal representation generated by the DM and will produce the exact realization of the formal model into a natural language utterance, depending on user preferences and/or current competence, etc.

Our technological framework is based on this basic and global approach. Nevertheless, the language learning environment has been proved as one of the most demanded and challenging.

When we set out to design an interface for dialogue and learning, our proposal was to make it useful for people and, at the same time, try to solve certain underlying problems that arise when designing a Dialogue System (DS). In the tension between the design of a useful and effective tool and the resolution of technical and theoretical problems, a new controversy also appears between the theoretical and the applied stuff.

The first problem is to describe those aspects of the behavior of human agents that interact with the system and that are not completely rational or, at least, are not predictable by a classical logical model. Human agents behave as non-ideal agents, while our DS must be as transparent as possible for its users. The interaction between an artificial agent – our DS – whose task must be to deal with human agents that make mistakes, has to be modeled in real time, while the communicative interaction takes place.

Dialogue Systems are defined as computer programs that accept as input speech acts that may be incomplete and that produce as output a new act of speech that must be clear to the human user. For this, the design of the DS should be maximally usable and the interaction tasks should be defined in the simplest way we could manage. Of course, we can imagine that this design of the DS is as versatile as possible, to implement it in different environments, but the one that concerns us is a language learning environment and we have to stick to it.

The human ability to learn through dialogue is a high-level cognitive capacity that requires the use of inferential processes of contextual elaboration and metacognition (attribution of knowledge or presumption of ignorance). The DS must be able to mimic this ability so that learning can be as natural as possible.

What we propose, therefore, is how we can make the SD handle all those linguistic phenomena that suppose a semantic enrichment of the discourse: presuppositions, lexical relations, metaphorical transpositions, etc. For this we have decided to analyze the role of the underlying logic in the interpretation and contextualization of dialogue processes in order to design formal models that represent the meaning of various speech acts in the NLU and NLG modules of our DS. The logical inferences necessary for the correct interpretation of speech acts in dialogue are defined as dynamic processes (programs) that lead from an initial “mental state" to a final state as a result of the successive application of well-defined logical rules on the preceding mental states. These inferences are involved in the interpretation of the communicative intentions of human agents, even when they make mistakes or the information they offer is not complete. Therefore, in the dialogue inferences become a fundamental part of the mental representation of the successive interpretations of the speech acts, necessary to give them meaning with respect to the mental states previously declared (states of information) and the mental states that the epistemic agents that intervene in the dialogue are ascribed to each other (cognitive states).

This is the way in which speakers establish the lexical and semantic relationships necessary to relate concepts in the dialogue, establish the essential presuppositions to give meaning to certain speech acts (for example, indirect speech acts), and extract the implicatures that contribute knowledge about the actual cognitive states of the interlocutor (human or

artificial), essential for the interpretation of semantically unrelated expressions but that are linked in the same context.

So, in our DS design, we consider communicative acts as processes of information flow between two or more epistemic agents, dealing with dialogue as the paradigmatic act of communication, defined as a sequence of speech acts in which the following requirements are met:

1. All epistemic agents involved share identical or similar language skills.
2. All epistemic agents change their mental states in each intervention.
3. Information flow between epistemic agents is continuous during the dialogue – interruptions can be treated as noise – and is subject to feedback.

As we know that the information provided by each speech act in a dialogue does not always represent a complete informative state – mainly due to noise, not fully referring expressions, lexical or structural ambiguity or the lack of a well-defined discourse domain – we need to consider it should be increased or supplemented by means of rational inferential processes by the epistemic agents involved in dialogue. Of course, these inferential processes operate over previous informative states as well as over those cognitive states attributable to the epistemic agents, what requires an Abductive Dynamic Epistemic Logic to be modeled as the underlying logic to any DS, in our opinion.

4. Controversies and interdisciplinary work

On the other hand, the socio-educational debate has been focused in the last decades on optimizing the results of language learning, even before being impulse by technological development. Nowadays, linguists, pedagogues and economists work together addressing the complex interactions between education, language skills and employability (Sáez, 2000), as a necessary solution to the challenges and recent changes in the labor market in the European Union caused by the financial crisis.

In this area of opportunity, we have to work hard in an interdisciplinary way if we want to get positive results. For this reason, we had been facing several controversies.

The researchers of the group belong to two departments with different particularities. On one side, the Department of Computer Science and Artificial Intelligence from the University of Seville and, on the other side, the Department of Language, Linguistics and Theory of Literature. We have different specific objectives because, while linguistic areas are interested in

how to teach and improve student's level, the computer area is looking to create a virtual human.

This is the reason because we needed to look for common points such as Natural Language Processing. In this way, we have found interesting objectives for both teams that allow to resolve the crossing borderlines controversies.

Another controversial aspect has been observing what other companies have been done. This field of work is currently dominated by several institutions such as Duolingo and Babbel. They are reference in the sector. However, not everything they do must be necessarily correct. For that reason, we have analyzed advantages and disadvantages as well as the gaps in which they do not work in order to differentiate our product. That is why, mainly, we seek the real conversation without limits, even if it is a really difficult challenge to achieve.

We have recently joined into a Explora Project (Ref: TIN2015-72709-EXP). This, on the one hand, allows us a very solid basis for investigation but, on the other hand, the work group is added with a new department (philosophy) as well as a new university (Malaga). This reinforcement is also positive because it offers the possibility of expanding human resources as well as new and different points of view.

Last but not least, it is the point of view of Economics and Marketing. This is really our main controversy because the project members have no specific training in this field. To be able to solve this controversy we have been guided and we are being helped with a specialized mentor ascribed to the pre-incubation and co-working project of the University of Seville that we obtained in competitive concurrence as one of the projects with better future. In this way, we hold weekly meetings with the specialist who give us tips from an economical and marketing point of view.

5. How to move forward

One of the main challenges is the design of strategies to understand utterances produced by non-native speakers. This problem cannot be reduced to the spellchecking phase. The literal translation from structures in the student's native language, in conjunction with all the standard types of mistakes made by language learners, represent a main challenge in the global design.

We have to point out that evaluating a complete dialogue is a complex challenge. Additionally, as our main goal concentrates on communicative competence, the evaluation scheme must carry out this idea. Currently, our evaluation scheme is based on three main criteria: accuracy, fluency and intent. For each criterion, a specific number of factors are analyzed.

However, we are testing our platform to improve the evaluation design. We have just tested it in Iceland and Portugal but we will need more students so we could compare our results with french students.

To continue with the research, we must expand the levels that we currently have prepared. In this way, we will be able to cover all the types of students and not only those at the initial level.

In addition, it will be fundamental to be able to compete with other similar applications to have a wide range of learning languages and not focus our efforts just in the Spanish language. In this way, we will be able to fulfill the marketing objectives and to have a profitable economical vision.

Maybe these controversies emerged so far in our research might seem natural, given the interdisciplinary nature of the investigation, but they need to be solved in order to keep moving forward.

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