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USE OF ENGLISH IN THE SCIENTIFIC COMMUNITY IN FRANCE: OBSTACLES AND STAKES

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Abstract. English as a *lingua franca* (ELF) has emerged as a way of referring to communication in English between speakers with different first languages. That is the reason why ELF is the language used in science. Yet language is not limited to communication; it is also tied to the creation of concepts. As English is developed and transformed by its non-native users into an international scientific communication language, there is a risk of developing an impoverished form of English. The use of English as a *lingua franca*, devoid of culture, and used in scientific discourse may affect the transmission and the production of scientific knowledge. We can wonder about the consequences of the development of English in the scientific academic community and scientific teaching and learning contexts as all French university curricula have integrated English. Thus, this paper examines the different representations of science and the English language used in science. In conclusion, we propose the development of research in English for science, teacher training, teaching English for science and science in English (Content and Language Integrated Learning; henceforth CLIL) to students in the language teaching sector for non-linguists (LANSAD in French).

Key words: representations, science, language, English as a *lingua franca*, knowledge, language teaching sector for non-linguists

INTRODUCTION

English has become the language of science. It is used and regarded as a *lingua franca* because everybody shares the conviction that science is universal (Lévy-Leblond, 2004: 104), so is its language. Despite being welcomed by some and deplored by others, it cannot be denied that English functions as a global *lingua franca*. In the last ten years, the term English as a *lingua franca* (ELF) has emerged as a way of referring to communication in English among speakers of different mother tongues and lingua-cultural backgrounds, including native speakers of English, who may use ELF as their additional language for aims of intercultural communication (Seidlhofer, 2005). What is distinctive about ELF is that, in most cases, it is 'a "contact language" between persons who share neither a common native tongue nor a common (national) culture, and for whom English is the chosen foreign language of communication' (Firth, 1996: 240).

Most of the time, language is exclusively considered for communication. It has been forgotten that knowledge owes its existence to language and thus

creates the scientific product. The product has to be designed in the scientist's mother tongue since it will be better thought about and expressed. As English is developed and transformed by its non-native users into an international scientific communication language, there is a risk of developing a form of Globish which is an impoverished form of English that serves as a basic tool in international communication. Hence knowledge and science are in danger because language conceives knowledge (Nicolas, 2012: 112).

We can say that there are two main positions:

- language is (only) a means of communication;
- language is the material in which knowledge is developed and which is the scientific product (Trabant, 2011: 20).

These two positions are generally deemed as alternatives instead of being complementary. Yet a major issue should be taken into consideration. ELF is used in science not only to communicate but also to transmit and produce knowledge. Communicating is not sufficient; understanding is also a key feature. Unlike communication, which only deals with inputs and outputs between transmitters and receivers, understanding is necessarily a reflexive process and means understanding each other but also to understand oneself (Supiot, 2013). According to Lévy-Leblond (1996: 246), the production of knowledge not English is the problem.

This article examines a reflective question on the development of English in the scientific community with a specific concern for French higher education (teaching English in the French university science degrees – an educational sector of languages for non-linguists called *Langues pour Spécialistes d'Autres Disciplines* in French – LANSAD). Here it is hypothesized that serious consequences are expected for the production and transmission of scientific knowledge if ELF is used in the scientific community. The link between the issue and our research domain as a teacher of scientific English and researcher in English for science at the university level is specified. Once the consequences of using ELF both in the scientific community and in scientific higher education have been discussed it is possible to start defining teaching English for science efficiently at universities to thwart the development of an impoverished form of English in the scientific community. Finally, the development of research in English for science, teacher training, teaching English for science and science in English to students is proposed since all French university curricula have integrated English.

STATE OF THE ART

The question of languages in the different disciplines has been debated in the European community for a long time particularly in the dialogue at the conference *Science and Languages in Europe* held in Paris in 1994 and collected in the book by Roger Chartier and Pietro Corsi (1996). The book focuses on languages in science, from a diachronic perspective with the opposition of

vernacular languages and the universal language, then between natural languages and the perfect language with the search for the ideal language of science and finally, between vernacular languages and vehicular languages. This was the case with Latin as it is with English in the contemporary scientific community, for example, in the proceedings of the symposium held at the University of Quebec in Montreal in 1996 on *French and the scientific language of the future* with a focus on French, and more recently in the Franco-German journal *Trivium* in 2013 in the issue *Science thinks in several languages* in the case of cultural studies. This is not a problem that refers to linguistics only. The issue is much more a fundamental question: how do scientists from different linguistic and cultural areas communicate with each other, and most importantly, how do they produce knowledge together? This question refers to the more general problem of the relationship between language and knowledge, a question as old as that of science itself. Another article written by two Germans, Ralph Mocikat and Hermann Dieter in the French journal *Les langues modernes* in 2014 deals with the future of the German language in science and the consequences of English used in science in the production of knowledge.

CURRENT REPRESENTATIONS OF SCIENCE AND THE ENGLISH LANGUAGE IN SCIENCE

Before dealing with science and the language used in science, we consider the 'social representations' (Jodelet, 1997: 53) of science and the English language in science.

There are ideological arguments in favour of the English used in this context. In our era of globalization and internationalization we commonly hear that English has become the international language in many domains. The argument consists in saying that English is *the language of* ... – for example, THE language of science, finance, Europe, companies. But there is no reality to these *obvious facts* that refer to politics in the broadest sense (Truchot, 2008: 142). As a result English has become the international language of science and this is a fact. At the heart of these discussions is the role of English in international contexts (Bruhns and Nies, 2013).

English is not envisaged in its language dimension by scientists. Historians of science have often overlooked the impact and meaning of the language in science and seen its role as secondary. Scientists such as Galileo and Descartes helped shape an image of science which is fully independent of words (Beretta, 1996: 105). As Lévy-Leblond (1996: 238) underlined, a language is not limited to its lexicon and specialized vocabulary is only a very limited fraction of the speech which is mainly performed in common language. Crosland (2006) added that language is a significant part of science even though it is often neglected. Lévy-Leblond (1996: 228) asserted that 'science goes through language' and that science cannot do without language. A text about physics not only contains

mathematical equations as students seem to think but also chunks of sentences. In all sciences, scientific abstraction and rhetorical concepts exist because of language in the form of a natural language, that is to say, a language of culture. The formulation of hypotheses and the construction of theories are the most important parts of the process of the production of knowledge. The process is conducted thanks to language which is part of the argumentation and thus plays a major role. While the experiments and measurements which participate in the process are independent of language.

Before examining the reason for the universality of English in science, the universality of science should be analyzed. Fourez and Larochelle (2004: 56) investigated the origin of science – in terms of place and time: 'whose knowledge is science? […] Are sciences the same in Moscow, Beijing and London?' They finally wondered if science is universal, which means valid in all places and at all times. In the introduction of *Science of Science and Reflexivity*, Bourdieu (2004: 10) asked:

> How is it possible that a historical activity, inscribed in history as scientific activity, produces trans-historical truths, independent of history, detached from all ties with the place and the moment, so eternally and universally valid?

Fourez said that he was trained in a world that believed in the existence of an eternal science (Fourez and Larochelle, 2004: 11). Lévy-Leblond (2004: 112) replied that we have to admit that science is 'universalized' because of globalization which is the victory of some types of Western science, at first European and then the USA. Yet this universality is spatial (place) and not temporal. For Lévy-Leblond (2004: 111), there are diverse sciences but also and above all radically different modes of production according to places and times. Fourez (1996: 124) alternatively stated that science is universal in some aspects. It is partial, biased and *partisan*. The *objective* descriptions that we can have in Oslo or in Naples give the effect of a universal discourse.

As Fourez and Larochelle (2004: 62) said it, yes science is universal and so is the English language. They justify the universality of English with economic and political factors which are not due to the language itself. English has been imposed as an *international auxiliary language* (Eco, 1994; Levy-Leblond, 1996: 236) for science, *auxiliary* being referred to 'natural languages that have been chosen to aid communication within a special domain (e.g. the use of English or French at international conferences' (Crystal, 1997: 254). An international auxiliary language is considered as an *interlanguage* which is defined as a language meant for communication between people from different nations who do not share a common native language. English incorporates the chronological series of *lingua francas* (Greek, Latin, French). This is both the universal language of the educated technocracy and language market. Science can be called universal in the same way English has become universal, that is to say in favour of economic, political and military domination (Menahem, 1976).

In science, the language dimension is viewed as non-essential whereas this is not the case in humanities, which are situated in a historical and cultural background. In hard science, using one sole language does not pose any problems. This opinion relies on an objectivist point of view which believes in the existence of a unique, objective truth which is independent of languages and history (Mocikat and Dieter, 2014: 36).

BACK TO LATIN AS THE *LINGUA FRANCA* USED IN SCIENCE

The use of English in science as the only language of communication and even as the general language of production and teaching of science is often justified with reference to Latin which was the language of European science for centuries. The history of Latin in Europe from the Renaissance allows us to better understand the current role of English as the international language. It reminds us that an auxiliary language is indispensable for the circulation of ideas, especially scientific ideas. It can be obvious, but it is often forgotten. Yet the choice of a *lingua franca* is essentially determined by the economic or military power of the dominant country. In the case of Latin, the spiritual power of the Catholic Church was decisive. It turns out that English now holds that position, because of the economic and cultural domination of the United States (Frath, 2001). Latin that was the language of scientific communication experienced its decline from the 17th century. Its domination in the Middle-Ages and early modern times caused real scientific sclerosis. At that time, the age of Scholastics, novelty was hardly part of people's interest; it was much more a question of compiling established knowledge and affirming the permanence of indubitable truths that is to say, given as objectively true. Maybe this was possible with a single language. However, when repeating canonical knowledge was not at stake but for understanding nature, that is to say formulating new knowledge and new theoretical methods, the universal language was no longer enough and vernacular languages were the solutions. An unprecedented rise of empirical science took place precisely when Latin was abandoned and the desire for knowledge freed from the shackles of Latin. In fact, the decline of Latin and the rise of national and vernacular languages to the status of scientific languages have played a fundamental role in the development of science in Europe.

THE CONSEQUENCES OF THE USE OF ELF FOR SCIENCE

The problem is not the excessive use of English but bad English, which might damage real scientific communication and thinking. As Lévy-Leblond (1996: 246) said, language pulls science ('la langue tire la science'). And it can pull it forward or backward according to the periods of time. Aden and Peyrot (2009) asserted that *non-national* languages cannot be regarded as utility languages.

'This would be without counting the complexity of the languages that are (also) the expression of social forms of thought' (Aden and Peyrot, 2009: 18–19).

Using a *lingua franca* for science in professional usage can raise the question of limited language proficiency such as impoverished forms of language and an absence of cultural references. There is also the risk of developing uncertain norms (Narcy-Combes, 2005: 32) which will lead to less comprehensible input both in oral and written communication. The use of ELF, devoid of culture, and used in scientific discourse may affect the transmission and the production of scientific knowledge. Lévy-Leblond (1996: 23) recommended granting as much importance to understanding scientific knowledge as to its production, to its past as to its present. 'We cannot know what we have until we know what others had before us. We cannot seriously and honestly appreciate the advantages of our time as we do not know those of previous eras' (Lévy-Leblond, 1996: 23).

We will examine the consequences of the development of English in the scientific academic community and scientific teaching and learning contexts.

1 TRANSMISSION AND PRODUCTION OF SCIENTIFIC KNOWLEDGE IN THE SCIENTIFIC COMMUNITY

In our era of globalization, international scientific communication has to be performed in English. Currently, non-native speakers are more numerous than natives and they usually communicate in ELF. Two fundamental issues at least can emerge from the situation: a broad public should understand the idea, but also the producer of the idea itself should understand it (Krämer, 2013).

When scientists use ELF in their professional activities 'how can we imagine that a conscious and determined language practice may become more critical and inventive at once, without deep roots expressed in the culture behind the language?' (Levy-Leblond, 1996: 245). Carter-Thomas (2005) pointed out that the essential content can be communicated with a minimum of words (700–1000 words) and in doing so the language may be depleted, which eventually can be dangerous for thought. As Louis de Broglie wrote in an article on *the French language as an expression of scientific thought* (1956), there is still the need to add language in physics, despite physics possessing the algebraic language since Descartes (1960: 391–401).

In the creative phase of the hypothesis formulation for example, it is necessary to use one's native language (when the user is not proficient in English), because it promotes the development of new ideas, and thus free access to knowledge (Mocikat and Dieter, 2014: 38). The message is first thought in the native language before being spoken so when a *lingua franca* is used in this case it loses its roots in the common cultural ground and is then deprived of a vital source. 'Science is done as it is spoken' (Levy-Leblond, 1996: 259–260).

When one uses a language, it means that they use a system of standards that shape thought and its relationship to the universe. Each language has a systemic

set of forms and categories which not only allow someone to communicate but also shape her/his analysis of reality, influence her/his reasoning (Leduc, 1996). Using French, English or any other language refers to a system of thought and culture that is specific to each linguistic group. The researcher's intuition opens with all its nuances and network of images at the heart of her/his mother tongue (Mocikat and Dieter, 2014: 38). A mother tongue is an engine for creativity of thought (Krämer, 2013); therefore, a *lingua franca* cannot generate thought. Thus it is no coincidence that the explosion of scientific discoveries at the end of the Renaissance coincided with the decline of Latin as the language of reflection in European nations. Galileo thought in Italian, and Kepler or Leibniz in German and Newton in English. Only the results of their reflections were published in Latin. 'Most people can think creatively in their native language, and if it excludes swathes of life and knowledge, then it is not possible to think out of the world in the mother tongue' (Krämer, 2013). In the words of Humboldt, researchers depend on their own language, which allows them to deploy all their intellectual abilities. What they have to say can only be expressed in their own language which is not universal.

Finally, Lévy-Leblond (1996: 246) concluded that English (no more than any other language) has a short-term chance of being sufficiently mastered by an international scientific community to become truly commonplace for communication and reflection.

2 TRANSMISSION OF SCIENTIFIC KNOWLEDGE IN SCIENTIFIC ACADEMIC TEACHING AND LEARNING CONTEXTS

The problem of transmission of scientific knowledge can be analyzed at two levels:

- in science courses taught in English by non-native science professors (based on a case study in a French scientific university (Chaplier, 2013)),
- in courses of scientific English by English teachers teaching in French scientific degrees (present situation and asking open questions).

2.1 SCIENCE COURSES IN ENGLISH TAUGHT BY NON-NATIVE SCIENCE PROFESSORS

Science professors teach courses of science in English more and more in French universities. In the case of Université Paul Sabatier (Chaplier, 2013), it is not the professor's concern to master language. Language gives way to the contents that are familiar to students and which are transmitted by the professors in a form of English they are not sure whether it is correct. Science professors have no teaching experience in a specialized scientific domain in English and no certification in English. They say they are not very comfortable linguistically even if they claim that language is not a barrier as they use it regularly. For them, the only subject of interest is the content.

Oral transmission of knowledge and oral interaction in class are issues of teaching science in English. Language skills mainly refer to the communicative competence or *ease factor* (Kurtàn, 2003: 147–150). The science professors speak of difficulties concerning fluency, clarity of expression, vocabulary and varied turns of phrases in order to reformulate what they have said. In general, they slow down the speed, avoid complex words and rely more on visual support (slides) than in native language (L1) (Flowerdew and Miller, 1996: 129–134). The phenomenon of *reduced personality syndrome* (the fact of not being able to speak in second language (L2) as well as in (L1)) can be evoked. They are not comfortable enough in English and sometimes maintain linguistic insecurity that will block their activity in the end. Long (1983) and Pica (1994) argued that comprehensible input (Krashen, 1982) is necessary for language learning. In this case, the very specific and new knowledge that teachers transmit to the students in English (the *input*) may not be really understandable as broad understanding is not the objective of master program's specialized courses.

The inverted situation may occur in the case of science courses in French. Non-native science professors may find it difficult to transmit their knowledge into their native language to their non-native students in class as they have read too many scientific articles in English. As they do not have the linguistic material to understand what they read in their native language, they may not be able to have the correct input to transmit in French. The input they have read in English may not be equal to the output they have expressed in French. The output in French will become the input to transmit.

Teaching means speaking about new topics whose understanding is arduous in our case (master's level). There are two dimensions, in language are both present: the semantic and pragmatic dimensions (Trabant, 2013). The semantic relation, that is to say the relationship to reality, is difficult to handle and above all in a foreign language. As teaching involves a relational dimension, the students can ask questions to clarify points on difficult subjects or ask for more details. Consequently the teacher has to know the nuances of the language to reply and to understand the underlying meaning of the student's question. The use of the *lingua franca* is problematic in this case.

The relevance of English for a science class taught in *lingua franca* can be raised when one knows that this language is devoid of any ethnic culture. Furthermore, there is another point to mention which concerns the curriculum taught in *lingua franca* when teachers and students are not English-speakers (Truchot, 2008: 125). These curricula are based on an *erroneous* estimate (ibid.) and therefore *aberrant* knowledge on language. The usefulness of obtaining such a degree, knowing that student mobility is increasingly widespread can also be questioned. Consequently, the validity of the English language has become an issue.

Beacco and Byram (2007) wondered what the consequences of the development of English as an international language in universities in most countries (Northern Europe) were. They recalled that the Action Plan 2004–2006

explicitly warned against 'unintended effects of this offer of English on the vitality of the national language', referring to

> The research that shows that if a language is no more than an expression of living science and modernity, its other societal functions can suffer from this loss of legitimacy: such dynamics may tend to create a situation of diglossia. (Truchot, 2008: 95)

For example, during an exchange among non-native scientists, a speech in genuine situations with a threshold of consistency will be performed. It will be done in an interlanguage. An interlanguage is an intermediary language which eases the communication among the persons who do not have a common language. The exchange of specialized content will cause a qualitative decline in form and backward linguistic development. There is a risk to 'build statements that juxtapose disciplinary concepts, such as labels, regardless of the L2 forms' (Narcy-Combes, 2005: 56). If the speaker is not a specialist in the field, he/she cannot 'build cohesion based on domain knowledge' (ibid.) and the interaction will prove to be difficult or impossible for the listener. In this case, it is even difficult to speak of language.

2.2 TEACHING SCIENTIFIC ENGLISH

The expression *scientific English* is used in the case of English teaching in French university science degrees. The questions of contents to be taught and of the competences of the English teachers in terms of specialized contents are raised.

Trouillon (2010: 100) asked a relevant question: 'Is scientific English an English apart?' Scientific English is a type of English as there are *Englishes* which are ' hybrids reflecting the complex process of loan word, combination and style with other language varieties (or discourses)' (Ricento, 2006: 4). Scientific English is therefore 'a particular variety of English in that it is very representative of a discourse community that does not need English as mother tongue [...]' (Trouillon, 2010: 100). It should be useful to distinguish between the English used by scientists (daily) from scientific English taught in class.

English teachers who teach scientific English in scientific degree programs think that they know their area of expertise: teaching and learning scientific English in an academic context for science students who are non-specialists of English. Yet they cannot integrate knowledge and expertise in scientific English in a professional context. However, it seems that the students must be placed in a context of action. They cannot either understand the scientific issues of their actions because they are not familiar with didactics of languages or of disciplines. In fact, teaching scientific English is based on teacher's personal knowledge. Currently there is no research object *English for science* which has been produced by researchers and therefore the knowledge taught at the university in our context is not based on any epistemological foundation except teacher's *practical epistemology* (Sensevy, 2007). Practical epistemology is a theory of knowledge that comes from practice and is constrained by the institution.

There is therefore a lack of teacher training in scientific English at universities. As a result, practical knowledge in English is taught without scientific knowledge, which could especially be damaging at the master's level. Without the knowledge of science, knowledge of practice remains less formalized therefore non-transferable (Dugal and Léziart, 2004: 37).

Although English teachers manage to create hybrid disciplinary knowledge, the question is to determine their degree of competence in specialized knowledge, being aware of the fact that learners position themselves as experts as they advance in their studies. As Dudley Evans and St John (1998: 188) noted, the teacher does not have to 'become a specialist discipline' or to replace her/his specialist colleagues (Dudley-Evans, 1993: 2).

PROPOSALS TO *RE-LEGITIMIZE* AND *RE-GIVE* CREDIBILITY TO ENGLISH USED IN SCIENCE

In France, the university training of teachers who will have to teach specialized English and in particular English for science remains very general. However, a specialized language cannot be seized without a real preliminary training, given its complexity. The question of the content of teaching and here specialized language is essential both in terms of credibility when facing the students, of legitimacy concerning the institution and recognition in terms of maintaining and renewing the teachers' commitment.

As the institution produces students who may have taken the above-mentioned courses and who will use the language that they have learned in the scientific workplace, we, as researchers and teachers, can play a role in designing English teacher training in the French university science degrees (language teaching sector for non-linguists called LANSAD in French): creating master's syllabi for teacher training, developing research in specialized English and didactics, reinforcing research-based courses in English (CLIL) and, finally, maybe, adopting a more structured linguistic policy in French universities.

We provide some proposals in order to *re-legitimize* and *re-give credibility* to courses of English for science and also re-motivate students and staff. As Chini (2010) suggested, we will refer to teaching language-culture for science at the university, culture being related to professional and subject dimensions (Taillefer, 2004), although teachers and researchers of scientific subjects say that English is a *lingua franca* in their subject teaching in English (Chaplier, 2013). A reflection should be started among both language and content teachers.

1 THE FRENCH SITUATION

Since 1988, the Bologna Process has pledged to transform and harmonize European universities so as to encourage mobility and student participation in the education process, foster the social conditions required to broaden the access to higher education, and promote employability.

1.1 THE FRENCH LANGUAGE TEACHING SECTOR FOR NON-LINGUISTS

Since the 1970s, all French university curricula have integrated language courses. Thus, a vast language training sector for non-linguists emerged called the LANSAD sector. It was faced with a high demand for English courses for non-specialists of English and many jobs were developed in universities to meet this demand. The 1989 reform restructured the French university degrees to make them compatible with European higher education courses. It contributed to introducing specialized content in language training. It also referred to a European dimension to the curriculum, which involves the question of the place of languages at universities. On-going globalization and increased trade have progressively highlighted the communicative dimension of language. Until the 2000s, the language teaching sector for non-linguists has grown rapidly and is characterized by its heterogeneity.

New educational needs have been identified. A new non-specialist English learner profile has emerged: a great number of students drawn from all academic disciplines, with heterogeneous levels in English and variable motivation with a limited number of hours for English courses. The workforce in this sector represents 90 percent of students enrolled in higher education (Causa and Derivry-Plard, 2013: 91).

1.2 THE POLITICAL DIMENSION OF ENGLISH LEARNING AND TEACHING

The political dimension of the issue of English learning and teaching in France cannot be underestimated. French was a language of international exchange and culture, and was spoken in many countries. The growing hegemony of English has generated many negative responses from policy-makers, institutions, the world of arts, and teachers. The latter deplore that globalization is gradually destroying whole swaths of culture, lesser-used languages, and even depriving English of its cultural dimension; hence the generalization of the word *Globish* refers to the reduction of a language to a *lingua franca* devoid of any traces of culture and languages (Forlot, 2010; Chini, 2010).

There is still no real language policy at universities that 'requires rethinking the ways of learning languages' (Rivens Mompean, 2013: 32), except at the European level (Common European Framework of Reference for Languages and European Language Portfolio).

2 REINTRODUCING THE LANGUAGE AND CULTURAL DIMENSIONS INTO ENGLISH FOR SCIENCE

In science, the language and cultural dimensions are not major concerns. However, language is essential in conceptualization and the historical and cultural background are key components in science which is also a social activity.

2.1 CULTURE IN SCIENCE

Culture is one of the most complicated words in the English language (Williams, 1975). Morin (1969) added that the concept of culture is unclear and complex in human sciences.

The cultural dimension in the use of English in scientific contexts is an issue. In English, the expression *scientific literacy* is used, which literally means 'the ability to write and read' science and in French *culture scientifique*. The question of culture in science is a controversial notion (Nicolas, 2012: 26). Matalon (1996: 9) stated that *culture in science* is generally either too far removed from culture (literature and art) or not widespread enough. Snow (1959) asserted that there is a *double culture*: it is a culture where scientists and literary-minded persons hardly communicate, where professional scientific practices and more personal reflections are totally separated. *Culture in science* should be reintegrated as a common culture even for non-specialists in science and in courses – in science or English.

Scientific discourse seems completely devoid of the rootedness of the particular speech of its villages and local cultural characteristics (Fourez, 1996: 124). It appears that scientific culture has been forgotten. Yet it is needed to understand a scientific description. Science forms a common language that provides benchmarks to scientists in the same way as local elements provided common benchmarks to all villagers. To realize the importance of this shared *culture in science*, one should try to read a *scientific* book from the 16th century: one will soon be convinced that common culture is necessary for the universality of scientific discourse to be operational (Fourez, 1996: 125).

Another type of culture which allows for appropriate scientific knowledge, through writing or oral forms should be evoked. Both are two different cultures (Trabant, 2013). Writing transmits rigor and oral performance belongs to another more open world with its own type of rigor and logic (Lévy-Leblond, 1996: 255).

2.2 LANGUAGE IN SCIENCE

The primary function of language is to communicate, and above all, it is a heuristic instrument. It has both an external communication function and an internal cognitive function. Language proficiency, if necessary, is not sufficient in a communication perspective. Rastier (2007: 1) pointed out that 'the mastery of a language engages as well the expression of the individual as social communication and cultural transmission'. Moreover, language shapes the thought of its speakers, but it is through language that culture is transmitted from generation to generation. As Galisson stated (1994), language and culture (concept of language-culture) cannot be separated. It is 'the unbreakable bond between language and culture' (Kramsch, 1993; Risager, 2006, 2007).

The complexity of the relationship between culture and language is best summarized by Levi-Strauss (1974: 84–85):

> First language can be treated as a product of culture: a language used in a society reflects the general culture of the people. But language is also part of culture and constitutes one of the elements among others [...] language can also be treated as a condition of culture, and for two reasons: the diachronic reason since it is mainly through language that a person acquires the culture of the group [...] language also appears as a condition of culture, insofar as the latter has a similar architecture to that language. The one and the other are built by means of correlations, i.e. logical relationships.

He added that both form the unity of the human mind. For Valdès (1985: 1), 'no one can feel emotion, and therefore genuinely think in an artificial language'.

Culture has been reintroduced not in language but in communication as a social act (cf. work of ethnography and anthropology of communication). According to Chini (2010), if a language is not recognized as the language of others, it is disconnected from its cultural dimension because no one identifies with it. Thus it is no longer expressive. It becomes a language-object which is not really a language (as it has been described).

2.3 COMPARING ENGLISH FOR SCIENCE AND ENGLISH FOR LAW

English for science can be compared to English for law in the teaching and learning context at universities. The latter is narrowly linked to the history of the systems and institutions that have developed their own unique legal concepts and principles. The language of science has always favoured the clarity of communication between researchers. In seeking common ground, it seems that scientists really sacrificed their own cultural background for a so-called universal language. According to some scholars, there is practically no language in mathematics classes taught in English, for example.

English for law has a high degree of cultural knowledge whereas English for science has a low cultural component. Yet this positioning has no scientific proof; it is more ideological and reports on current practices. English for law has a real existence in teaching contexts at universities compared to science in France because a distinction can be made between the French law system and the American and British systems. As some disciplines are stamped *Anglo-Saxon* like economics and law, English becomes a natural vehicle to thinking. In hard sciences, English has no cultural dimension, it is only vehicular. Therefore, Fourez (1996: 5) noted that scientific effort has been constantly traversed by historical projects and a cultural dimension. Scientific English does not take into account the cultural aspect at universities in France.

Language and culture are two factors to be deemed in the process of teaching and learning a foreign language. When learning a language, one not

only stores knowledge about the language, but one learns how to speak and to use it to communicate (M.-F. Narcy-Combes, 2005: 81). It is for this reason why integrating scientific culture in courses of English for science is essential.

3 PROPOSALS

We propose to develop research in English for science, teacher training, teaching English for science and science in English in the CLIL system to students since all French university curricula have integrated English

3.1 MASTER'S DEGREE FOR TEACHER TRAINING IN THE LANGUAGE TEACHING SECTOR FOR NON-LINGUISTS

The increasing demand to ensure courses in specialized English in the language teaching sector for non-linguists has not changed the training of future language teachers. Teaching in the teaching sector requires knowledge of specialized language that cannot be reduced solely to vocabulary. This language requires, however, a solid education which must integrate discursive, historical, cultural, professional and disciplinary dimensions. It is therefore necessary to train teachers, not to specialized English in general but to a specific variety of specialized English like English for science. Thus teachers will be operational in this sector where the demand is high. However, before developing training, research on the subject which starts with a description and a reflection in terms of the didactics system is essential. For any training, didactic transposition and references to *knowledge* (Chevallard, 1985) are needed and required.

If formal training in the subject specialization is difficult to design – linguistic training and non-linguistic discipline training at the university level – training in specialized languages of a specific specialization included in the linguist training should be envisaged. There is scarce training for teaching in specialized languages and specialized English in the classical path of Anglophone studies dedicated to teaching, but none are mandatory either before the competitive examinations (capes, agrégation), or even later. There are two master's degrees for *anglais de spécialité* (ASP, French conception of specialized English): one at the École Normale Supérieure in Cachan and one at the University in Le Havre. These courses specifically address the needs of qualitative language teaching sector for non-linguists in specialized English, but they remain below the quantitative requirements of the sector. Master DIDALAP (DIDActique des Langues étrangères utilisées dans les Activités Professionnelles/ *Didactics of Foreign Languages Used in Vocational Activities*) will be opened soon (in September 2016 in Toulouse) for students and teachers in the language teaching sector for non-linguists. The master's degree seeks to train for the teaching of languages used in professional activities notably in the language teaching sector for non-linguists (at university). It aims at developing the capacity to use language in action at the workplace and at combining field teaching skills and training in research of didactics.

3.2 RESEARCH IN SPECIALIZED LANGUAGES/ENGLISH

Even though numerous studies have been conducted on the *transversal* characteristics (e.g. speech, style) of specialized languages, the *vertical* studies on the same object – the intersection between language and specialty – remain rare (Van der Yeught, 2014). There is a real epistemological deficit in specialized languages (ibid.). This remains true for scientific English.

My own research on the elaboration of a concept called *English for science* illustrates the research in specialized English. Some elements of the epistemological reflection are given here. The first problem lies in the concept of science. Fourez and Larochelle (2004: 62) said that science is universal and consequently valid at all times and in all places. This statement is only partially true. In reality, science has a language, culture, territory and temporality (Pestre, 1995). Science is inherently a social activity. Even if an individual discovers new knowledge, it is not part of science unless the new knowledge is communicated and evaluated by others. And science requires collaboration, often with many people with diverse skills and knowledge.

While its transverse features (e.g. discourse, genre) have been widely investigated, scientific English still lacks a comprehensive approach pertaining to the multifaceted object at stake: (1) a scientific content, (2) expressed in a foreign language, (3) which needs to be appropriated by learners. *Weaving* together the three dimensions mentioned above and resorting to Piaget's 'internal epistemological critique' (1970), we will be able to elaborate a new concept, that of English for science instead of scientific English. Contrary to scientific English which usually erases the historical and genetic circumstances of scientific discourses in order to make them universal (Stengers, 1987), English for science, neither the juxtaposition of English and science nor its sum (Morin, 1982), will then transgress, combine and articulate the cultural, linguistic and didactical (Chevallard, 1994) dimensions of specialized English. Science is not only a matter of objectivity but also scientific practice as construction (Hacking, 1983). The aim is to reintegrate *scientific thinking* to the pragmatic aspect of the language of science (especially, English) through an interdisciplinary approach: history, sociology, and philosophy of science.

3.3 TEACHING WITH THE CONTENT AND LANGUAGE INTEGRATED LEARNING SYSTEM

Given the move towards English-taught programs in universities with the Anglo-Saxon conception of specialized English (English for Specific Purposes tradition), the roles of language and content merit further research, specifically their integration, and the courses which can be learnt from an English specialized perspective to adapt to this new situation.

CLIL, which has grown in Europe since the 1990s (Dalton-Puffer, 2007), has been defined as 'an educational approach where [content] subjects […] are taught

through the medium of a foreign language' to students at all educational levels (Dalton-Puffer, Nikula, and Smit, 2010: 1). Some approaches highlight the dual integrative focus on content and language, taught by subject specialists or team teaching (Greere and Räsänen, 2008). There are different types of classification of CLIL courses ranging from the absence of the integration of language and content to full collaboration between language and discipline specialists. The cases for courses where the objective is both disciplinary and linguistic (Wolff, 2003: 37; Stoller and Grabe, 1997: 19–20) are 'rarer and more positive' (Taillefer, 2004: 111).

Science courses in English could be envisaged through the CLIL system with a partnership among field specialists in cooperation on the part of the teacher's investment – cooperation (being the lowest degree of teacher's investment), collaboration and team-teaching (Dudley-Evans, 2001). The aim here is to reinforce the language dimension in science courses in English which is often forgotten (cf. Chaplier, 2013). As Gajo (2009: 19) emphasized, there are language issues of the disciplines and disciplinary issues of languages. Sustained interaction between content and language lecturers is not common (Räisänen, 2009), probably due to a traditional lack of interaction between disciplines. This cooperation is obviously not simple to implement. It depends on the field situation: material/organizational issues, financial problems but also relationship problems and *risk taking* (Aden and Peyrot, 2009: 25). Relationship problems (Hutchinson and Waters, 1987; Barron, 2002) may be due to differences in personality, pedagogy and also subjects taught (especially science and language).

This approach can be implemented in the laboratory works (chemistry, biology, physics, etc.) in scientific universities which are often managed with two professors, one of them can be the English teacher. The latter will participate in the lab work in French by taking notes on the linguistic and pragmatic difficulties met by the students. He/she will take into account the academic input, the treatment of the contents in the reception and production phases and the interaction which are the main features of CLIL (Wolff, 2003). Finally both professors will conceive the lab work in English and the course of English for science will enrich the lab work.

With such collaboration the contents have a better chance to match those that are taught in the parallel curriculum so that the input is understandable, emotionally marked (Krashen, 1981) and correlated with the learners' acquisition level (Pienemann, 1984).

CONCLUSION

It is undeniable that a common language of communication is necessary in the scientific community to exchange knowledge. But it is essential to understand the relation between language and specialist domain, and the various communicative dimensions conveyed by language (Lévy-Leblond, 1994: 239). Many examples in written and oral scientific communication demonstrate

linguistic and cultural problems related to language. It is indeed necessary that a real political language in science (Levy-Leblond, 1996: 248) and at universities is implemented. Consequently it is essential to revisit the teaching of languages and English for science. In university education, the epistemic function of language is more important than its communicative function. Good teaching not only provides information but always tries to re-elaborate knowledge, thus engaging students to participate in the creative process of research. The epistemic function of language must be considered and that is what we have tried to do in our approach. Thus the language teaching sector for non-linguists would be better structured and will be a first step towards a linguistic policy within universities.

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