Using a Creative Science Approach for Teaching English as a Foreign Language to Postgraduate Students

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1 Introduction

Currently innovation has become a "hot topic", not only in the technological world but also in education. Creativity is the engine of Innovation and a skill which makes our lives more pleasurable and companies more profitable. Thus, academia searching for effective ways of including innovation studies within most disciplines is hardly surprising.

The capacity to innovate and to create is inherent to every human being and has enabled humanity to make the various cutting-edge technological advances which have made possible the fairly sophisticated world we now inhabit.

Thus, to ensure a bright future, it is fundamental to nurture upcoming generations with the ability to think creatively, ensuring that the world can continue to overcome difficult challenges, develop new technologies, create prosperous businesses and fashion pleasurable living environments.

Of course, we all live in an increasingly global world, where communication plays a vital role in driving learning and business. In this world English has become the de facto international medium and, as a consequence, the acquisition of English as a second language has become a vital skill for graduates. In this world students

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will be the agents transforming companies, creating new technologies and doing business in a very complex and globalized world.

The study that we report here was based at The León Technological Institute which is part of the National Technological Institute of Mexico, a multi-campus system with 266 campuses around the country, and with more than half a million students, mainly engineering students [1] (over half of Mexico's engineering graduates). The Technological Institute of León offers the courses of Engineering in Computer Systems, Engineering in Information Systems, Industrial Engineering, Mechatronics Engineering, Electronic Engineering, Logistics Engineering, and Business Management Engineering, as well as postgraduate studies with an MSc in Computing and a doctorate in Computer Science. The master's degree in Computer Science at Instituto Tecnológico de León has two research areas: Intelligent Environments and Intelligent Systems. The programme is accredited by Conacyt as a programme of quality and excellence, so that admitted students receive a scholarship to pursue their postgraduate studies [2].

2 Literature Review

The methodology of creative science has been successfully tested in different scenarios, including business innovation, training, teaching and driving business start-ups [3]. It is rooted in the concept of creating high-fidelity stories that exercise the use of an imagined product in such a realistic way as to be able to test it; such a story becomes a kind of prototype. The methodology was proposed by Brian David Johnson who, at the time, was Intel's futurist. He called the methodology Science Fiction Prototyping (SFP), setting out the principles in a 2011 book [4]. Science Function Prototypes vary in size from Twitter-sized stories, Micro-SFP [5] to scientific paper-sized stories, Mini-SFP [4]. We will adopt both of these formats at different stages of learning.

Creative Science has been successfully applied in teaching the English language to computer students in China, substantially improving the traditional sentence-by-sentence translation strategy. In the Chinese work Zhang used Science Fiction Prototyping with classes of almost 200 students to develop there oral and written skills in "Computer English", together with improving their computer science knowledge and innovation skills [6–8].

Wu has developed a methodology based on Creative Science called Imagination Workshops, with the aim of teaching business innovation to entrepreneurs in the Asian region [9]. Our context in Leon is quite similar, since the subjects involved are professionals (many with industry experience, such as IT consultants, or software developers).

In project-based learning, students develop skills using a real problem (or one inspired by reality) as an anchor so that by using tools from different disciplines it is possible to find a solution. This approach has been successfully tested in different initiatives [10], where students from several disciplines have been able to apply

their knowledge in the design of a car for the elderly. Such project-based learning presents the students with real-world problems and challenges, thereby enabling them to acquire new knowledge with real significance and deep understanding in a realistic context where, most of the times, they would need to build or create a device or prototype [11]. Being a science and engineering faculty most of our work would be termed as being part of STEM (Science, Technology, Engineering and Maths) but by adding in ARTs, in which creativity plays a more obvious role, it might better be described as STEAM (Science, Technology, Engineering, Art and Mathematics), a combination which has been shown to work well in the classroom (https://www.edutopia.org/blog/pbl-and-steam-natural-fit-andrew-miller).

Problem based learning is another generic skill that has been successfully applied at university level in various universities [12] (https://www.maastrichtuniversity.nl/education/why-um/problem-based-learning), developing multidisciplinary skills, focused on solving problems in contexts as close to reality as possible. For this reason, the participation of experts from different areas is desirable, including specialists from the industry. It has also been applied in young children, with excellent results. Naturally, creative thinking is also useful for solving problems in innovative and clever ways.

3 Methodology Proposed

The methodology planned for this initiative is founded in the principles of Creative Thinking, Problem-Solving and Creative Science.

Given how crammed modern curriculums are, the ideal methodology would combine in the teaching-learning creative thing along with English as a second language while advancing the area that the student is majoring in. There are a number of possible mechanisms we might incorporate which we now briefly review.

First, there is Communicative Language Teaching (CLT) which focuses on how language is used [13]. An approach in which functional language is relevant and the plentiful exposition to language in use and plenty of opportunities to use it are vitally important for a student´s development of knowledge and skill [14]. Activities in CLT typically involve students in real or realistic communication, where the successful achievement of the communicative task they are performing is at least as important as the accuracy of their language use [14].

Second, there is Task Based Learning (TBL) which is pertinent to the implementation of our new programme. TBL makes the performance of meaningful tasks central to the learning process and it holds the belief that if students are focused on the completion of tasks they are just likely to learn language as if they are focusing on language forms [15].

Consequently, as students deal with the completion of the task the use of certain grammar structures, vocabulary and proper pronunciation will become evident thus the teaching-learning process of it will emerge naturally, providing the students then with meaningful skills.

Although there has been some criticism about the use of tasks as the base of all pedagogical methodology in reason of the specific needs of students and the fact that other functions of the language would be left out [16], it is important to outline the profile of our students to fully understand how relevant the application of this methodology will be. The subjects of the present methodology are adult learner students of MSc in Computing Sciences in the postgraduate department. Their area of expertise is related with varied engineering bachelor's degrees and therefore their aptitudes, interests and learning styles are alike. Having in mind the previous considerations the implementation of the proposed methodology will make students competent in the area of interest they all have in common, Computing Science, helping them tackle their communicative needs as MSc students and later on as professionals of their areas. The fact that all students solve common tasks under the principles of Creative Science has the capability to provide them with the functional language they need along with creative skills and additional discipline knowledge.

Thus it is planned to pilot this method following the approaches mentioned before, considering the four skills in teaching English (reading, listening, writing and speaking) and the language systems: grammar and vocabulary (see Fig. 1).

Since the approaches of TBL and CLT are being followed, the methodology will contain a specific task or challenge to be accomplished, involving research, brainstorming, design and implementation. Some input of vocabulary will be given to the students when stating the problem/task to be solved. This is to be accomplished through the receptive skills listening and reading. Selected texts and/or audio files are to be presented to students with the purpose of informing about the task and clarifying terms related to it (Pre-task).

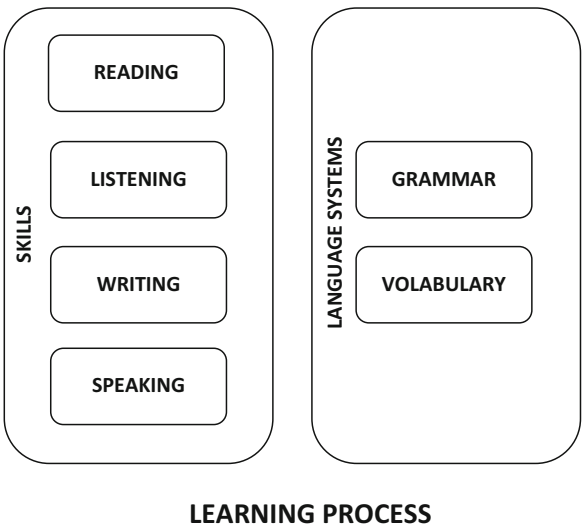

Fig. 1 The English learning process is based on four skills (reading, listening, writing and speaking) and language systems (grammar and vocabulary)

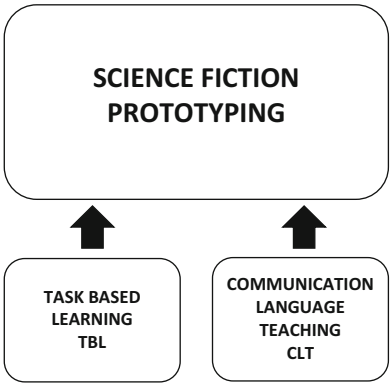

Fig. 2 The methodology proposed is based on the Science Fiction approach, together with Task Based Learning (TBL) and Communication Language Teaching (CLT)

In a second phase, students are to be focused in the solution of the problem/task, planning and reporting about their findings. In this phase it is useful to utilise Creative Science principles because the need to research, analyze and use the information in a creative way, will be fundamental to solve the issue. During the process of researching, analyzing and presenting results, students are required to use both receptive and productive skills. Teacher's function is to be monitoring the process (Task Cycle).

During the last stage, teacher will be required to help students analyze specific grammar structures, vocabulary, syntax elements, etc. which they encountered during the earlier problem-solving stage (language focus).

It should be noted that, since the Creative Science approach is fundamental to our methodology, the problems or tasks which are to be given to student have a direct relationship with a technological and scientific area, and the development of an innovative device/model (see Fig. 2). Because of this, we are considering using a team-teaching approach which would include both an English Language and technology facilitator/expert.

Our intention is that this methodology should help students achieve international certification as competent English users, which is essential since reaching the B1 level is the requirement for students to graduate with an MSc in Computer Science.

Being engineering students (i.e. studying systems, computer, electronic, mechatronics or related), the students are required translate their Science Fiction Prototypes into hardware or software engineering prototypes using tools such as:

1. Apps development: Students in computer-related areas have the skills to program on Android or IOS; however, it could also be used tools for the accelerated development of prototypes, such as App Inventor [17], Proto IO [18].
2. 3D Printers: Additive manufacturing has revolutionized the development of agile projects using open source design tools such as Blender [19] or CURA [20].
3. Internet of Things: with the large number of embedded computational tools, it is possible to quickly create prototypes using devices such as Raspberry Pi [21], Arduinos [22] and other kits such as Little Bits [23].

4 Discussion

As was explained earlier in this paper, we are at the early stages of this work and the project is a work in progress. In this paper we report on our plans, pedagogical models and the background information. We plan to implement and deploy this methodology during the academic term August–December 2017 with the 1st year students of the MSc in Computer Science at Instituto Tecnológico de León. Clearly there will be a considerable amount of work involved but we are fortunate to be building upon earlier work in China undertaken by Dr Shumei Zhang learning from her experiences at Shijiazhuang University [7]. We plan to use the same evaluation methodology (including questionnaires) with our Spanish students as were used with the Chinese student, enabling us to make some direct cross-cultural comparisons which we hope will provide useful information for deploying the Creative Science methodology more widely across world languages all of which we plan to report in further papers.

5 Conclusions and Future Work

The teaching of English is a strategic subject for competitiveness, especially in the area of engineering. Graduate students require English language proficiency, which will allow them to improve their employability conditions when they obtain their MSc in Computer Science. Likewise creative thinking and innovation skills are important skills for graduates in order for the companies they work for to achieve the necessary levels of competiveness in modern global economies. In this paper we have argued for this by using a Creative Science methodology it is possible to combine learning innovation, technology and language within an efficient pedagogical framework that uses engaging strategies that are directly connected to the student specialism.

This methodology will be implemented during the next term (August–December 2017) with the 1st year students of the MSc in Computer Science. And we hope to report our results in future conferences.

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