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García-Carbonell, Amparo

[agarcia@upvnet.upv.es](mailto:agarcia@upvnet.upv.es)

Watts, Frances

[fwatts@upvnet.upv.es](mailto:fwatts@upvnet.upv.es)

Universidad Politécnica de Valencia

Valencia, Spain

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## Introduction

Since the beginning of the 1990's, the students of Advanced English at the School of Telecommunications Engineering of the Universidad Politécnica de Valencia have participated, as part of the course syllabus, in the telematic simulations of Project IDEALS and, later, Project ICONS and Project IDEELS<sup>1</sup>. The enthusiasm aroused in the students by the new experience led to believe that it was a methodology with strong potential and therefore to the consideration that measuring its effectiveness as a learning method in the specific context of engineering would be a useful topic of research. Over a period of almost twenty years, different studies have been carried out<sup>2</sup>. The study presented in this paper is action research based on daily classroom tasks that pursues quality learning and has two objectives. The first is to prove the effectiveness of simulation and gaming methodology in English as a foreign language teaching in a technical context. The second objective is to examine to what degree telematic simulation is an effective

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<sup>1</sup> IDEALS: International Dimension in Education via Active Learning and Simulation  
ICONS: International Communication and Negotiation Simulation  
IDEELS: Intercultural Dynamics in European Education through onLine Simulation

<sup>2</sup> García-Carbonell, 1998; García-Carbonell and Watts, 2007; 2009; García-Carbonell et al, 1998, 2001a, 2001b, 2001c, 2003, 2004; Rising et al 2001; Watts and García-Carbonell 1996, 1999; Watts et al 2001, 2006, 2007, 2008 2009.

tool for improving communicative skills, particularly the macroskills of reading comprehension and writing.

The use of simulation in language learning, and more specifically in learning a language for specific purposes, implies taking into account a series of general principles. First, any simulation used for language learning should be doable and have the language as the objective of study. Second, it should be designed or adapted so that communication is a natural component, without distortion by the technical or scientific component. Third, the information content must not intimidate the participants or the teacher-facilitator nor, on the contrary, bore them. Last, the simulation must respect the language needs of the student. If these principles are transferred to learning terms, it can be said that the use of simulation in language acquisition must allow participants to handle a range of language registers and vocabulary in a concrete context for a specific purpose. In spite of the emphasis on specific, there are simulations that have not been designed for a certain aim, the validity of which has been well-documented<sup>3</sup>.

## **Simulation and language learning**

Simulation and gaming methodology in the teaching and learning of languages is of a shorter tradition than in other disciplines<sup>4</sup>. Forty years ago learning theories began to consider communication and interaction important and now is when simulation and gaming is really beginning its consolidation as a methodology.

Different authors have approached simulation and gaming as a language and communication teaching/learning strategy that comprises the enhancement of communication skills as well as social relationships, negotiation, strategy design, leadership, team work, decision making, affective values of the participants and facilitators, community learning and self- and shared assessment<sup>5</sup>. It is a relevant methodology for the functional practice of interlanguage storage in implicit knowledge and in the interaction in the access and usage phase that increases implicit knowledge. It has no direct effect on society, i.e., the non-simulated world, which means that the consequences of making mistakes are low-cost. In general,

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<sup>3</sup> Andreu-Andrés and García Casas, 2009, 2010; Coleman 1990, 1992; Cabré and Gómez de Enterría, 2006; Crookall and Oxford, 1990<sup>a</sup>, 1990b; Dunkel, 1991<sup>a</sup>, 1991b; Fraile Arbiol, 1993; García Carbonell, 1998; García Carbonell and Watts, 1996, 1997; García Carbonell et al. 1998; Rising, 1999, 2009; MacDonald, 2005; Watts et al., 2006; among others.

<sup>4</sup> For more information see: Andreu-Andrés et al, 2005; Bredemeir y Greenblat, 1981; Duke, 1974; Faria, 1987; Klabbers, 2006; García-Carbonell and Watts, 2006, 2009; Greenblat, 1975; Jones, 1982, 1995; Rising, 2001; Scarcella y Crookall, 1990; Wolfe, J. 1990, 1991 1993; among others.

<sup>5</sup> Armstrong, 1994; Crookall and Oxford 1990; Duke 1974; García-Carbonell and Watts 2009; Greenblat and Duke 1981; Jones 1995; Klabbers 2005; Rising 2009; Starkey et al 2005, among others.

participants are capable of producing more complex registers because there is less pressure than in a real situation.

Most of the research that has been done on simulation and gaming refers to the high degree of motivation and involvement that it generates in the users of the language. An important characteristic of simulation is its capacity to create varied and sometimes complex models of communication and social relationships. Likewise, the topics of discussion give way to the use of language patterns that are varied and complex, which attracts participants not only to learn content but also to learn the language because the language is needed to cope with the situation. A very common reaction among participants in a simulation is to forget that they are learning a new language and simply throw themselves into using it to solve situations or conflicts as they arise. This happens to the point that the urgency or novelty of the situation, the pressing need to understand and be understood, makes users recur to passive or unused language knowledge. In this way, learners find themselves communicating spontaneously and they develop the ability to use the language creatively. The language is used to find information, to understand better and to manage the situation-action in which the individuals are immersed.

Simulation and gaming creates a natural context which allows students to communicate and therefore develop their own social and linguistic creativity. The immediate feedback offered in the natural context in language use indicates to participants if their communication is appropriate and efficient.

In short, teaching and learning a language through simulation and gaming foments genuine communication, where the language produced is processed by the participants, who determine and manage the content, resorting to adjustments and situational changes as necessary, making the language a means for an end. The learning process is circular. It starts and finishes in a concrete experience, where the context establishes a bridge between the controlled learning of the language and the relative uncertainty of the real world. The academic, professional or social language models reproduced encourage individuals to confront real communication processes, all of which, in turn, leads to more meaningful learning.

## **Materials and Method**

For the study and testing of the hypotheses, the design of the experiment was based on the international telematic simulation, ICONS<sup>6</sup>, in which multidisciplinary teams from all over

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<sup>6</sup> For more information see: <http://www.icons.umd.edu>

the world participated in synchronous and asynchronous bilateral and multilateral negotiations. The main objective of the experiment was to measure and contrast the effectiveness of two different teaching strategies, applied to two different subpopulations. The experimental groups (EG) were treated by instruction using a simulation and gaming method and the control groups (CG) followed a more conventional method.

Figure 1 outlines the study. To measure the effectiveness of the methodology, pre- and post-test treatment was used with the different groups, with the aim of observing the progress made in the acquisition of different skills. The test used was the TOEFL (*Test of English as a Foreign Language*), as well as a guided writing exercise.

After obtaining the pre- and post-treatment results of the EG y CG, statistical analysis of the data was two-fold. Quantitative analysis included factor analysis of intergroup variance and intragroup discriminant analysis. The first type compares the results of all the groups, skill by skill; the second compares the results of all the skills within a group. In second place, mixed analysis of variance with all EG and CG compared the global means of the two subpopulations so as to determine the real effect of the method applied.

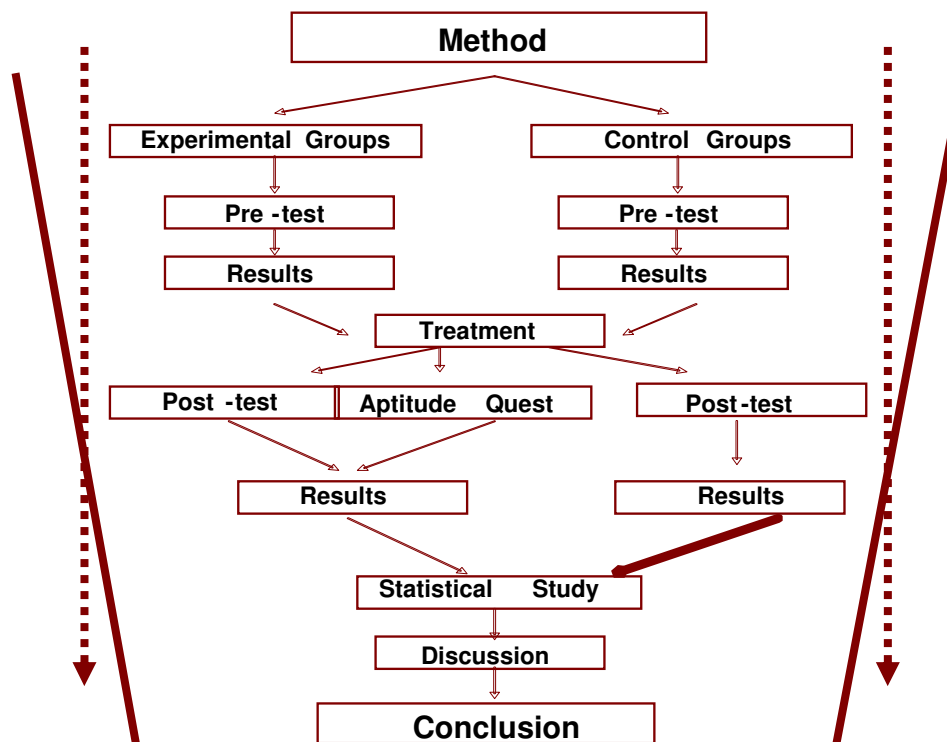


Figure 1. Outline of the study

In addition to the three quantitative analyses, qualitative study of the experimental groups included an aptitude survey.

## **Results and Discussion**

In the experiment described above, quantitative analysis between and within groups by way of analysis of variance revealed that the experimental groups using telematic simulation (TS) significantly improved in the macroskills of oral comprehension, reading comprehension, written expression as well as in grammatical competence; the control groups in conventional classes (CC) improved but not significantly. Thus, we believe that the results confirm the first hypothesis, that telematic simulation is more effective than conventional classes, since significant progress was observed in the EG and not in the CG.

The second hypothesis, confirmed descriptively after the first parametric analysis, is that telematic simulation is particularly effective in enhancing the skills of reading comprehension and written expression. The EG showed a highly significant increase, whereas the CG did not improve significantly in either of the skills.

Both hypotheses were ratified after the discriminant analysis, in which none of the CG obtained significant results, i.e., the improvement shown by the CG in the different skills did not reach a level of discrimination high enough to go on to the second level of multivariate analysis. In contrast, the results by the EG obtained in the discriminant analysis not only show highly significant improvement in all of the skills with respect to the CG but also that in the EG reading comprehension and written expression are the only macroskills that present high power of discrimination with respect to the rest of the skills. On observing the graphics that summarize the compared results of the EG and CG in the first two analyses, we see that in Figure 2 the ascending lines clearly show the differences in listening comprehension. Grammar competence results are pictured in Figure 3. Reading comprehension results are shown in Figure 4. Written expression results are displayed in Figure 5, where the difference is truly outstanding.

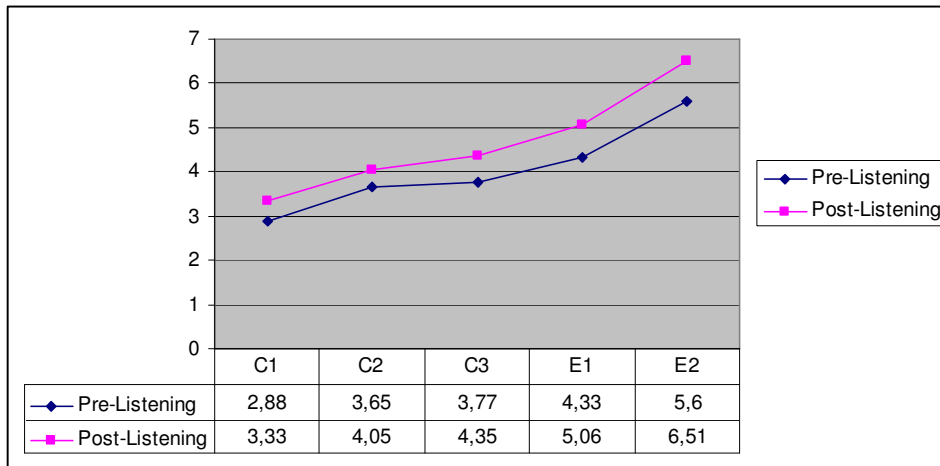


Figure 2.- Pre-Post Listening results

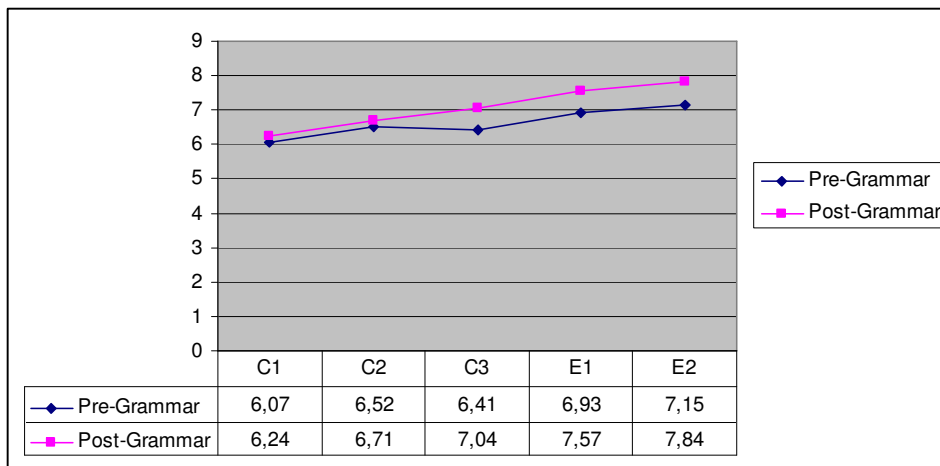


Figure 3.- Pre-Post Grammar results

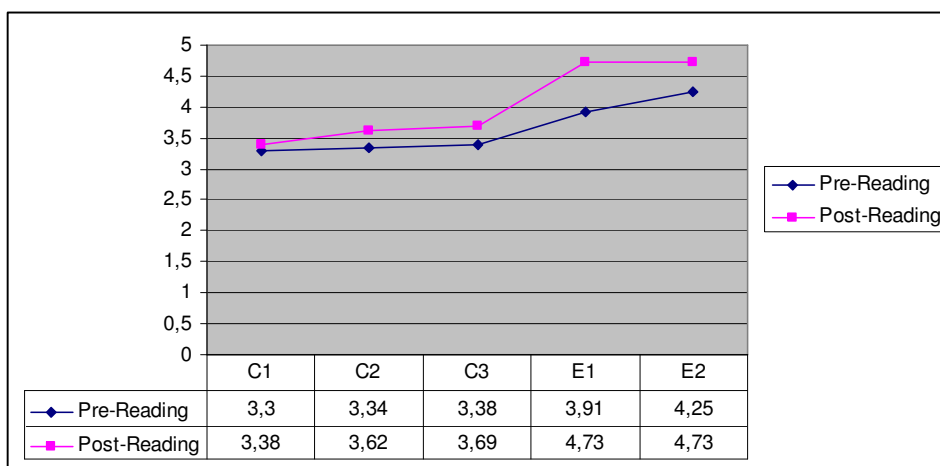


Figure 4.- Pre-Post Reading results

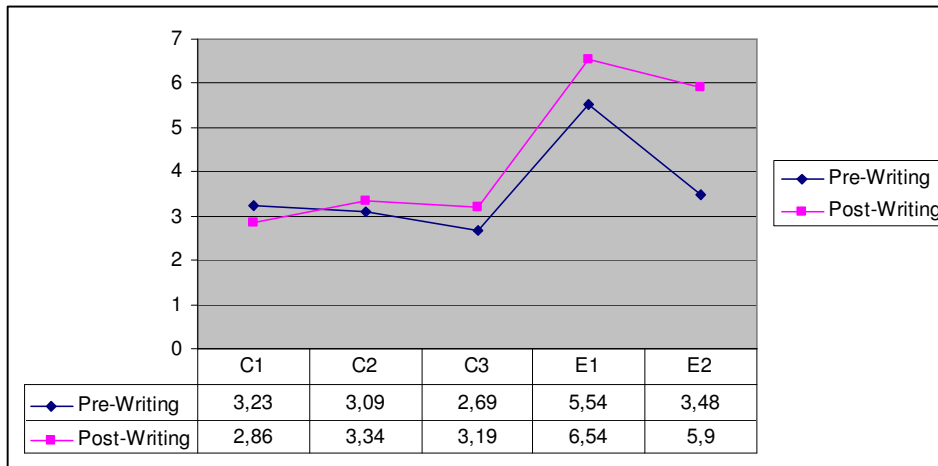


Figure 5.- Pre-Post Writing results

The third mixed analysis of variance ascertains the hypotheses globally, after comparing the EG and CG as two single subpopulations that were subject to different methods (EM = telematic simulation method; CM = conventional class method) and tested at two different moments (T1 = pre-treatment; T2 = post-treatment). The results obtained in the third analysis highlight the improvement in the experimental subpopulation when compared to that of the control subpopulation.

On observing listening comprehension, the results that appear in Table 1 show that the EM has significantly higher global results (mean = 5,15) than CM (mean = 3,6).

<b>Listening</b>		
<b>E M pre-test</b>	<b>4,68</b>	
<b>E M post-test</b>	<b>5,63</b>	mean EM = 5,15
<b>C M pre-test</b>	<b>3,36</b>	mean CM = 3,60
<b>C M post-test</b>	<b>3,88</b>	mean pre-test = 4,02
		mean post-test = 4,75

Table 1.- Pre-Post Listening results

Similarly, the averages over time reflect significant differences, with the joint values of the pre-test groups being 4,2, clearly lower than the post-test mean of 4,75.

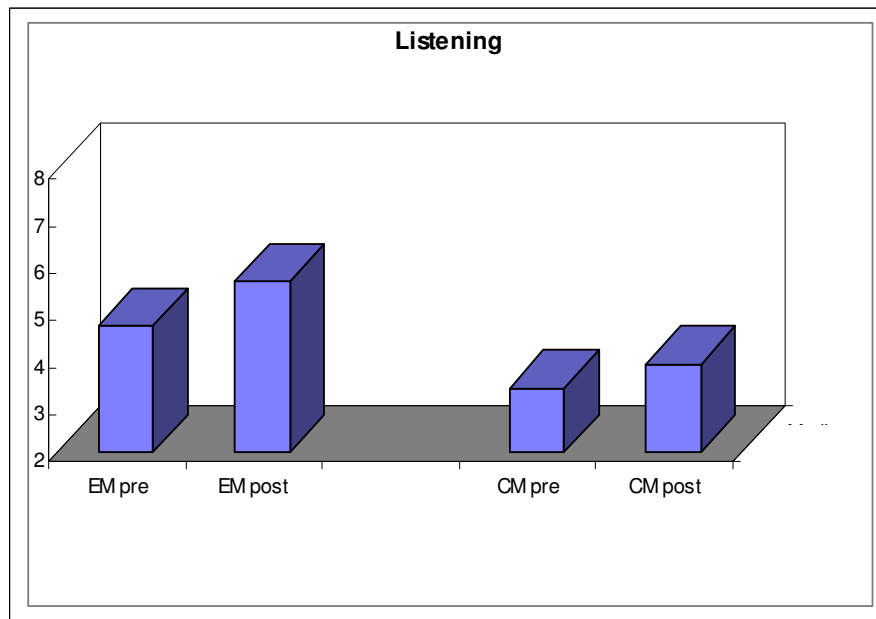


Figure 6.- Pre-Post test Experimental and Control Method

In Figure 6 the differences are clearly appreciated, with the EG mean in the post-test (mean = 5,63) standing out over the values of the rest of the conditions.

In grammar competence, as the data in Table 2 indicate, EM has significantly higher global results (mean = 7,35) than the traditional CM (mean = 6,45). Equally, the average over time shows significant differences, with joint values of the pre-test groups (mean = 6,63) lower than those of the post-test groups (mean = 7,17).

<b>E M pre-test</b>	<b>7,01</b>	<b>mean EM = 7,35</b> <b>mean CM = 6,45</b>
<b>E M post-test</b>	<b>7,68</b>	
<b>C M pre-test</b>	<b>6,24</b>	<b>mean pre-test = 6,63</b> <b>mean post-test = 7,17</b>
<b>C M post-test</b>	<b>6,64</b>	

Table 2.- Pre-Post Grammar results

Figure 7 corresponding to grammar competence shows that the results of the interaction are equally significant because the EG in the post-test situation (mean = 7,68) is significantly higher than the other values.

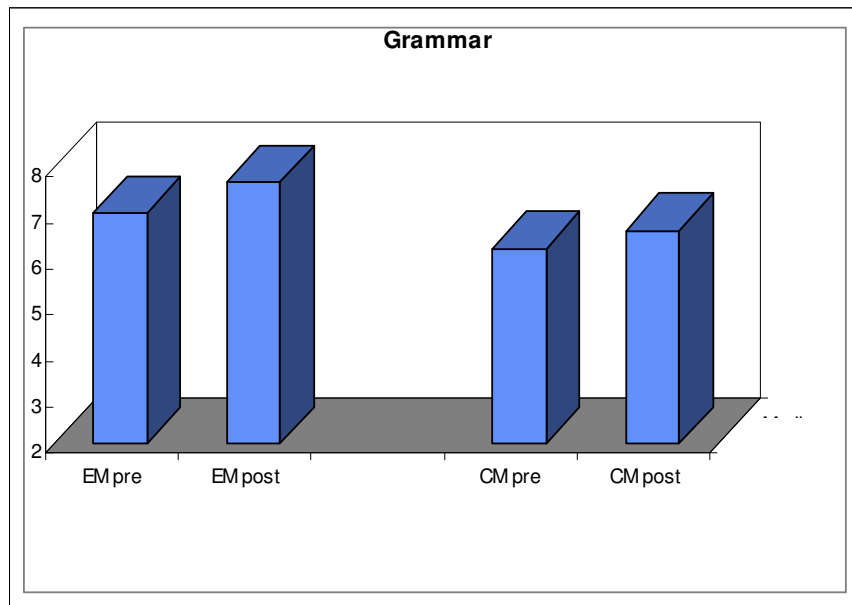


Figure 7.- Pre-Post test Experimental and Control Method

The skill of reading comprehension in Table 3 shows global results of EM (mean = 4,39) that are significantly higher than those of CM (mean = 3,42). In the average over time there are also significant differences between the mean of 3,6 in the pre-test and 4,14 in the post-test.

<b>E M pre-test</b>	<b>4,05</b>	<b>mean EM = 4,39</b> <b>mean CM= 3,42</b>
<b>E M post-test</b>	<b>4,73</b>	
<b>C M pre-test</b>	<b>3,28</b>	<b>mean pre-test = 3,60</b> <b>mean post-test = 4,14</b>
<b>C M post-test</b>	<b>3,56</b>	

Table 3.- Pre-Post Reading results

Figure 8 clearly shows these differences, as well as the important interaction values, since the EG in the post-test presents a mean of 4,73, well over the rest of the conditions.

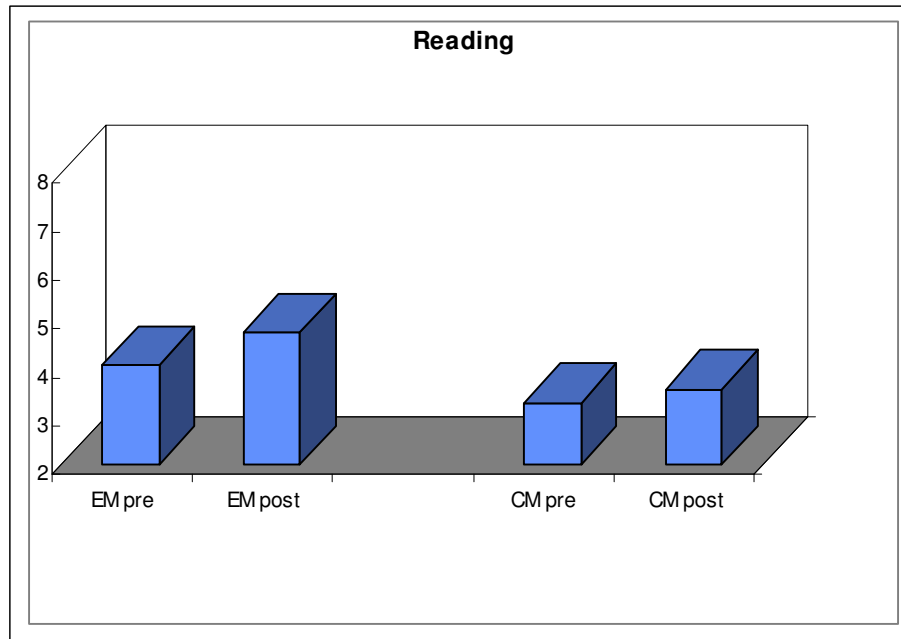


Figure 8.- Pre-Post test Experimental and Control Method

Finally, in the results of written expression that appear in Table 4, it can be appreciated that the telematic simulation method obtains significantly higher global results (mean = 5,52) than the traditional method (mean = 2,99). Over time there are also significant differences; the pre-test values (mean = 3,8) are lower than those of the post-test (mean = 4,69).

<b>E M pre-test</b>	<b>4,75</b>	<b>mean EM = 5,52</b> <b>mean CM = 2,99</b>
<b>E M post-test</b>	<b>6,29</b>	
<b>C M pre-test</b>	<b>2,90</b>	<b>mean pre-test = 3,80</b> <b>mean post-test = 4.69</b>
<b>C M post-test</b>	<b>3,09</b>	

Table 4.- Pre-Post Writing results

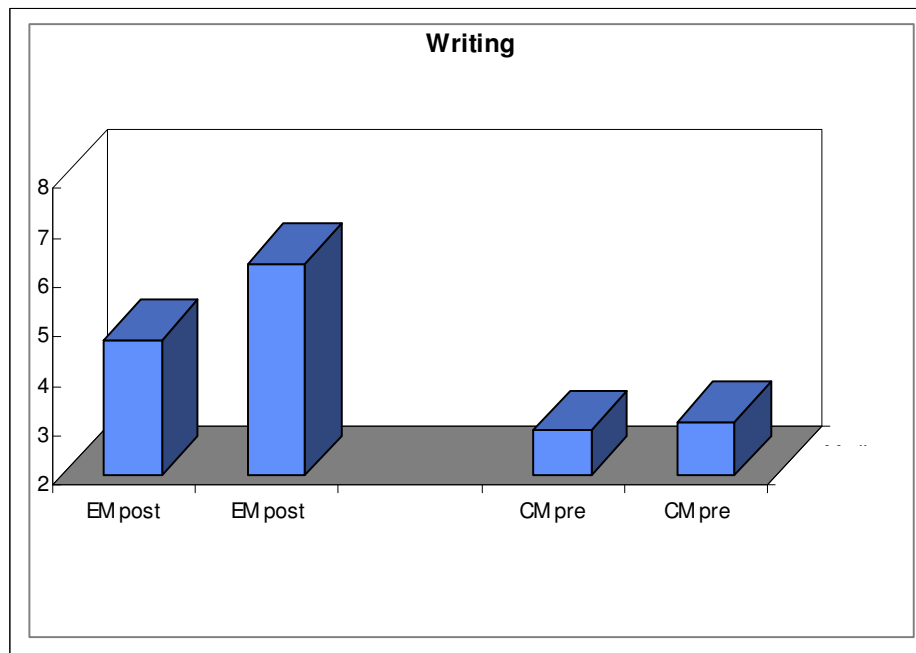


Figure 9.- Pre-Post test Experimental and Control Method

Upon observation of Figure 9 corresponding to written expression, these differences can be clearly appreciated, although without a doubt, the most notable result is that of the interaction which is highly significant. The experimental group in the post-test (mean = 6,29) is very significantly higher than the others.

## Conclusions

In the case of oral comprehension, the averages indicate that the experimental group improved approximately 31% more than the control group. In reference to grammar competence, the means indicate that the experimental group improved 44% more than the control group. In reading comprehension, the experimental group improved approximately 96,8% over the control group. The averages in written expression indicate that the experimental group showed spectacular improvement (395%) in comparison to the control group (see Figure 10).

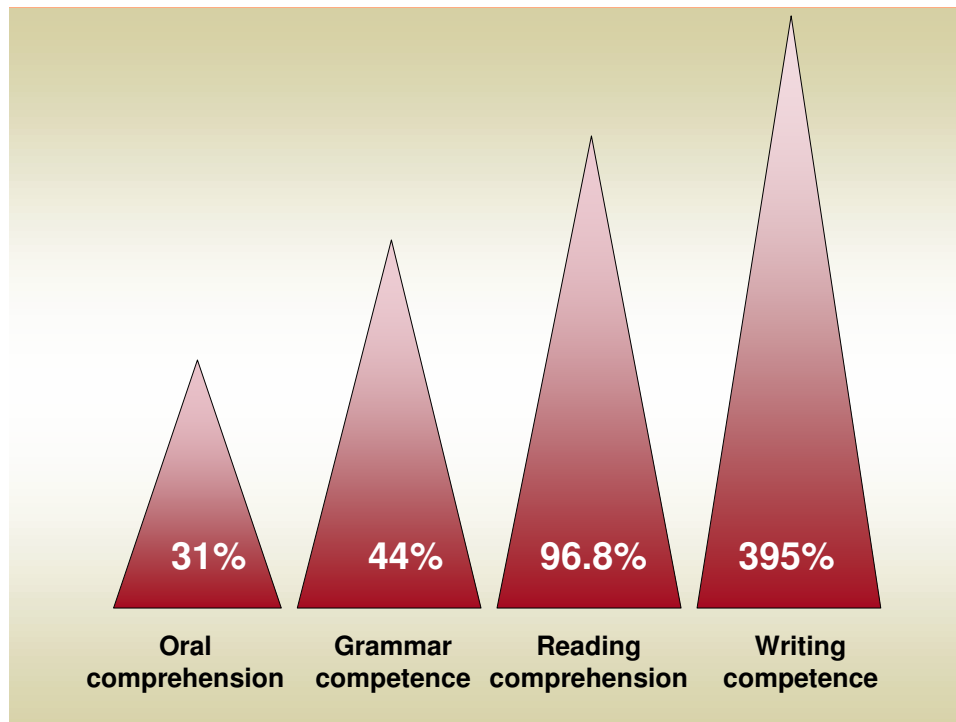


Figure 10.- Comparison of skill improvement

If we relate these conclusions to the qualitative analysis carried out, the central idea is that the students submitted to the experimental method of telematic simulation positively value the *learning by doing* offered by the method. The variable *preference* could serve the purpose of summarizing the results of the qualitative analysis: 94,4% of the individuals surveyed prefer telematic simulation over 61,9% who value with similar scores the conventional classes. This analysis represents what in statistical terms would be called ecological validity, which certainly ratifies the results of the quantitative analyses in the context in which they have been produced.

The present study has attempted to demonstrate the effectiveness of telematic simulation empirically. For this purpose, we followed a rigorous verification procedure by analyzing the results of a whole procedure of selection, treatment and interpretation of dependent, independent, parametric and nonparametric variables. The results produced enough evidence to be able to state that telematic simulation is an effective tool with enormous potential for language learning improvement in a specific context. Telematic simulation contributes to the objective of communicative theory: Learners enter realities rather than artificial situations. In conclusion, by measuring the progress in the different abilities in the acquisition of communicative competence in English as a foreign language, we have shown that simulation and gaming is a teaching/learning strategy that can guarantee optimum results.

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