



## Use of a Course Blog for Critical Thinking Skills Enhancement in Chemistry Graduate Students

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### Abstract

*Critical thinking skills are fundamental components of higher education and particularly of scientific education. It is recognized the close relationship that exists between these skills and various aspects of the practice of science, for example for the verification of hypotheses, decision making, problem solving, argumentation to support the conclusions drawn from the research, among others. Successful experiences have been reported where computer-mediated communication tools are used as pedagogical resources to promote a number of skills as reflection, teamwork, communication and, in particular, for the use of critical thinking skills. This paper reports the use of a blog in the course of Green Chemistry of the Chemistry Master's Program of a Peruvian university. The purpose of this activity was to promote the use and improvement of these skills in graduate students. Some directives were used for the elaboration of the posts, but the work done by the groups of students was a high level of autonomy. The content and characteristics of the posts were assessed as well as the comments and replies that were produced for each of them. The results regarding the development of critical thinking skills with emphasis on the use of argumentation skills were quite satisfactory.*

**Keywords:** *Critical thinking, argumentation skills, blogs*

### 1. Introduction

The need to incorporate the development of critical thinking skills in the pedagogical models of higher education has been recognized for several decades, since they are an important part of the skills that prepare students to face the complexity of life and of the work environment. In the context of the training of new scientists, the relationship between the components of critical thinking and the processes involved in scientific practice is clear. The conscious and intentional use of thinking skills is essential to develop hypotheses that will be later confirmed or refuted based on the analysis of evidence and the application of knowledge; as well as to draw conclusions from the results obtained and to support them with good arguments [1, 2].

Critical thinking is defined in literature in many different ways; it is sometimes used as a synonym for evaluative judgment, analysis, issuing judgments or personal opinions, formal thinking, metacognition development or, as a process of reasoning and solving problems in general. From the psychological-cognitive focus, the interest is on skills and dispositions that can be improved through education. Critical thinking is understood as one that has a purpose, is reasoned and directed to goals, in addition to containing an evaluative component of the process itself [3, 4]. From this perspective, the different models for the teaching of critical thinking skills include, for the most part, the skills to elaborate and / or analyze arguments. Argumentation and reasoning are essential aspects of the discussion and exchange in the scientific community.

Technology development has made available new tools for computer-mediated communication (CMC) that, in turn, have become attractive resources for education. One of these resources is the blog, a publication on the public domain website, which in addition to the content (called post), includes hyperlinks, images and videos; likewise, it is configured so that the public can send their comments directly to the author, establishing a bidirectional communication. These characteristics make the blog an appropriate pedagogical tool to promote that students deploy a set of skills, such as communication skills, analytical, creative and critical thinking, all of them are desirable in professional training [5, 6].

Studies have been reported in which the blog has been used as a mean to evaluate the critical thinking skills used by university students, proving that this is an effective tool to explore the development of these skills [7 - 10]. This paper reports the use of a blog with graduate students, in the course of Green Chemistry of the Master's program in Chemistry of a Peruvian university. The purpose of the activity was to encourage the use of critical thinking skills with an emphasis on argumentation skills. Our interest was to explore the quality of the arguments made by the students both in the post and in the comments after its publication throughout the course.

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## 2. Method

### 2.1 Description of the activity

The activity was developed in the context of the Green Chemistry course of the master's program. The main purpose of the course is to facilitate the knowledge of the fundamental principles of this subject, through the critical review of research reported in scientific literature, thus motivation and interest of the participants to get involved in this line of work are promoted. The students, organized in groups, had to freely select some topic related to those involved in the course, make a critical analysis of the selected topic and propose a group position in front of it. The post should be published according to an established schedule and following the format indicated for this purpose. All students had to analyze and comment on each post and the authors could respond to these interventions.

The blog was created on the university's platform using the Wordpress content manager.

### 2.2 Assessment of arguments quality

The arguments deployed in a medium such as blog are informal in nature, that is, they seek to sustain a position using relevant reasons that are appropriate to the particular situation. Sometimes, an extended argument will establish reasons that support a particular conclusion, and reasons that refute the same conclusion, the latter are called counter arguments. In these cases, the conclusion remains unchanged since the argument has been elaborated in such a way as to suggest that the counter argument is weaker than the main argument. Taking as reference the model suggested by Halpern [4], a rubric was elaborated in which the criteria of assessment of the argumentative quality of the post are established, according to its content and clarity. Assessment of the quality of the reasons that support the claim is based on their acceptability and consistency, their relationship with the claim and the strength of the support provided. To analyze the comments and responses after the post, the quality of the commentator's conclusion and the reasons that accompanied it was considered. Each assessment criterion is related to some of the core critical thinking skills reported by Facione [3]. Figure 1 shows the rubric used in the activity.

### 2.3 Participants

The course had 17 students, with an average age of 27 years, 41.17% were men and 58.83% were women. They formed four working groups, three of them with four members and one with five members.

	Related CT skills [3]	ACCOMPLISHED (A)	COMPETENT (C)	NEEDS IMPROVEMENT (NI)	LIMITED (LI)
Claim quality (post)	Interpretation Inference	Claim includes a contention or opinion relating selected theme. Claim is written clearly.	Claim includes a contention or opinion relating selected theme. Claim is written with some clarity.	Claim includes a contention or opinion relating selected theme. Claim is not written clearly.	There is no claim relating selected theme.
Conclusion quality (comments)	Analysis Inference Evaluation	Conclusion is consistent with analyzed claim. Conclusion is justified on the basis of the reasons presented in the post.	Conclusion is consistent with analyzed claim. Conclusion is justified on the basis of some of the reasons presented in the post.	Conclusion is consistent with analyzed claim. Conclusion is not justified on the basis of the reasons presented in the post.	Conclusion is divergent with analyzed claim. Conclusion is not justified on the basis of the reasons presented in the post.
Reasons quality	Analysis Explanation	The claim (conclusion) is supported by at least two reasons that: • are acceptable and consistent. • are coherently related to the claim. • strongly support the claim.	The claim (conclusion) is supported by at least two reasons that: • are acceptable and consistent. • are coherently related to the claim. • support the claim.	The claim (conclusion) is supported by at least two reasons: • that are acceptable and consistent. • the relationship with the claim is not clearly shown. • support for the claim is weak.	No reasons presented to support the claim (conclusion) or they do not meet any of the desired characteristics.
		In the argument, at least one counter argument is included that reinforces the claim (conclusion).	In the argument, at least one counter argument is included but does not reinforces the claim (conclusion).		The argumentation does not include a counter argument

Figure 1: Rubric for assessment of argumentative quality of the blog



### 3. Results

Each working group elaborated a post, so there were four post throughout the course. Figures 2 to 6 show graphically the results obtained in the assessment of the post and the comments made during the activity. The % of frequency of each level of achievement is reported for each aspect evaluated.

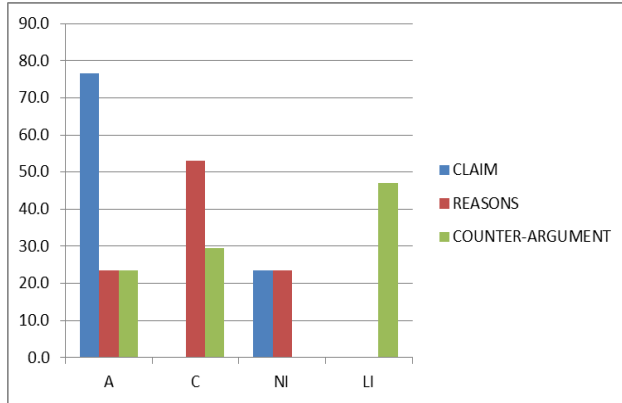


Figure 2. % frequency of each level of achievement achieved in post assessment

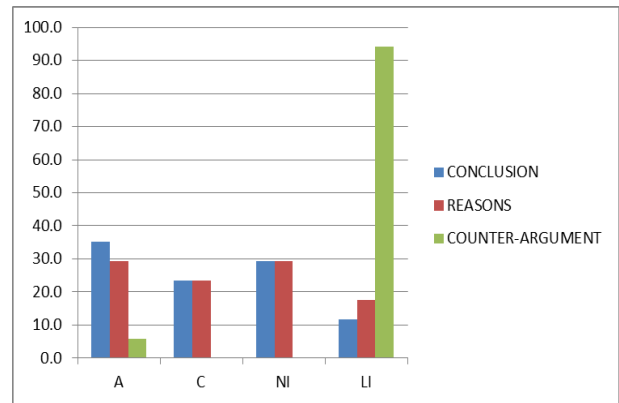


Figure 3. % frequency of each level of achievement achieved in comments made to post N° 1

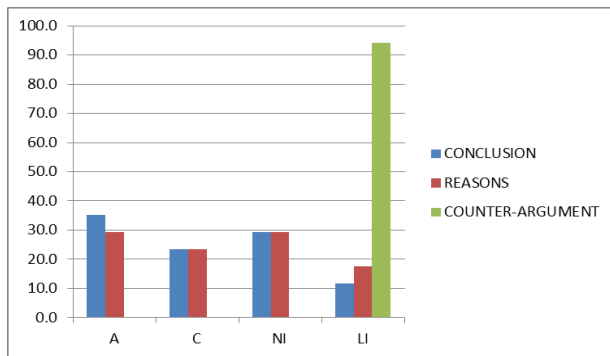


Figure 4. % frequency of each level of achievement achieved in comments made to post N° 2

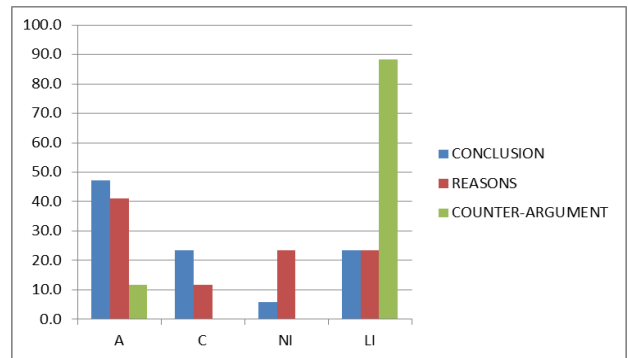


Figure 5. % frequency of each level of achievement achieved in comments made to post N° 3

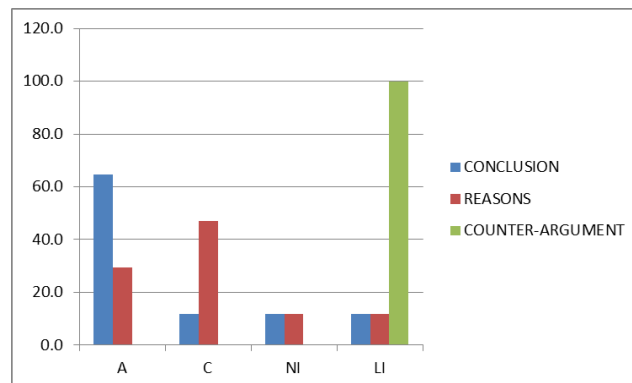


Figure 6. % frequency of each level of achievement achieved in comments made to post N° 4



#### 4. Conclusions

The results show that the argumentative skills of the students were good, emphasizing particularly in the elaboration of the post, where the frequency of maximum achievement was 76.5% in the quality of the claim. In the case of the reasons developed to support the claim and the comments, they had a lower level of achievement; however, the % of frequency in the two highest levels was above 50% in all cases. One notable aspect was the use of counter arguments, this is an element used by subjects with greater expertise in the use of argumentative skills and it seems that this was not the case of the study participants. When observing the progress in a transversal way, it is possible to emphasize the growth of the frequencies of greater profit towards the fourth blog, being an evidence of the improvement of these abilities according to the students had greater familiarity with the use of this resource. This experience is a good starting point to incorporate some relevant and efficient CMC tools to improve the use of argumentative skills, as well as to use the proposed assessment strategy in the deepening of research in this line.

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