

# Debates: An Useful Tool to Promote Students Deeper Thinking in Stem Disciplines <sup>†</sup>

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**Abstract:** The utility of debates for the evaluation of a series of transversal competences related to critical thinking is highlighted. Our main target has been to depict a novel evaluation methodology via discussion through a directed discussion system in a STEM discipline.

**Keywords:** debate; critical thinking; STEM disciplines

## 1. Introduction

The process of adapting the Higher Education Systems to the European Higher Education Area has meant a deep change in the educational plans at University; unlike the previous situation, where only intellectual capacities were taken into consideration, like memorizing, seeking for information, and its selection and critical analysis, currently, besides such capacities, highlighting some other skills is also a pivotal target, like autonomous and teamwork, public speaking skills and building their own knowledge [1,2].

This change has provoked the search for new learning and evaluation tools, being the use of debates one of the most appropriate instruments [3]. This activity presumes the involvement and participation of all the students enrolled in a certain course, and also an exhaustive preparation of the topic, as it is not just a matter of memorizing the information provided by the Professor, but they must collect the information and besides, carry out a critical analysis, and reflect on all the possible aspects, allowing them to build a critical thinking. Moreover, debates allow the development of some other competences necessary for passing the course and the Graduate studies. Firstly, participation of all the students is promoted, as they must speak in public in order to debate the topic. In this sense, students must know not only the topic, but they must learn to communicate among them in an effective fashion, to argue their position, and to counter-argue when the other section presents a question.

Another transversal competence that is used in debates is team-working, not only in the documentation step, but also when deciding which members will talk in each of the argumentation turns. In debates, it is important not only what is said, but also who and how it is said. Thus, this tool allows the Professor to determine which students show leading capacities: who is in charge of repeating, organizing and distributing the work.

Finally, from the students point of view, this kind of strategies increases the interest for the topic, and thus, for the course, as they do not consider it as the classical exam in which they have to memorize the information provided by the Professor, but it is them who prepare the topic, search for arguments against their colleagues, and therefore, it is focused as a *ludic* activity, although it has a direct impact on their learning process.

## 2. The Debate as a Teaching Methodology

The experience shown in the current manuscript is fitted within the elective course Agroalimentary Organic Chemistry, in the fourth course of Chemistry and Enology Graduate studies of Extremadura University (Spain). This course, within the Organic Chemistry area, intends to provide the students with the required knowledge about food composition, identification of the compounds responsible for the colors, flavors and tastes, possible transformations that food could undergo, and also about food additives, both natural and synthetic. Finally, an historical overview of the main agrochemicals used in history is presented, according to the different target organisms.

In the organization of the course, the use of debates was considered as a way of going beyond the knowledge evaluation by using traditional tools. In particular, the evaluation of the capacities for searching for information, arguments and teamwork is a pivotal task.

With the aim of reaching the proposed targets, for the debate activity, the following topic was selected: Should the functional foods be promoted? With this selection, it was intended to involve the students in the study of knowledge and skills necessary for the appropriate evaluation, recommendation and correct application of the development and use of functional foods in their diary professional tasks, by using a series of solid scientific evidences about their additional benefits (or not) in human health.

Three weeks before, the discussion topic was provided, directly correlated with the course contents, and therefore, the debate is also a good methodology for connecting the different courses at University and the reality that surrounds the students. Moreover, they also received instructions about the basic rules for the debate, as well as a series of recommendations; such information was transmitted via a traditional lecture, and also via some files located on the course virtual space. Finally, some other questions prior to the debate were also considered.

During the course 2015/2016, 15 students were enrolled in the course, which were divided into three four-membered groups, and a single three-membered group, always keeping parity between them, and two debates were programmed, always with the same question. All the groups had to prepare both positions, as they did not know which posture to defend until the same day of the debate, which was assigned randomly.

The structure of the debate was the following:

- Pro position, participation of one member of the team for four minutes.
- Opposing position, participation of one member of the team for four minutes.
- Pro position, participation of one member of the team for five minutes, during which one member of the other team (previously assigned) can make questions, although never in the last minute.
- Opposing position, participation of one member of the team for five minutes, during which one member of the other team (previously assigned) can make questions, although never in the last minute.
- Opposing position, final argument of a member of the team for three minutes.
- Pro position, final argument of a member of the team for three minutes.

It must be highlighted that in the four-membered teams there is one student that only participates for directing questions to the other team during the questioning stage.

When each debate is concluded, the other two teams that were not participating filled in the following scoring checklist (Table 1) in order to evaluate their colleagues, and thus, to be able to decide, according to them, which group had won the debate.

**Table 1.** Scoring checklist for evaluating the debate by the students.

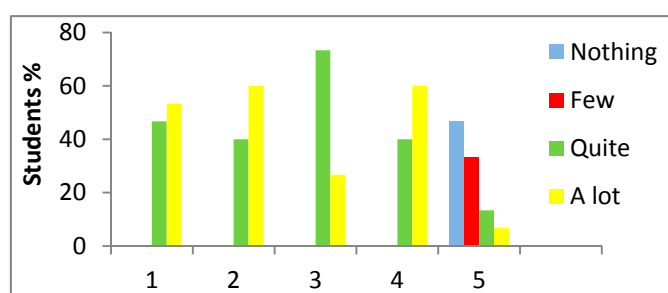
CONCEPT	PRO TEAM	OPPOSING TEAM
1. Team attitudes		
2. Clear and interesting exposition		
3. Familiarization with the topic		
4. Good evidences		
5. Naturalness and expressivity		
6. Use of turns (appropriate use of time)		
7. Best answers		
8. Best questions		
9. External resources		
10. Space control (own and general)		
<b>TOTAL</b>		

A scoring checklist was also filled in (Figure 1) in order to evaluate both the degree of satisfaction, and the utility of the experience. From the data analysis (Figure 2), it is concluded that all of them considered the debate to be a very convenient tool for the teaching-learning process, and was also useful for improving their skill for speaking in public. 73% of the students considered the debate to be a very good methodology for summarizing the key points of the discussion and 60% considered it as an excellent way of promoting the teamwork. However, 80% of the students do not consider that this strategy has been useful for defining a leading student within the group. The student's opinion is in disagreement with that from the Professor, as the presence of a leading student was obvious in each group.

1. Do you consider that the Debate is a convenient tool in the teaching-learning process?
2. Has this experience been useful for thinking about your capacities of speaking in public?
3. Do you think that with this methodology you have developed skills for summarizing the key points of the topic being studied?
4. During the preparation of the Debate, has the teamwork been promoted?
5. During the preparation of the Debate, have you observed that any of the other students or yourself has become the lead of the group?

□ **Nothing**
□ **Few**
□ **Quite**
□ **A lot**

**Figure 1.** Scoring checklist for evaluating the utility of the Debate.



**Figure 2.** Students' answers to following questions: 1. Useful as teaching-learning tool? 2. Good to improve your skills in public speaking?; 3. Useful to summarize important points? 4. Good to promote teamwork?; 5. Good to define leader of the group?

### 3. Alternative to the Classical Evaluation

With the most frequent classical tests, like written exams, it is almost impossible to measure the degree of learning of procedural and attitudinal contents. In the case of certain specific competences, like organization, social interaction, communication and expression, direct observation of the student behavior, can be quite useful as a method of evaluation [4]. For that reason, the debate evaluation is carried out through observation; in particular, three main aspects are considered:

- Quantity and quality of the information obtained.
- Quantity and quality of the contributions (arguments and counter arguments).
- Teamwork.

Quantity of the information and participation, as a simple approach to the acquired knowledge, is evaluated according to the average behavior of the group. In connection with the quality of the contributions, the up-to-date information, the treatment or data elaboration and difficulty for their obtainment are considered.

This methodology allows a continuous evaluation of the students, as just a final qualification is not only used (a final examination that only evaluates the intellectual capacity), but some other competences can be evaluated, like the capacity for defending their points of view, the capacity for controlling a debate, etc.

### 4. Conclusions

We consider that this quite a fast, practical and easy proposal as a start point that fulfills some of the targets proposed in the European Higher Education Area, like teamwork, autonomous work, self-learning, etc., so some of the competences specified in the Graduate studies can be developed. Thus, the students will acquire a major compromise with the course, as they will develop a pre-established role, besides provoking them a major satisfaction.

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