

**Argumentation and Science Education for Citizenship:
Quality of arguments produced by 9th graders on the Greenhouse Effect**

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ABSTRACT

The Portuguese National Curriculum as well as other official documents emphasise the development of students' argumentation in low secondary school. This emphasis is consistent with the results of several research studies most of them informed by Toulmin's perspectives. The importance of the argumentation competence lies on its contribution to the understanding science contents, the development of research an epistemological competences and the preparation of students to participate actively, critically and consciously on decision making processes focusing on complex socio-scientific issues in their future lives. One of the socio-scientific issues that are complex for students, citizens and scientists is the Greenhouse Effect.

This research study aims at characterizing the quality of written arguments produced by 9th grade students on the Greenhouse Effect. Data were collected by means of an achievement test-like questionnaire from 90 students coming from two schools in the Madeira Island. Data Analysis was based on Toulmin's argument structure as well as on the identification of argument elements and sequences of elements included in students' answers.

The research results suggest that the majority of the students were able to produce arguments based on the different types of backings (mainly socio-economic and scientific-technological backings) when they were not given theoretical and empirical pieces of information. Only when they were asked to evaluate a study carried out by a scientist, were they able to produce valid arguments from a formal point of view that is, arguments including Data, Warrants, and Claims. However, many of them were unable to identify Data and/or limitations of the study and they used neither Rebuttal nor Modal Qualifiers in the arguments they built when evaluating the study. In addition, the analysis of the relationship between the arguments formal structure and the students' achievement in Portuguese Language and in physical Sciences indicates that a positive relationship may exist between the former variable and each one of the latter variables.

Thus, the research results suggest that argumentation should deserve more attention in Science Education, especially in low secondary school, if curriculum orientations concerned with this issue are to be fulfilled at this level of schooling and if relevant competences within a Science Education for Citizenship perspective are to be put into practice.