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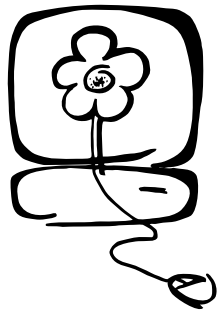

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Table of contents

Erasmus KA2+ Project "Oxford Debates for Youths in Science Education": The Contribution of Oxford Debates in Deeper Learning of Science

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Abstract

The goal of the current paper is to present an innovative Erasmus+ KA2 project in STEM and, especially, in science education which is inextricably interwoven with the concept of deeper learning due to the use of argumentation and debate. The "Oxford Debates for Youths in Science Education" consists of a strategic partnership between scientific institutions of four European countries: Poland, Greece, Serbia and Esthonia. It is addressed to students and teachers of STEM education in Junior and High Schools (13-19 years old) and aims at promoting and deepening students' knowledge through their participation to argumentative debates relative to modern controversial scientific topics.

Keywords

debates, STEM education, teaching Science, Oxford Debates, secondary education

1. Introduction

Controversy is essential within the Science context. Scientists' disagreements are related to the application of experimental methods, to theories that explain certain phenomena or to various research hypothesis. For example, the transition from the geocentric system to the heliocentric theory for explaining the planets' motion is a characteristic scientific controversy. Its duration was quite long. The debate lasted more than two centuries after the death of Nicolaus Copernicus (1543). It was hard to convince both the scientific community and the masses of people

about the scientific truth of the new model [1]; [2]. New scientific evidence, as the elliptic orbits of Kepler (1609) and the theories of Galileo (1610) contributed to the progressive conversion of the era's scientific beliefs and to the transition and final acceptance of the new model.

Such scientific controversies are essential for the promotion of Science, as Thomas Kuhn [3] notices. In the *Structure of Scientific Revolutions*, the author invites all the members of the scientific community to get acquainted with the techniques of persuasive argumentation, signaling "a rhetorical turn" [4] within the Science field.

In other words, scientists as modern orators, are invited to express their personal opinion about a scientific issue and to search for evidence in order to efficiently support their position. Within this framework, both controversy and argumentation are related to the promotion of research and to the further examination of significant socio-scientific issues with moral dimensions that influence daily life, such as cloning [5].

As we understand, controversy and argumentation used for the rejection of old scientific models or beliefs and the acceptance of new ones become closely related to the teaching of STEM education (Science-Technology-Engineering-Mathematics) and, consequently, to the formation of scientifically literate students. Following this line, the European Research Program Erasmus+ KA2 O*xford Debates for Youths in Science Education* attempts to involve teachers and students of Secondary STEM Education (Junior and High School students) in debating, since controversy and argumentation are interwoven with the debating process. So, the aim of our paper is at presenting the main educational goals of the program which might deepen students' learning. Before the afore-mentioned presentation, we will attempt to, shortly, review some of the main theoretical positions regarding controversy and argumentation within STEM educational context.

2. Theoretical framework: Argumentation and controversy in educational praxis

The demand for enhancing students' scientific literacy because of the continuously increased needs of the 21st century becomes imperative, since a scientifically literate person is able of following the appropriate processes and principles, needed for decision making. Such an individual can be intellectually and actively involved to public dialogues and debates concerning the management and resolution of problems that influence his/her personal and social life [6].

Undoubtedly, the formation of scientifically literate students is related to teaching practices which are opposite to teachers' traditional didactic monologues, to limited dialogic interaction among students [7] and to the passive acquisition of knowledge. The transformation of students from "empty vessels" to "deeper learners" presupposes their exposure to a new form of teaching related to:

a) inquiry processes and
b) to theories that situate problem's resolution to the center of the learning process [8]. Within this framework, controversial scientific issues get the form of ill-structured problems that demand a solution which is not universally or commonly accepted [9]. Subsequently, both learning and the construction of scientific knowledge are conceived as a complex socio-cultural and constructivist process, since they are influenced by cognitive operations, the context and the subsequent interpersonal interactions [10]; [11]; [12].

So, within this framework, the cultivation of students' discursive practices for the solution of ill structured problems becomes imperative. Among them, the development of argumentative skills is prominent for the construction of meanings and the acquisition of scientific knowledge.

For Sampson, Grooms & Walker[13], scientific argumentation consists of an explanation, a conclusion, a generalization, a response to a research question which is supported by evidence based upon facts, measurements, observations or findings of other researches. In more, the development of argumentation skills requires the enhancement of reasoning processes for ensuring the validity of the evidence used through principles, models, hypothesis and various concepts.

The pre-mentioned model of scientific argumentation is a simplified version of Stephen Toulmin's procedural model of argumentation. For Toulmin [14], argumentation aims at the sufficient and acceptable justification of a thesis. Its validity depends on the structure of the argument within a specific context or field. The argument is described as a motion from acceptable information (data), to a claim through a warrant, that is a reasoning line which justifies the validity of the motion.

Within the framework of teaching Science, teachers' and students' familiarisation with argumentation might contribute to the development of a new learning form, since argumentation:
a) permits students' involvement to the public dialogue related to scientific issues and
b) allows the implementation of the acquired knowledge for individual decision making relative to these issues. In particular, Driver, Newton & Osborne [15] support the idea that students' acquaintance with argumentation facilitates:
   a) the evaluation of the provided evidence,
   b) the invention of alternative ideas,
   c) the establishment of the validity of the proposed scientific positions,
   d) the presentation of opposite scientific proposals and
   e) the presentation and support of the opposite evidence.

In other words, the "movement towards argumentation" [16] and the use of the "attractive strategy" of controversies in educational praxis [17] (Klumkowsky, 2017) reinforce the importance of debates as an educational tool.
Debates become an important didactic method that contributes to the efficient

research and bilateral examination of scientific and/or socio-scientific issues [18]; [19], while they are linked to the development of life skills or the "ή 4C's super skills [20], such as communication, critical thinking [21], creativity and collaboration. Additionally, it is supported that debates enhance students' oral argumentative skills based upon evidence [22], sharp their reasoning and enrich the scientific content knowledge [23].

For all the above reasons, in USA debates have influenced, as important didactic techniques, the *Next Generation Science Standards-NGSS* [24]. In this way, it becomes clear that Science is not only "a group of facts" [25]. For example, according to NGSS standards students must be able to "evaluate claims, evidence and the reasoning behing the idea that electromagnetic radiation can be described either by a wave model or a particle model" and that for some situations one model is more useful than the other" (https://www.nextgenscience. org/topic-arrangement/hswaves-and-electromagnetic-radiation).

3. The European research project Erasmus+ KA2 *Oxford Debates for Youths in Science Education*

The European research project Erasmus+ KA2 O*xford Debates for Youths in Science Education*, which started in October 2018, aims at contributing:
a) to the research regarding the didactic use of debates in science education in Junior and High School (students of 13-19 years old) and
b) to enhance students' reasoning skills through the cultivation of logic, scientific reasoning, the analysis and synthesis of scientific data.

Oxford Debates for Youths in Science Education consists of a strategic partnership between scientific institutions of four European countries: Poland, Greece, Serbia and Esthonia. In more, the project aims at:
a) increasing students' interest in STEM topics,
b) contributing to the development of students' communication skills in their mother tongue making practice of oral argumentation and delivery of public speeches in a debating context,
c) +encouraging educators and students to use debates within the daily school routines in Science education.

The above goals are closely related to the development of students' rhetorical-communication skills. The presentation of scientific facts is converted from a wooden process addressed to a narrow circle of individuals with special interest in Science to a dialogic interaction open to all students. As in every communication circumstance, the 'nascent scientist' has to develop argumentative, persuasive skills and eloquence due to the correct use of language.

Also, students must be able:
a) to produce written texts where their scientific ideas must be clearly and precisely expressed and

b) to orally develop and share their scientific claims in a pleasant manner in front of an audience.

For achieving the above goals, students have to develop communication skills such as: active listening, critical examination and interpretation of opposite ideas, kind exchange of controversial scientific positions and negotiation skills. As we understand all the pre-mentioned skills refer to qualities of an active democratic citizen who is able of participating to public forums and contributing to the co-formation of the social, cultural, political and scientific becoming of each era.

The project lasts thirty (30) months and it will be implemented in five (5) phases:

a) Phase of preparation (October 2018 to July 2019). Within this period:
a) research relative to the topic will be conducted and,
b) the methodological framework of the stake-holders will be defined.

Also, during this period two methodological guides will be written as intellectual outputs. The methodological guides O3 and O4 aim at providing students and teachers with all the necessary knowledge about the implementation of *Oxford Debates* in school context, referring to the rules and principles of the debating contest. Lesson plans concerning the teaching of argumentation and the development of students' communication skills will be offered, while the goals of the project adapted to the national curriculum of each participant country will be provided. In more, the writing of twenty (20) educational packages on STEM topics will begin (intellectual output O8). Five (5) educational packages will be written in the mother tongue of each participant country, while all the packages will be translated in English.

b) Phase of Schools' declaration of interest in participating to the project (September 2019). During this period the recruitment of thirty-two (32) school-participants, at least, will be completed in Poland, Greece, Esthonia and Serbia.

c) Phase of pilot implementation of the project (October 2019 to July 2019). The third phase of the project implementation will include an experiential workshop for educators. Teachers will become acquainted with the rules and the principles of the debating process and they will be informed about the content of the educational packages and the resolutions of the debates. According to these rules, educators, based upon the prepared teaching material, will prepare their students for the upcoming debating contest. During the school year, the four scientific institutes will offer mentoring to the participant educators and students relative to the successful implementation of debates, while meetings with expert-scientists will be realized. In the end of the pilot phase, a debate contest among the participant schools will be organized in each participant country and the two semi-final winning debating teams of students will be selected.

d) Phase of the diffusion of the project (September 2020 to March 2021). During this period experiential workshops for educators and the organization

of a national conference will be realized. The thematic axes of the national conference will be relative to:
a) the presentation of good practices of the participant schools,
b) the presentation of the educational material,
c) papers regarding the role of debates in the STEM educational context.

Also, during the conference, the final debating contest among the semi-final teams will be conducted and the winning school will be announced. Within parallel experiential workshops, new educators will be trained to the debating process and to the educational material, while "mini-debates" of educators will be implemented.

e) Phase of project's evaluation. (January 2021 to March 2021). During this phase evaluative reports will be produced relative to the implemented activities, while proposals about the generalization of the teaching material and of good practices in all European schools will be presented.

4. Conclusions

The European project Erasmus+ KA2 *Oxford Debates for Youths in Science Education* aims at adding value to the teaching of STEM education for all European students due to its positive influence to teachers, students and educational institutions that will participate to its implementation.

Several expected benefits from the participation to the project can be highlighted, such as:
a) the increase of students' interest in Science and STEM education due to their active involvement in the inquiry and research process.
b) The significant improvement of students' argumentative, critical, dialogical, rhetorical and communication skills due to the free oral expression, the practice in the invention of the appropriate arguments for supporting the proposed scientific claims, the familiarization with the main principles of the debating process and the cultivation of the dialogical culture.
c) The revitalization of teaching STEM due to the existence and use of prepared educational material that will facilitate the implementation of debates in daily school practice and/or in the context of rhetorical scientific clubs of students.
d) The openness of the scientific and the educational institutions that will be involved in the realization of the project through the presentation of its results to a large audience that, probably, is not familiarized with the use of such a scientific vocabulary. More specifically, the participation to the project will provide all the participants with efficient tools and skills relative to the use of modern technological applications that enhance scientific and teaching aspects of their work.

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