



The Energy Blackout in Debate. An Activity to Develop Argumentation in Pre-service Primary Teachers

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Abstract

Society increasingly requires citizens with reflective and critical thinking skills to navigate challenges arising from scientific and technological advancements. Developing argumentation skills, crucial for personal, social, and professional life, is an important educational objective. Focusing on pre-service teacher education brings benefits, enabling critical analysis of pedagogical theories, educational practices, and research findings. Debates emerge as a highly relevant strategy within this educational context, fostering important processes, such as making informed decisions, mainly through evidence-based argumentation, for students' intellectual and civic development, which is important for building an informed and engaged citizenry in a democratic society. This paper delves into how pre-service teachers argue about Science, Technology, and Society (STS) issues, setting the stage for mobile applications addressing environmental concerns to advance digitalisation and sustainability in education. The study introduces a "Microdebate" activity involving pre-service primary education teachers in a brief debate on the possibility of an energy blackout in Europe. The activity unfolds in four phases: initial decision-making, debate preparation, staging the debate, and final decision-making. Analysing the initial decision-making revealed a majority favouring an energy blackout, citing arguments such as excessive energy resource use and political factors, with a significant portion offering conclusions without justified arguments. A notable shift occurred in the final decision-making, with the majority now against, primarily citing negative energetic consequences. Environmental considerations also emerged prominently. Notably, there was a significant reduction in students not providing justifications post-activity, indicating the potential of debate to enhance argumentation skills. These preliminary results will inform the design of mobile applications focused on arguing about environmental actions.

Keywords: Pre-service teachers, argumentation, decision-making, debate, educational strategies

1. Introduction

Nowadays, there is unanimous agreement on the importance of critical thinking for citizens and on its consideration as one of the main goals of science education [1]. Unfortunately, for many years, science education has neglected the development of critical thinking skills [2], even though today's society demands that science education should play an active role in its development in the context of problems related to energy, environmental, food or health issues.

Although critical thinking is a complex construct, many authors agree that argumentation and decision-making are remarkable skills [3]. For this reason, fostering the development of argumentation and decision-making has become two of the main objectives of education today. It is considered an essential personal, social, and professional skill [4]. Moreover, focusing on pre-service teacher education brings multiple benefits, enabling them to critically analyse pedagogical theories, educational practices, and research findings to make informed decisions [5].

Furthermore, they will be responsible for educating the next generations, who can take advantage of developing argumentative and decision-making skills, enabling them to face the various challenges that our society presents. Science education considers these skills important to train students to make decisions about everyday situations and problems whose consequences may affect citizens in different areas. Hence, it is essential to have scientifically and technologically literate students who can fully exercise their rights and participate in decision-making in today's democratic societies.



Therefore, this training must help them adopt responsible, reasoned, and knowledge-based positions. Moreover, it is based on scientific and technological knowledge [6,7].

In this context, debate is a highly relevant educational strategy that enables the exploration of opposing viewpoints, fostering processes for students' intellectual and civic development crucial to building an informed and engaged citizenry in a democratic society. Also, debate is considered a suitable activity for developing critical thinking from everyday problems, as it is based on reasoning, argumentation, decision-making and communication [8,9]. Debate requires students to evaluate and identify data and information, reflect on different opinions, defend and reason rationally, and make decisions based on quality evidence [9]. It thus facilitates exposure from different perspectives, making it a good strategy because it enhances the acquisition of competences and learning and promotes autonomy and participation, thus contributing to the integral education of students, who develop knowledge and attitudes cross-cutting and transversal way [11]. Debates also contribute to changes in position [12].

Therefore, this paper focuses on developing argumentation and decision-making as dimensions of critical thinking through discussions of everyday problems in pre-service primary school teachers (hereafter PSTs) by showing the results of a case study on the possibility of an energy blackout in Europe.

2. Method

The activity was carried out as part of a programme of debates with 45 pre-service teachers (PSTs, 87.8% women and 12.2% men) of the Degree in Primary Education at the University of Malaga (Malaga, Spain) in the subject "Didactic of Experimental Sciences" during the first term of the academic year 2022-2023.

This paper analyses the results of a classroom debate on the possibility of an energy blackout in Europe. It is introduced with the question: *Do you think an energy blackout can occur in Europe?* The participants in the debate, three of the PSTs, were a presenter and two debaters, one in favour of a possible energy blackout in Europe and one against. The remaining PSTs acted as listeners. The activity posed the following tasks (figure 1):

- Task 1: Initial decision-making about the problem. The PSTs make a reasoned decision on whether they could consider a possible energy blackout in Europe before the debate without access to information.
- Task 2: Debate preparation. Debaters develop arguments based on their role for or against at home during a week. The presenter should prepare a digital presentation on the issue.
- Task 3: Classroom debate. It is structured as follows: 1. The presenter introduces the problem supported by evidence in three minutes. 2. Each debater presents his/her position in one minute, and then they debate for five minutes, supported by data, images and graphs of the problem. 3. Each debater has one final minute to draw their conclusion.
- Task 4: Final decision-making. After the debate, the same initial question is administered for the PSTs to answer reasoned.

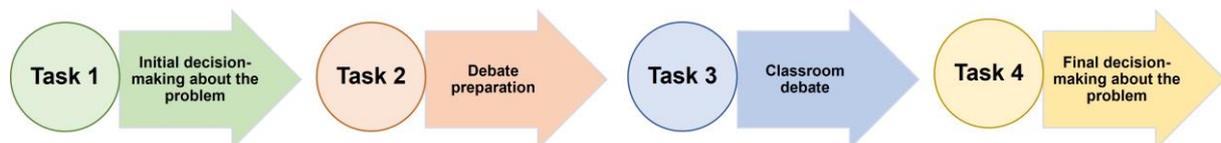


Figure 1. Task included in the debate process.

Figure 2 shows a schematic representation of the possible classroom disposition of the presenter and debaters during the activity.

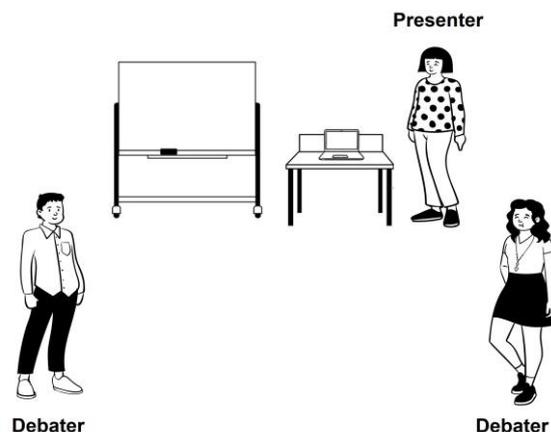


Figure 2. Possible classroom disposition.

3. Results

Starting point about the problem

The examination of the initial decision-making data revealed a notable majority of the PSTs, 57.8%, inclining towards endorsing the prospect of a possible energy blackout. Figure 3 shows the different topics on which the students based their arguments. Their rationale behind this decision was multifaceted, with 44.4% articulating concerns about the unrestrained consumption of energy resources. Two examples provided by students related to this topic were:

I think there are significant indications that could lead to this disaster. Nowadays, we are very dependent on electricity; most daily devices are linked to electricity. We are so dependent that if a blackout were to happen one day, we would suffer paralysis in our daily lives (PST 06).

According to Cope (2021), Europe is one of the world's most secure continents in terms of energy supply, despite its high energy consumption, and therefore one of the least exposed to the possibility of a prolonged blackout, although this does not mean that it cannot happen on occasion (PST 25).

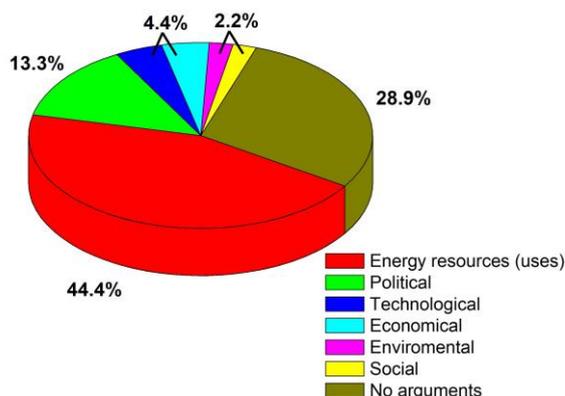


Figure 3. Students' topics justify their arguments in the initial decision-making.

Additionally, 13.3% of the participants highlighted political factors as pivotal in the intricate web of energy supply distribution. Two examples provided by students related to this topic were:

From the information I have gathered in recent months, Europe is not in a perfect energy situation because it depends on electricity from Russia, among other reasons. Thus, with the EU imposing "punishments" on that country, the amount of energy coming from there has



been dramatically reduced, so many problems are currently being experienced regarding this issue. Given this political instability, I think it is possible that such a phenomenon could occur (PST 42).

In my view, it would not be an unexpected blackout. However, the different European governments could orchestrate it for political reasons to alert citizens to the importance of electricity and how we depend on it (PST 43).

It should be noted that the PSTs used, in the minority, other aspects related to technology (4.4%), economics (4.4%), social (2.2%) and environmental (2.2%) aspects to support their arguments. To conclude this section, 28.9% of the students presented conclusions devoid of well-substantiated arguments. It suggests that a considerable proportion relied on conclusive statements rather than thoroughly justifying their viewpoints. Identifying such patterns in the decision-making process adds a layer of complexity to our understanding of the students' thought processes. It underscores the importance of fostering argumentation in evaluating complex issues.

Final point about the problem

The analysis of the final decision-making showed that a prevailing trend emerged among the students, with a substantial 66.7% expressing a stance against the contemplated scenario. Notably, the justifications put forth by this majority predominantly centred around the anticipation of adverse energetic repercussions, constituting a significant 60.0% of the articulated reasons (figure 4). This suggests a heightened awareness among the students regarding the potential negative impacts of the proposed course of action. Two examples provided by students related to this topic were:

Most experts confirm that an energy blackout in Europe is almost impossible. Of course, as in everything else, there are possibilities, but a series of unlikely events must come together to make it practically impossible (PST 11).

The data provided during the debate made me think that despite being energy-dependent on other countries, it is doubtful that there will be an energy blackout. This is, among other things, because we have 50 days' worth of stored energy. Moreover, now that the law has changed, there is a more significant commitment to renewable energies, which makes us more accessible. We must add that the leftover energy is accumulated, and only 13% of the energy produced is consumed (PST 14).

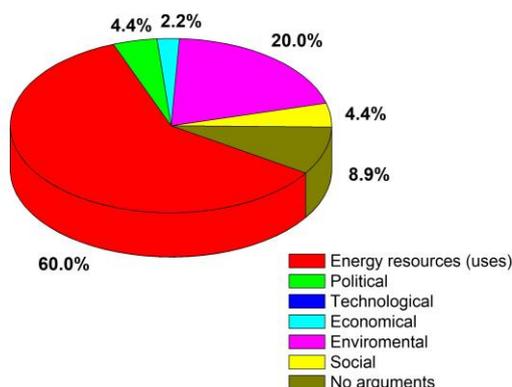


Figure 4. Students' topics justify their arguments in the final decision-making.

Equally noteworthy was the emergence of environmental considerations, constituting 20.0% of the justifications provided for the opposing viewpoint. This underlines a shift in the discourse, with students extending their concerns beyond the immediate energetic consequences to incorporate broader environmental implications. Incorporating such considerations reflects a more comprehensive



understanding of the interconnectedness of energy-related decisions with broader ecological concerns. Two examples provided by students related to this topic were:

The probability is relatively low but not impossible. Moreover, at this low probability, we should already be preparing for other disasters that can occur at a moment's notice, such as a possible tsunami, which also has a probability. Moreover, we should always be prepared for any natural disasters that can occur, which are unpredictable and unavoidable (PST 16).

The current trend is for the electricity system to rely heavily on renewable energy, especially wind and solar energy, which is variable and difficult to predict. If there is a sudden change in weather conditions, such as a heat wave or a storm, renewable energy production could decrease dramatically, which could cause a blackout (PST 41).

In this case, minority categories related to technological, economic and social aspects remained below 5%, while political aspects were drastically reduced (4.4%) after the debate. The post-activity analysis revealed a marked decrease in students abstaining from providing justifications, now at a reduced 8.9%. This positive shift indicates that the structured debate format facilitated by the activity had a discernible impact on enhancing argumentation skills among the participants. The reduction in unreasoned conclusions underscores the potential of debate as an effective pedagogical tool in nurturing critical thinking and encouraging students to articulate their perspectives with greater clarity and depth. This evolution in the decision-making process highlights the educational value of engaging students in structured debates to foster a more informed and articulate citizenry.

Maintenance or change in decision-making

Figure 5 represents the percentage of pre-service teachers who maintained their position (for or against the possible energy blackout) before and after the debate or, on the contrary, changed their decision.

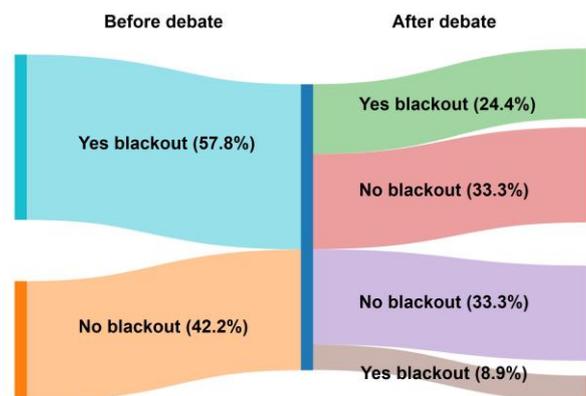


Figure 5. Maintenance or change in decision-making before and after the debate.

In general, students are not reticent to change their positions, as 42.2% of the pre-service teachers made another decision after the activity, regardless of whether their initial position was for or against a possible energy blackout. Remarkably, the most significant change occurred among pre-service teachers who initially indicated that an energy blackout in Europe would be possible and finally decided it would not be possible.

4. Final considerations

The experience with pre-service primary school teachers, focusing on implementing a didactic strategy such as debate to foster the development of critical thinking, has proven to be highly effective. This approach has significantly strengthened key skills, such as argumentation and decision-making, among the participants. The results reveal a substantial improvement in the pre-service teachers' ability to articulate arguments coherently and well-justified. The debate has also enhanced their ability to analyse information, evaluate different perspectives and make informed decisions. This strategy



has provided future teaching professionals an effective platform to explore and express their ideas, fostering an environment where critical thinking is encouraged. The practical application of the debate strategy has boosted the development of crucial competences for their future educational work, as it focuses not only on content mastery but also on reasoning and analytical skills. In summary, the experience based on using debate as a didactic tool has proven to be a valuable pedagogical approach, significantly enriching the training of future primary school teachers and preparing them to face the complex challenges of today's educational environment.

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