

Role-play Activities as a Framework for Developing Argumentation Skills on Biological Issues in Secondary Education

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Abstract Argumentation is a necessary skill for every citizen in a modern democratic society. Although in recent years many countries have incorporated it into their science curricula, students have been experiencing difficulties in developing argumentative skills. Socio-scientific issues (SSI) and role-playing activities, are thought to constitute ideal frameworks for helping students overcome these difficulties. The purpose of this study is to examine the degree of which a role-playing activity created by 10th grade's Greek State school students and relevant to an SSI from the field of Biology can enhance their argumentation skills. Students answered five open-ended questions, and their arguments were evaluated based on the Toulmin's model. The results showed that despite the general low level of arguments provided by the students, there was an indicative improvement in the argumentation level of question number 3. This indicates that a creative role-playing activity which actively involves students can have a positive impact on the development of students' argumentation skills. The increase in argumentation level was also reflected in the students' ability to construct stronger arguments during the activity, which has a promising interpretation.

Keywords: *argumentation, socioscientific issues, science education, biology education, creative role-playing, vaccination*

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1. Introduction

Nowadays life is highly influenced by rapid developments in science and technology, as well as one's ability to think critically and make sound decisions based on the arguments presented is essential. As only a limited group of citizens possesses the knowledge required to manage complex scientific and technological issues, a problem is created for democratic systems [1]. A central element of education in a democratic society is the preparation of individuals with critical thinking skills, which empower them both to make decisions about issues concerning their lives, and to construct arguments related to applications of science in the society [2]. The issues that people are required to address in modern societies are both individual and collective [3]. Such issues, which deal with many different fields at the same time, are called Socio-scientific Issues (SSI) and are considered controversial as they can be resolved in different ways depending on one's point of view [3,4,5]. Argumentation, the ability to form and negotiate arguments [8], is not only an effective tool for discussing such issues [5,7], the teaching methods that strengthen argumentation are also considered to be at the heart of an effective science

teaching [9]. In this paper, we examine the role of "creative" role-playing in the development of argumentation skills in 10th grade Greek students.

2. Argumentation

2.1. Argumentation in Science Education

Argumentation is an important part of decision-making processes and is used to challenge scientific and technological knowledge [1]. It is part of science practice and is used to evaluate, improve and establish new theories [10]. In recent years, there has been a great deal of research done in the field of science education about the incorporation of argumentation in the classroom and its importance in the cultivation of scientific knowledge [1,2,3,5,9,11-19]. In particular, some of these studies have either examined students' ability to produce arguments [5,12,16,17], or suggested teaching frameworks and teaching methods to enhance the aforementioned ability [5,15,18,19]. Other studies have considered the role of the teacher and how it relates to the development of students' argumentative skills [3,21]. The value of developing arguments has been widely recognized, and several countries has already been incorporated it into their

curricula. Some of these are the United States, Cyprus, United Kingdom, Chile, Spain, Australia, Israel, South Africa, Turkey, Canada and Taiwan [16]. In Greece, argumentation is not explicitly included in the State guidelines for Biology curriculum, but rather included merely descriptively, as a component of scientific literacy [16].

2.2. Role-playing in Argumentation

As mentioned above, argumentation can be developed through specific teaching approaches. One of the ways to incorporate argumentation into science classes is through role-playing activities [1,18,20]. Role-play is a method derived from social drama in which students play character roles in a particular scenario [22]. Since playing comes naturally to children, engaging them in a role-playing activity would not only be beneficial for them but joyous as well. Role-playing has been found to encourage even the participation of students who do not normally get involved in classroom discussions [23,24]. Additionally, through role-playing, students learn to rely on themselves, which increases their self-confidence [25].

According to McSharry and Jones [23], role-playing is based on playing, and a student's desire to play and consequently learn is a fundamental part of human psychology. It is also important that the majority of children, especially the younger ones, find role-playing exercises relatively easy and receive a great deal of pleasure and satisfaction from them. It is believed that the use of role-playing in Science enhances a deeper understanding of the subject, while at the same time increases the development of collaborative, communicative and argumentative skills [22]. Usually by playing different roles, the likelihood of understanding other peoples' point of view and opinions increases [26,27]. Cakici and Bayir [28] studied the use of role-playing activities on Israeli students aged 10-11 and found that it facilitated the creation of an appropriate environment for effective learning through communication, collaboration, improvisation and argumentation. Zeidler and Sadler [29] point out that role-playing allows argumentation to occur in an environment relevant to the daily lives of students, constituting a highly successful teaching strategy. Simoneaux [18] suggests using classroom discussions, either through role-playing or through dialogues, as a way to help students develop argumentative skills and scientific literacy. In another recent study, Agell et al. [22] studied how Spanish teenagers use argumentation skills in decision-making through a role-play about an SSI in the field of Biomedicine. They argue that role-playing facilitated the development of argumentative skills of the students who participated in their study. Role-playing also helped them identify different perspectives in SSI (scientific, ethical, legal, social) and provided support in their opinions [22].

2.3. Creativity

The learning environment is an essential part of any lessons' success. Davies et al. [30] studied environments of creative learning at school and noticed significant benefits, such as better academic performance, increased

levels of motivation, enjoyment, engagement, concentration and enthusiasm of students. Furthermore, creative learning environments were found to enhance creative thinking, as well as to contribute to the emotional evolution of students through the development of social skills. Participating in playful activities is considered to be an important factor in the development of creativity. According to Kozbelt et al. [31] creative ideas can emerge through the fun and the tranquility the game offers. The present research examines the contribution of creativity in the light of the construction of a role-play by the students called in this paper "creative" role-play, in which they invent and embody themselves roles as a framework for developing argumentative skills.

2.4. SSI in Role-playing and Argumentation

Due to the rapid development of science and technology, social problems associated with their application in everyday life constitute a central issue in modern societies [4]. Issues such as cloning, renewable energy sources, recycling, in-vitro fertilization and water management are just some of the problems that people in today's societies have to deal with. According to Patronis et al. [1], students are able to develop arguments and come to conclusions when they are actually involved in a situation that they have to deal with. Thus, it is suggested [3,15] that students should be engaging in dialogues and argumentation on scientific issues, relevant to their everyday life and society in which they live in. SSI are complex, controversial issues which require a combination of knowledge from different fields in order to be resolved [32], and are often subject to political and social influences [5]. It has been found that using an SSI framework can get students to use more complex arguments [10], and that students' involvement in the reasoning process may enhance their understanding of the issue presented to them [3].

For the purposes of our study, we chose the currently much discussed SSI of vaccinations. Students already possess the necessary cognitive background from school, and it is also quite likely to arouse their interest, as at that age they begin to form opinions that they will adopt later in their lives [33,34,35]. During the past few years, both in Europe and worldwide, there has been a rise of the anti-vaccination movement. The World Health Organization [36] has called the anti-vaccine movement an international health threat, with an increase of 30% in measles outbreaks worldwide in 2018 [36]. Measles is a disease which can be completely prevented by vaccination, and the population is considered to be immune when 95% of individuals are vaccinated. Europe recorded a measles outbreak of 85,000 cases and 74 deaths in 2018 [36]. The controversy over this vaccine began in 1998, when a study linking the measles-mumps-rubella (MMR) vaccine to autism was published in the British Medical Journal *The Lancet*. Although the study was proved to be false and was rejected by the journal and the doctor published this study lost his license, some groups of people remained skeptical about vaccination. Other factors that contributed to the rise of the anti-vaccination movement were misinformation, the loss of trust in the system, the shift to "anti-systemic" politicians who often oppose mandatory

vaccination, and the development of alternative therapies such as homeopathy. Based on the 2018 data, WHO [36] ceases to believe that the disease has been 'eliminated' in the United Kingdom, Greece, the Czech Republic and Albania. Specifically, in Greece there were 2,193 cases in 2018 [36]. The issue of vaccination is therefore crucial for maintaining global health.

2.5. Research Question

Can a role-play activity, developed by the students, improve their ability to express arguments when involved in a vaccination-related SSI?

3. Methodology

The present study was conducted to determine the degree to which a student-designed role-playing activity (creative role-playing) contributed to their ability to develop arguments involving an SSI relating to vaccinations. The students' arguments were analyzed both quantitatively before (pre-test) and after (post-test) the role-play, and qualitatively during and after the activity. For the quantitative evaluation of the arguments, a research tool (questionnaire) consisting of five open-ended questions was created (Appendix), and the structure of the arguments were analyzed according to the Toulmin's argumentation model [37]. The role-play was recorded and transcribed, and the oral arguments of the students were qualitatively analyzed.

3.1. Participants

The sample consisted of twenty-two 10th grade Greek State school students, of which ten were boys and twelve were girls. However, since four boys and one girl were absent from one of the lessons, their answers were not taken into account in the final results. This reduced the actual number of participants in the study to a total of seventeen. The participating students were from a public school in the southern suburbs of Attica and they were mean achievers according to their school teachers. They had no prior experience in argumentation, as they had never been taught methods of developing an argument.

3.2. Scenario

The intervention was conducted in four sessions, for a total of six teaching hours (i.e., two one-hour and two two-hour sessions during Biology class hours). The purpose of the intervention was for students to create a role-play focused on a framework provided by the researchers to address the SSI "Vaccinations: Yes or No?".

The following section outlines each stage of the intervention. A brief description of each step in the methodology is presented in Table 1 below.

Introduction to the topic: 1st meeting (1 hour):

In order to examine whether students had the required knowledge of the immune system to formulate arguments relating to it, we created a semi-structured concept map [38] and distributed it to students. Students were asked to individually complete the concept map, so as to provide us

with an idea about their level of knowledge. After this, we presented the immune system to them, based on concepts from the chapter "Human Defense Mechanisms" of the school textbook [39]. A second presentation (Power Point slides) on the history of vaccines followed, which informed the students about the contribution of vaccines to the elimination of extremely serious diseases throughout the human history. Furthermore, the latest data exhibiting the increase in the incidence of certain diseases due to non-vaccination in western countries were presented as well.

Pre-test: 2nd meeting (2 hours):

The students were first asked to individually complete the same concept map for a second time. The overall improvement in students' knowledge of the immune system was briefly evaluated and found satisfactory as most of the gaps on the concept map had been correctly filled in (>7/11 correct answers on average). After that, they were asked to answer the questions of the research tool (questionnaire) which we had created to identify their argumentation level prior to the role-play (pre-test). The questionnaire (Appendix) consisted of five open-ended questions based on concerns about the use of vaccines in modern societies, most of which have emerged from the rise of the anti-vaccination movement in recent years. Students were asked to answer *YES/ NO/ I do not know*, and to justify their answer. The validity of the research tool had been ensured by having it been approved by a biologist, two biology teachers, a biology-teaching researcher, and two biology professors. Reliability was achieved by having the results evaluated separately by the two researchers, who later discussed their disputed answers regarding the levels of argumentation of some students.

A 15-minute clip from the documentary "The Vaccine War" (<https://www.youtube.com/watch?v=VPOrnU3ImxI>) was presented to the class in order to enhance students' interest [22,25,40]. The documentary presents the views of American citizens who are in favor of or against vaccination, so that students were informed of both sides, and would be able to support their views on the issue, regardless of their position.

Organizing the Role-Play Activity: 3rd meeting (2 hours):

At the third meeting the activity was pre-planned so that students would have the opportunity to work in pairs and to participate in a plenary. The formation of two-membered teams was deliberately chosen so that members would actively participate in discussions with each other, thereby eliminating the opportunity for a student to be 'hidden' within a large group. Some of the students would play the roles of characters which they would create by themselves (aided by some researcher-prepared prompts designed to assist students in creating the persona of the characters they created), while other students (in particular those who had been absent from some of the preparatory lessons), were assigned the "observer" role; the observers took notes during the activity and decided the winning team as exclusive judges at the end of the procedure, voting for the most convincing team. In order not to have a single-person team, one student was asked to participate in the role-play even though she had been absent from one of the previous meetings, but her answers

were not evaluated in the final analysis. The procedure in detail follows.

After the students had been organized, we presented the framework of the role-play to them. The issue is an imaginary situation, but one that could also be real [18]:

“In a small village in southern France, near Marseille, which is one of the major Mediterranean ports connecting Africa with Europe, people live in harmony with the natural environment. They consume many of the food items they themselves produce, such as wine, cheese, vegetables and fruits. There are several yoga, homeopathy and meditation centers in the village. Villagers believe that their calm and healthy lifestyle can protect them from the diseases that affect people in big cities.

Plan a role-play: Create roles of people who are both from within the village or outside of it. Then argue why you are in favor or against vaccination.”

A plenary brainstorming session followed in order to create the possible characters for the role-play. Hence, after discussion and various suggestions students ended up with the nine characters used in the activity trying to keep a balance between the characters that could be opposed to or in favor of vaccination: 1) a doctor, 2) a priest, 3) a journalist, 4) a teenager, 5) a biochemistry instructor, 6) a minister of health, 7) a shepherd, 8) a homeopathic doctor, and 9) a mother. As students' number was 18, except of the observers who were 4, it was obvious that 9 different characters were needed, one for each team.

The roles were drawn by lot by each team. All the teams were given one "role form" that included basic instructions for the subsequent role-play and questions/prompts about the characters (such as name, age, occupation, and marital status) designed to help students develop their personas [25]. As has been mentioned, students' prior knowledge of the immune system and vaccines had been assessed through the semi-structured concept map and was found to be sufficient. However, supplementary authentic materials from different sources (newspaper articles, citizen opinions, documentary interviews) accumulated by the researchers was shared with each team, to ensure that students had sufficient data to use in the role-play [28,40]. Each student team worked to develop its character and write down the character's arguments.

Performing the role-play and post-test: 4th meeting (2 hours):

In the final two-hour meeting, the role-playing activity was performed and audio-recorded [10,18,22,24,28]. The rules of the activity were explained, and each team presented its character in plenary [10,18,22,25]. The researcher had just a coordinating role at the procedure. Each team initially presented their arguments on the topic, and a dialogue followed, in which majority of the class participated by raising their hands and asking to take the floor to counterargue the previous character's arguments. After all the teams had put forth their arguments, the observers voted and the game was over [22]. Observers expressed their opinion on which side was more convincing to them. Observers' vote was not used to assess neither the argumentation level of them (or their classmates') nor the total procedure. It was used as to engage students that could not participate in the main

research, taking part at the role play as one of the nine characters. In the same time we found it a constructive way to present all the information about vaccination to those students that were not present at all the four meetings. Observers' vote was in favor of vaccination.

Finally, each student completed the post-test questionnaire, which we used to quantify student's post-intervention argumentation level.

Table 1. Methodological Sequence (Ss: students, R: researcher)

Meetings	Activities
1st	Students (Ss) complete the concept map Researcher (R) revises Ss' immune system knowledge (through ppt presentation) and vaccine history presentation R informs students about the role-playing activity
2nd	Ss once again complete the concept map Ss complete the questionnaire-argumentation level evaluation tool (pre-test) Ss watch a 15-minute documentary video clip
3rd	Ss form teams of two R introduces the role-playing activity to Ss Plenary brainstorming session to fix roles and assign each team a role by draw R distributes supplementary informational material to groups according to their role Each team of Ss prepares for the role-play by developing their characters and arguments using the informational material provided by R
4th	R presents the purpose and 'rules' of the activity to class Ss perform the role-play Ss once again complete the questionnaire -argumentation level evaluation tool (post-test)

3.3. Analysis

The students' written arguments were analyzed according to Toulmin's Argumentation Pattern (TAP) [37]. Claim represents the respondent's opinion, data are the evidence used by the respondent, and warrants are the route that is followed in order to reach the claim. Backings further enhance warrants, and qualifiers reveal the limits of the claim. Rebuttals show the conditions under which the claim is not true (Appendix). Results were analyzed using the scale created by Georgiou [17], which is a combination of TAP with the scale used by Dawson and Venville [5]. It is a five-level scale, with the first level consisting of arguments of only a claim. At the second level, arguments include some data or warrants in addition to the claim. The third level consists of arguments that include claim, data, warrants, and also backings or qualifiers. At the fourth level arguments consist of claim, data, warrants, backings and qualifiers. The fifth level includes all the above, but also rebuttals, the conditions under which the claim is not true. This criteria is shown graphically in Table 2.

Table 2. Description of the levels of argumentation used

Level of Argumentation	Description
1st	Claim
2nd	Claim, data and/or warrants
3rd	Claim, data, warrants, backings or qualifiers
4th	Claim, data, warrants, backings and qualifiers
5th	Claim, data, warrants, backings, qualifiers and rebuttals

4. Results

We collected 17 completed questionnaires (i.e. 85 answers) from the students prior to the role-play and 17 after the role-play (i.e. 74 answers, as some students did not answer to all the 5 questions) (Appendix). Pre-test and post-test evaluation of the level of argumentation was carried out based on the written answers of the students. Figure 1 and Figure 2 show the percentages of students' responses corresponding to each argumentation level before and after their involvement in the role-play, respectively.

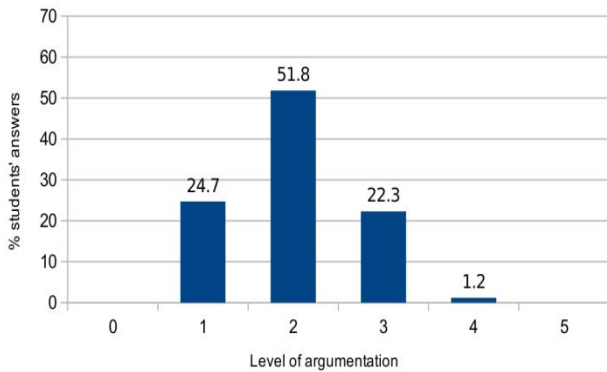


Figure 1. Distribution (%) of students' responses regarding the level of the arguments they developed before the role-play.

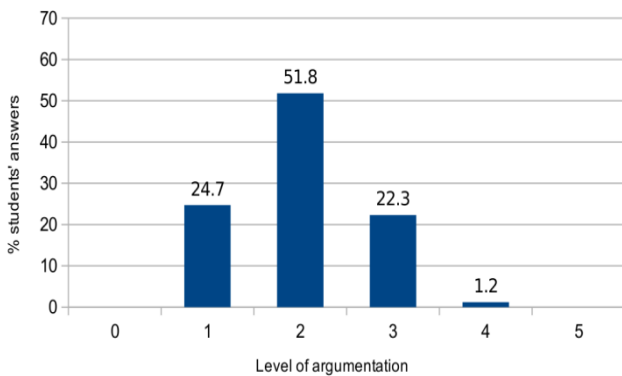


Figure 2. Distribution (%) of students' responses regarding the level of the arguments they developed after the role-play.

As shown in the graphs, both before and after the intervention, most of the responses given by the students were low-level arguments, as they contained only a claim with some data, which corresponds to argumentation level 2, according to the scale we used (Table 2). Arguments of level 3, which include claims, data and warrants, as well as backings or qualifiers, were increased after the role-play activity. More specifically, prior to the role-playing, only 14.1% of the total sample responses were assigned to level 3, a number which increased to 22.3% after the activity. Level 4 arguments were very low in both cases (1.2%), while level 5 arguments were completely absent.

Although our sample was small, we decided, apart from the descriptive statistics, to make a statistical comparison of the overall level of students' arguments before and after the role-play with the IBM SPSS statistical program. It was found that there was no statistically indicative difference at the argumentation level before and after the

role-play. Besides, working on a small group of participants, we could not refer to statistical significance but only to indicative. We followed the same procedure checking the argumentation level of each question individually. The five questions of the research tool were analyzed and evaluated regarding their level of argumentation, as shown in Figure 3.

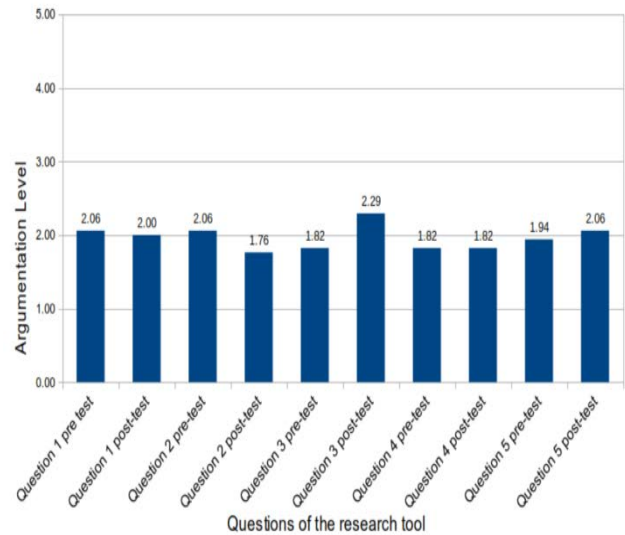


Figure 3. Average argumentation level in each of the questions before and after the role-play.

The evaluation revealed that four of the questions did not lead to an indicative increase in the students' argumentation level after participating in the role-play. The only indicative improvement was found in question 3, $t(16)=-2.426, p=0.027<0.05$.

Finally, the oral arguments of the students were analyzed, after the recorded role-play had been transcribed. The results are presented in Figure 4.

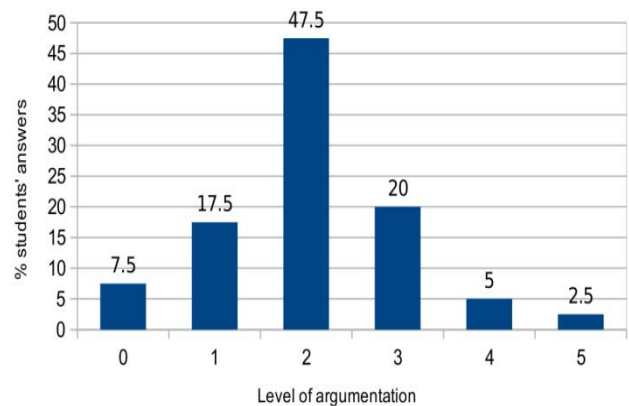


Figure 4. Distribution (%) of students' responses regarding the level of arguments they developed during role-play.

Although oral argumentation during the role-play in class is a completely different process than formulating written arguments, we dared a qualitative comparison of the results. It was observed that, during the activity, students were actively involved in the role-play, as they expressed enthusiasm and constructed more complex arguments. We identified some level 4 arguments and one argument with a rebuttal (level 5) in the oral arguments of the students.

5. Discussion

The results show that some students (8%) managed to increase their level of argumentation from level 2 to level 3 after the role-play. This strongly indicates that there is an improvement in students' arguments, as some constructed more complex opinions. There has also been a 2% increase in Level 1 arguments. This difference should not be interpreted as a decrease in students' argumentation level after role-playing, but could possibly occurred due to other factors such as students' fatigue on the last day, or their reduced motivation to develop arguments that they had previously expressed in both written and oral form during the role-play.

We found that the largest increase, which was also statistically indicative, occurred in question 3, which increased from 1.82 to 2.29 after the role-play (Figure 3). It seems that this question stimulated the students' interest and contributed to their further involvement in the construction of arguments, thereby improving their argumentation level. The question concerned the case of a mother who became reluctant to vaccinate her child after she was informed that the vaccine had caused autism in another child, believing that the diseases which the vaccine protected against were not especially dangerous ones. As emotions are much involved in social processes, including role-playing [30,41], it seems that question 3 which includes the emotional factor led the students to improve their level of argumentation. This observation is very important because it suggests that the involvement of students in an SSI through a creative role-play activity can constitute a framework for developing their argumentative skills when there is emotional involvement.

On the other hand, the decreased in the level of argumentation observed in question 2 is not statistically significant, and this is probably due to the fact that students were not highly motivated to construct more complex arguments after the role-play. Since it may not be the case that the students' argumentation level had decreased after their involvement in the role-play, the decreased score in question 2 may be due to the decreased motivation of the students to argue twice for the same questions. In fact, some of the students had complained during the completion of research tool, stating that they had not changed their minds.

As aforementioned, the role-playing process was recorded and then fully transcribed. Although oral argumentation in groups is a completely different process than formulating written arguments, we dare a qualitative comparison of the results. More level 3 and 4 arguments were found in relation to the written answers, and also a level 5 argument was recorded, as shown in Figure 4. It was also positive that students listened carefully to their classmates' positions and often stated that they agreed with some groups, while disagreeing with others, indicating their active involvement in the process. Students' participation and enthusiasm were clearly greater in the oral role-play than in the completion of their written answers.

For the role-playing activity, the arguments were constructed in groups of two and were orally presented in plenary. Whereas, in the written arguments, students were asked to individually complete the assessment tool twice

(first in the second intervention session, and then in the fourth). It is possible that the free expression and cooperation with their peers was a motivation for students' participation in the role-play. Moreover, the oral arguments were formed in a playful context, which may have raised the students' interest and involvement in the construction of arguments, contrast to the written arguments.

The results of this research suggest that the level of argumentation of 10th grade students in Greek State schools is mainly low-level, but there was a tendency for increasing the level after students participated in a creative role-playing activity on an SSI relative to Biology. The relatively low-level arguments we identified are in line with recent research conducted on the ability of students of the same age to develop arguments about SSIs in the field of Biotechnology [17], in which students also failed to develop strong arguments (74,2% of total arguments were of level 2). Levels 3, 1, and 4 followed respectively, with only 0.6% at the 5th level of argumentation [17]. No written arguments belonging to level 5 were found in the present study, but the sample was considerably smaller. However, a level 5 oral argument was identified during the role-play (Table 2). Arguments at the 5th level are difficult to formulate, especially in written form, as there is no opportunity for discussion with other individuals in order to construct rebuttals.

Studies on the level of student argumentation have also been conducted outside Greece, with similar results. For example in Australia, Zohar and Nemet [6] studies concluded that level 2 arguments were prevalent (56% of total arguments), followed by level 1 arguments and then level 3 arguments, while the 4th level had the lowest percentage of arguments [6]. In another study in England [12], observed high school students discuss in small groups about an SSI, and concluded that level 2 arguments were the ones that prevailed both before and after intervention. They also found that level 3 arguments increased by 6 percentage points, which while not a statistically significant difference, they found to be an encouraging result. Zohar and Nemet [6] also came up with similar results by studying the level of both written and oral arguments and concluded that 90% of the arguments consisted of one statement and few justifications, corresponding to level 2 of the present investigation. In a study by Agell et al. [22] it was observed that in all role-playing dialogues, evidence and justifications were used (corresponding to level 2 of the present study), while few encountered rebuttals (level 5) and transitions to new contexts. According to Agell et al. [22] role-playing is an effective tool for reflection and discussion around SSIs. In this study, some of the students did not complete all the questions of the post-test, which was interpreted by the researchers as having no particular motivation to do so or that they were very tired. This may have been the case in the present study, as some of the students stated that they had already answered the same questions and had not changed their mind or omitted some of their post-test answers. Simmoneaux [18] also suggest the use of classroom discussions, either through role-playing or through dialogue with arguments, as a way to help students develop argumentative skills and adopt scientific literacy [18].

6. Limitations

Students were asked to complete the final evaluation tool with the relevant SSIs at the end of the final two-hour meeting, the day before the school closed for the Easter holidays. This may have been caused by the students' being tired, so it is likely that the written answers given by the students at the end of the process were slightly lower than their abilities. The low performance may also be due to the decreased motivation of students to develop arguments that they have previously constructed in written (pre-test) as well as in oral form (during the role-play). This was noted by some students' comments complaining that they had to answer the same questions again. The decreased motivation of students may also have distorted the results of this study by an increase shown in level 1 of argumentation after the role-play. Future research could be better designed to avoid similar situations by conducting the evaluation at a subsequent meeting so that students complete the post-test evaluation at a more suitable time.

In addition, it is likely that four meetings were not enough for students to develop a significant increase in their level of argumentation. In fact, there is a contradiction among researchers relating to this issue: some support the view that establishing argumentation skills is a long-term process [12], while others had proven that it could be a short one [6]. In future research, students could be given more time to become familiar with both the scientific knowledge relating to the SSI and the mindset of the creative role-play.

Finally, the sample of this research was limited, with only 17 pupils being evaluated on their level of argumentation, so no generalizations can be made. Therefore, the results are indicative and further research with a larger student population is needed - more representative population as well, different regions within Athens and outside Athens, different income households, different income regions, private and public schools- to ascertain the value of using creative role-play for the intended purpose. At present we have captured a first positive trend, mainly during the oral procedure, which we believe to be promising.

7. Conclusions and Implications

The analysis of students' written responses to five socio-scientific questions regarding vaccination, both before and after role-playing, showed that low-level arguments (level 2) prevailed. In a few cases, arguments with claims, data, warrants and backings or qualifiers (level 3) were observed, and in only one case there was an argument containing all of the above (level 4) both before and after the role-play. Arguments containing rebuttals were not identified in any of the students' written answers, but only in the oral arguments during the role-play. The results of the evaluation of the oral arguments could not be compared quantitatively with the arguments evaluated from the written answers, but only qualitatively, as they involve a different kind of discourse, a different way of working (group-individuals), and a different context (improvisational game-answers to specific questions). From the transcript analysis, it was evident that there was

an increased involvement of students in the process with more and stronger arguments. The students showed interest and enthusiasm for the role-play, which was reflected both in their active involvement in developing their roles and in the creative ways in which they described their roles. Role-playing has been found to contribute to creating a positive environment of collaboration, joy and socialization [41], while fostering imagination [24]. Furthermore, this research concludes that playing and having fun can be a source of motivation for students during role-playing activities [25].

Although there was no indicative increase in the level of argumentation of students after applying the role-play, this research suggests that there is some evidence of improvement. This improvement in the level of argumentation was noted both in the percentage of students using level 3 arguments and in the average level of their answers to Question 3 of the research tool. The increase observed in students' level 3 arguments is noteworthy because, although the sample was small, it appeared that some students enriched their arguments with additional components such as backings or qualifiers following the role-play. This is an indication that there has been an improvement in students' argumentation level after the role-play. However, it is worthwhile to conduct further studies with a larger number of participants to confirm these results. It was recognized that creative role-playing facilitated the development of arguments on the reflection raised in Question 3 of the research tool, indicating that engaging in an SSI through role-playing in which students are emotionally involved can be a promising framework for improving students' argumentation skills.

Research on the evaluation of arguments in secondary education in Greece is very limited, so there are not many opportunities for comparing our results with other studies on Greek students. In the present study, we explore argumentation with the aim of encouraging students to be thoughtful and active members of society. Therefore, we argue that research in this direction can be socially valuable because it encourages active citizenship through the development of students' critical skills and their ability to support and negotiate arguments. Consequently, further research on argumentation through creative role-playing activities can benefit modern societies. The present study contributes by providing an incentive for further study on the promotion of argumentation through creative role-playing activities.

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Appendix

Examples of research tool's questions, corresponding students' answers and evaluation levels.

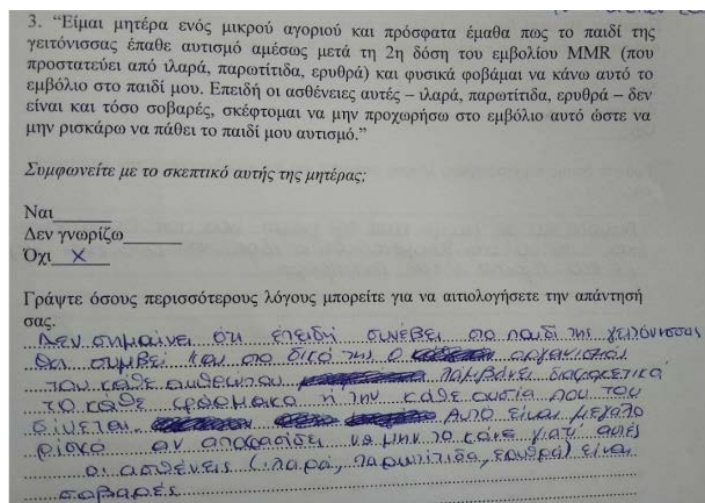


Figure 5. Research Tool Question 1

Statement: "The HPV (Human papilloma virus) vaccine for young girls aged 12-26 has been developed in recent years to prevent cervical cancer caused by the virus. In the future, there will be a corresponding vaccine for young boys.

Q: Do you think this will benefit society even though boys cannot develop cervical cancer?

Student's Answer: Yes. It is very important that the majority [of the population] is vaccinated, as the HPV virus is not transmitted only sexually."

Evaluation level: 2

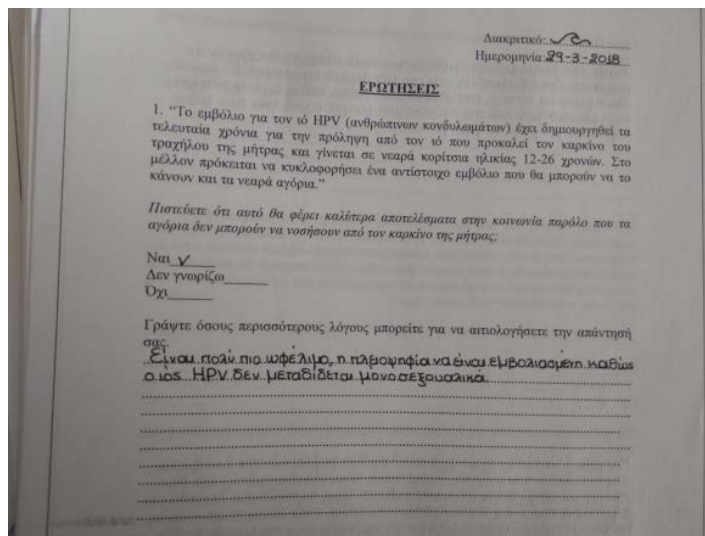


Figure 6. Research Tool Question 3

Statement: "I am a mother of a little boy and I recently learned that the neighbor's child was diagnosed with autism shortly after receiving the second dose of the MMR vaccination (which protects against measles, mumps, and rubella), so of course I am afraid of getting this vaccine for my child. As these diseases - measles, mumps, rubella - are not that dangerous, I think I should not get this vaccine so as not to risk my child having autism."

Q: Do you agree with this mother's reasoning?

Student's Answer: No. It does not mean that what happened to the neighbor's child will happen to hers as well. Every person's body reacts differently to each drug or each substance it is given. It is a great risk if she decides not to do so, because these diseases are dangerous.

Evaluation level: 3

