The Effects of Debating Technique on Science Prospective Teachers' Willingness to Argue: An Example of Discussion as Regarding Renewable Energy Sources

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Abstract
This study aimed to investigate the effect of debating activities on prospective science teachers' willingness to argue. The sample group consisted of 27 students studying in the second year of Science Teaching. The Argumentation Willingness Scale and a structured interview form were used as research tools to collect data in the present study, conducted with an exploratory sequential mixed methods design lasting for five weeks for the purpose of examining the variation in prospective teachers' willingness to argue. The Argumentation Willingness Scale was used to determine the prospective teachers' level of willingness to argue before and after the implementation procedure. The resulting data were analysed with the paired samples t-test (a repeated measures t-test). Content analysis was also used to analyse the data obtained from the structured interview forms, which were administered after the procedure was completed in the qualitative dimension of the study. As a result of the quantitative data analysis, the debating activities were found to be efficacious in increasing the participants' willingness to argue. The analysis of the qualitative data, on the other hand, revealed the prospective teachers' views indicating that debating activities helped them acquirea number of skills such as research skills, discussion skills, and self-expression, and that they would use such activities especially while teaching socio-scientific issues in their professional life in the future.
Keywords: Debate Technique, Willingness to Argue, Science Prospective Teachers, Renewable Energy Sources.

Introduction

In the 21st century, the world's energy demand is constantly growing due to a variety of reasons such as rapid population growth, industrialization, and fast pace of urbanization. In this connection, the ever-growing energy problem is one of the most critical issues of our age. Increasing energy demand is mostly met by current sources of fossil fuels, i.e., natural gas, oil or coal (Acaroğlu, 2013; Öztürk, 2013).The use of fossil fuels, however, poses serious environmental and health hazards due to such sources being unsustainable (Curtin et al., 2019). The inevitable depletion of fossil fuels and the environmental problems resulting from their use encourage people to use clean energy sources with low-carbon emissions. The main goal is,actually, to switch from fossil fuels to clean energy sources (Jiand Zhang, 2019). From this standpoint, renewable energy sources with almost zero greenhouse gas emissions become considerably prominent (Zakhidov, 2008). It seems that renewable resources in nature, such as wind and sun, which can produce energy over and over, will play a major role in the world's future (Demirbaş, 2006).Integrating the issue of the necessity of such resources into education helps to raise awareness in this regard (Cohen & Horm-Wingerd, 1993). As renewable energy sources affect our lives as a whole, they should be taught in schools with utmost attention as a critical topic within science education (Carr & Kirkwood, 1988).

Generally speaking, renewable energy sources are contained within socio-scientific issues in science education. Socio-scientific topics "include scientific and moral reasoning skills for resolving socio-scientific problems related to science and technology." Such topics primarily aim to develop students' scientific thinking habits within the context of socio-scientific issues (MoNE, 2013, p.6-7). Socio-scientific activities not only improve students' discussion skills (Osborne et al., 2004), but also help increase their motivation and interest in the subject (Erduran et al., 2004). Socio-scientific discussion activities integrated into the science environment prove to enable students to develop their decision-making skills by clearly addressing the relevant issue from an ethical, social, and scientific perspective (Ratcliffe, 1996). In this sense, students with the ability to looking at the subject from different perspectives can make a critical evaluation (Osborne et al., 2004).

The Ministry of National Education also recommended drawing upon the debating technique as a socio-scientific way of discussion for the purpose of teaching students the topic of renewable energy resources, which is also an area open to discussion (MoNE, 2006). Debating can be defined as a setting in which two different groups advocate their opposing views as regards a pre-determined topic before a certain jury (Büyükdinç, 2007). During the debate activity, students try to draw a conclusion by evaluating more than one point of view. As a group or individually, they try to persuade the other party to agree to the idea that they have adopted as a result of the process of reaching such a conclusion(Linn et al., 1999).In this respect, students discuss, analyse, and practice rather than passively accepting the given content (Bonwell & Eison, 1991). In order to fully advocate the given content, students are expected to comprehend the supplied subject matter well and improve their critical thinking in order to act in accordance with changing situations (Kennedy, 2007). As a method which helps to create a democratic atmosphere in the classroom, debating enables students to think, discuss, criticize and be criticized, as well as being tolerant of different ideas, and reaching a consensus (Yeşil, 2003).In-class debating practices are also likely to provide students with the opportunity togrow up as individuals who are capable of thinking critically and showing empathy (Kennedy, 2007), as well as questioning, and expressing themselves clearly (Durkin, 2004).

A review of the relevant literature demonstrates that the academic studies conducted on discussion as a teaching method in science lessons generally focus on scientific discussion and argumentation (Akbaş & Çetin, 2018; Chen & So, 2017; Demiral & Çepni, 2018; Konstantinidou & Macagno,2013; Lazarou et al., 2016; Okumuş, 2020; Osborne, 2005).In the teaching and learning process within the science curriculum, teachers assume the role of a guide, while students are considered as individuals who conduct research, question, and discuss information (MoNE, 2013). In this regard, it is of great importance that teachers or prospective teachers make use of the debating method effectively in their lessons. In the present study, as the students of today and the teachers of the future,the prospective science teachers are expected to learn how to use the debating method while they are still students and how to apply it in the lessons that they will teach in the future. It is expected that, while teaching, they will be able to build their lessons around the acquisitions suitable for the use of the debating technique in accordance with the curriculum.

Research Questions

In line with the following research problem: "What is the impact of debating technique on the prospective teachers' willingness to argue?", answers were sought to the research questions presented as follows:

1. Is there a statistical significance between the pre-test and post-test scores of prospective teachers regarding their willingness to argue?
2. What are the opinions of the prospective teachers about the debating activities?

Method

Research Model

Explanatory sequential design was used in this study so as to investigate the impact of the debating technique on the prospective teachers' willingness to argue. The first stage of this design was to collect quantitative data, while the second stage was to

gather and analyse qualitative data. It is well known that qualitative results help explain quantitative data (Creswell & Clark, 2014).The first stage include da single-group pre-test-post-test design, which is one of the weak experimental designs from among the quantitative research methods. The reason why this design was chosen was that this study was conducted in the elective course, namely Renewable Energy Sources, which consisted of a single group instructed by the researcher.

Sample Group

The sample group consisted of a total of 27 prospective teachers - 15 girls and 12 boys- studying at a public university and selected by the convenience sampling,a method which was chosen since the place of study was the university where the researcher worked and instructed the course. In this way, the researcher gave speed and practicality to the work by choosing a close and accessible situation, with the chance to intervene immediately in case of mishaps that may occur during the study (Yıldırım & Şimşek, 2008).

Data Collection Tools

This study was conducted by using the "Argumentation Willingness Scale" and structured interview form as data collection tools.

The Argumentation Willingness Scale was used to measure the students' willingness to participate in discussion activities. The scale first developed by Infante and Ranger (1982) in order to determine students' willingness or avoidance to scientific argumentation was adapted into Turkish by Kaya (2005).Constructed as a 5-point Likert-type scale ranging from "always" to "never", the Scale consisted of 20 items, 10 of which were prepared in a way to determine the students' avoidance of argumentation (Sample item: In a discussion, I am worried that the person whom I am discussing with will have a negative impression of me), whilethe other 10 were prepared in a way to determine their willingness to argue (Sample item: Discussing any subject improves my intelligence). The reliability coefficient of the translated form into Turkish was found as .71, whereas it was found as .68 in the present study.

A structured interview form was used to collect students' ideas about the debating technique. Four open-ended questions were asked in the structured interview form, which are presented as follows:

1. What knowledge and skills did you gain during the debating activities?
2. What are the aspects that you think are your strongest during the debating activities (preparation or discussion)?
3. What are the positive and negative aspects of teaching a lesson with debating activities?
4. How and in which subjects would you draw upon the debating technique in your lessons in the future?

Data Collection Process

The subject matter, namely Renewable Energy Sources, was instructed within six weeks (two hours a week) of the thirteen-week training period. At the end of the sixth week, all students were administered the "Argumentation Willingness Scale" as a pre-test in order to measure their willingness to argue. During the lesson in the seventh week, the students in the experimental group were taught the subject matter in relation to the following questions: "What is a debate?" and "How is it carried out?", after which a mock debate activity was examined together. In addition, students were asked to form groups of 3-4 people for the debate. Two groups of students were formed as debating teams for each renewable energy source, one in favour and the other in opposition. A lot was drawn in order to determine which renewable energy source the students would work on and the groups that would each advocate the positive or negative aspects of the renewable energy sources in question. It was also clearly stated which groups would be debating in the following weeks. The renewable energy sources that the groups would discuss about included solar, hydraulic, wind, and geothermal sources. Each week, one group with positive and the other with negative views made discussions for 45 minutes by using the debating technique,after which the other students in the class voted to determine which group would win the debate. After that, the way the debate was conducted was discussed as a class. As a result of the procedure that lasted for a total of five weeks, the

participants were administered the "Argumentation Willingness Scale", as a post-test in order to measure their willingness to argue. At the end of the five-week process, the students were also administered a structured interview form to collect their views about the activity.

Validity and Reliability Measures Taken During the Study

Prior to the study, the prospective teachers were informed about the study through conducting a sample lesson. The study started and ended with the participation of 27 students,with no loss of participants. During the data collection process, the lessons were held in the same environment with the same lecturer. Data collection tools did not undergo any changes during data collection. Debate activities were held during the courses without allocating any extra time for the activities. After the structured interview form was created, it was sent to two faculty members in order to gather their opinions. During the analysis of the open-ended questions in the structured interview form, another coder, who is an expert in the field, was asked for assistance. Both coders coded the first 10 students independently of each other. Upon ensuring coding reliability between the two coders (78%), the researcher analysed the remaining data alone.

Data Analysis

The answers given for each scale were scored between one and five. Reverse scoring was used for the negative items in the scales. The highest score to be obtained from the Argumentation Willingness Scale was 100, while the lowest was 20. The appropriate t-test was applied according to whether or not the scores obtained from the inventory were suitable for normal distribution. Content analysis, one of the qualitative data analysis methods, was conducted for four open-ended questions presented in the structured interview form.

Results and Comments

The difference between the scores in the pre-tests and post-tests of the Argumentation Willingness Scale were estimated in order to test whether or not our data were normally distributed. As the difference scores proved to be normally distributed (S-W=.967, p=.906>0.05), a paired sample t-test was used to analyse the data. The results obtained from the study are presented as sub-headings in accordance with the purpose of the study and sub-problems.

Table 1 Pre-Test and Post-Test Scores of the Argumentation Willingness Scale

	M	SD	t	p
Pre-test	65.25	6.83	-2.65	.013
Post-test	69.33	8.94		

A statistically significant increase (t(26) =-2.65, p <.05) was found in terms of prospective teachers' willingness to argue,considering their post-activity scores (M=69.33, SD=8.94) in comparison to their pre-activity attitude (M= 65.25, SD=8.83). The Eta squared value was .21, indicating a medium effect size.

Each question in the self-evaluation form was handled as a separate category, and the data analysed with the help of content analysis was presented in four categories.

Table 2 Knowledge, Skills and Insights Gained During the Debate Activities

Codes	Frequency (f)
Research skills	10
Discussion skill	12
Self-expression	10
Listening	8
Respect	10
Subject matter	6

As can be seen in Table 2, six different codes were generated regarding the knowledge, skills and insights gained by the prospective teachers during the debating activities performed in the study. It appeared that the most repeated code was the discussion skill (f=12), while the least repeated was the comprehension of the subject matter (f=6). In addition to these, the codes of research skill, self-expression, and respect were the second most repeated codes. Some of the views of prospective teachers on the subject are presented as follows:

PT5: *"First of all, I have learned that I need to be a good and attentive listener in order to boost up my skills as regards conducting research as well as collecting source and data for an efficient preparation process. I can say that it was a successful study where I learned that I should be able to express myself at the right time and place."*

PT7: *"Within the scope of the subject matter, I gained knowledge in a more permanent way. I also gained the skills of expressing myself, exchanging ideas, and an understanding of looking at an event from every positive and negative point of view."*

PT12: *"The activities have helped me learn to listen more carefully, to take notes of the important points people say and to form opposing opinions, and to be able to respond respectfully to the people we have discussions with."*

PT13: *"The activities have been beneficial in many ways, especially in terms of developing the ability to analyse and discuss, as well as learning to listen to others, pay attention to their thoughts, and show them respect."*

PT16: *"My research skills have remarkably improved. I have realized my shortcomings in my communication skills. My ability to speak in front of the class has grown. I have noticed that I lack some listening and focusing skills."*

PT25: *"I got a lot of new information that I had not previously known. Following the rules of discussion, I learned how to argue in a debate and how to refute a thought."*

Table 3 Strengths during the Debate Activities (Preparation and Discussion)

Phases	Codes	Frequency
Preparation	Research skill	14
Discussion	Staying calm	2
	Promoting idea	4
	Self-expression	3
	Being able to refute the other party	6
	Ouick response	2

Overall, 8 of the prospective teachers said that they felt strong about the preparation phase, while 11 of them turned out to feel strong during the discussion phase. Six students, on the other hand, stated that they felt strong in both stages. A single code was generated as a research skill regarding the preparation phase, while five different codes were created for the discussion phase. Among these codes, being able to refute the other party was the most repeated (f=6), while the codes of quick response and staying calm (f=2) were the least repeated codes. Some of the views of prospective teachers on the subject are presented as follows:

PT8: *"I think I am good at both preparation and discussion. We worked hard before the debate, so our information background was very good. We had very sound and convincing evidence based on both current news and scientific research. As for the discussion, if we asked anyone, they could tell us only a few of the negative aspects of the Sun. I think we resisted quite well against a team that had researched all the positive aspects of it, known and unknown, and had come up with a great deal of information".*

PT13: *"Having done a lot of detailed research made me feel very strong before and during the debate. I also felt very confident due to being able to express myself mostly during the debate, to get minimally excited, and to be able to refute the arguments of the other party."*

PT9: *"Listening to the other side well and responding to their opinions, being able to find answers to everything the other party said to us and turning their opinions in our favour made me feel strong."*

PT18: *"During the discussion, I felt very strong about responding to negative aspects and coming up with relevant solutions."*

PT19: *"I had done a lot of research and read many articles and news about the view that we were going to advocate."*

PT23: *"The aspect I felt most strongly about during the preparation period was the moment when I started to enjoy doing research. I wanted to keep doing research as I learned new information."*

Table 4 Positive or Negative Aspects of Debating Activities

	Codes	Frequency		Codes	Frequency
Positive	The ability of argue	4	Negative	The sense of competition	2
	Group work	5		Shyness	2
	Enjoyable	9		Theloss of respect	7
	Self-expression	5		Tension	5
	Research skill	5		None	5
	Gaining a perspective	3			
	Productive	4			

As seen in Table 4, seven different codes were generated for the positive aspects of the debating activities conducted with the prospective teachers, whereas five other codes were created for the negative aspects. As regards the positive aspects, the most repeated code was being enjoyable (f=9), while the least repeated code was gaining a perspective (f=3). On the other hand, the most repeated code among the negative aspects was the loss of respect (f=6), while the least repeated codes were the sense of competition and shyness (f=2). Some of the views of prospective teachers on the subject are given as follows:

PT1: *"To me, the positive aspect is that it instilled in me the ability to argue and carry out group work, while,I think, the only negative aspect is the sense of competition."*

PT3:*"One of the positive aspects is that students try to express themselves straightforwardly. I guess the students' senses of fear and shyness before debating are some of the negative aspects of the activity."*

PT7:*"I believe that teaching the course in a way other than the classical method changes the course environment and makes the students, namely us, gain certain skills apart from theoretical knowledge,such as expressing oneself, discussing ideas, putting forward claims, and refuting the claims of the other party."*

PT11*:"Listening to different opinions and showing respect, as well as being able to express one's own opinions are positive aspects, while the likelihood that the respect among the students can be damaged as a result of disagreeing with each other's opinions could be assumed as a negative aspect."*

PT16:*"It allowed us to learn while having fun. I can say that the permanence of the subject was boosted after such exciting moments when we were all ears, trying to choose our side while they were having a debate about the topic, and when suddenly the other group proved to be victorious though one group seemed to have been winning up until then. As this method directed us to sources different from the textbooks, we read and reinforced the subject matter many times. The necessity of advocating the topic provided more attachment to the subject and made us learn willingly. This way, the participation of the whole class was ensured. I could not find any disadvantages."*

PT21: *"There are many positive aspects;for example, the opportunity to ensure cooperative learning, group work, and self-confidence. I donot think there are any negative aspects, but because of the nature of people, they can sometimes fail to be have with respect and understanding, and this can be distrustful and upsetting for the other party, even for the whole group they belong to. I mean, if it does not happen during a debate, I can say that there are no other negative aspects."*

Table 5 Using the Debating Method in the Future

Using statues	Codes	Frequency
Using	Genetic	4
	Earth and Universe	5
	Living Things and Life	4
	Socio-scientific Issues	6
	Environmental Issues	2
Unanswered		5

Five students left the given question unanswered when asked about whether they would like to use the debating method in their professional life in the future. The topics for which this method can be used were gathered in two groups, namely Earth and Universe, and Living Things and Life, which are among the four subject areas in the knowledge area of the science curriculum. In addition, a code of socio-scientific issues in the Science-Technology-Society-Environment dimension was created out of the answers given.

PT2: *"Now I can hold debates on genetics or on cloning in biology."*

PT5:*"I will definitely use this method very frequently in my future classes. I will probably make use of it for certain topics such as the Earth and the Universe, and Living Things and Life."*

PT9:*"Now I can have debates conducted on controversial topics, such as the positive and negative aspects of GM foods. This way, students can gain the ability to express themselves."*

PT12: *"By using various topics that concern the society, such as global warming and genetics, which have advantages and disadvantages, I can learn during the debate the opinions of my students on the relevant subject and can also get them to learn something better and permanent."*

PT17:*"In the future, I will use this method in my lessons on environmental issues because, unfortunately, not every subject of our lesson is suitable for debating activities. For example, I can make a small-scale discussion to make students gain the acquisition, which is'F.5.6.2.4: Discuss the benefits and drawbacks of the interaction between humans and the environment by giving examples', under the Human and Environment unit."*

Conclusion and Discussion

The main purpose of this study was to observe the variation in prospective science teachers' willingness to argue about renewable energy sources through debating activities. It was obtained from quantitative data analysis that debating activities caused a statistically significant increase in discussion requests. The results of the quantitative data analysis show that debating activities caused a statistically significant increase in their willingness to argue. As can be seen in the results section, the results of the qualitative data analysis demonstrated that positive answers were received from the students in terms of the knowledge and skills they acquired.

The quantitative results also indicate that the debating activities caused a significant increase in the participants' willingness to argue,which can be associated with a moderate effect. Our results were in conformity with many other studies in the literature conducted with scientific discussion method (Bilasa &T aşpınar, 2018; Gülhan, 2012; Kaya, 2005; Yalçın Çelik, 2010). In addition, YalçınÇelik (2010) revealed that besides the students' willingness to argue, the quality of the items contained in the discussion process became higher.

According to the qualitative data, the students' opinions about the debating activities seemed quite positive. In like manner, another study conducted with science teachers reported quite positive views of teachers about debating as a teaching method (Şimşek et al., 2012). The participants in this study stated that they gained some skills such as research skills, discussion skills, and self-expression during the debate activities. The relevant literature review also indicates that the debating activities will not only improve the students' discussion skills (Osborne et al., 2004; Yeşil, 2003), but also their self-expression skills (Durkin, 2004). During the activities, some of the students found themselves strong during the preparation phase, while others appeared to feel that way during the discussion. In particular, they said that they felt strong while doing research during the preparation stage, and mostly in terms of expressing themselves, advocating their ideas, and refuting the arguments of the other side during the discussion stage. The ability of students to justify their ideas can be developed both by finding an innovative way to present their ideas (Jagger, 2013) and by having a good command of the subject(Kennedy, 2007). Finding new resources that would enable them to advocate their ideas during the preparation phase appeared to have made the students feel strong, and during the discussion, the students who had a lot of scientific data at hand and used it to outperform the other side ended up feeling strong. In general, the positive aspects of the debate activities were related to group work, enjoying the course hour,

and gaining research and discussion skills, whereas the negative aspects were associated with loss of respect and feeling shy. The results obtained are similar to those reported in the relevant literature. A similar study in the literature conducted with science teachers reported that, during the debate, students' participation in the lesson was higher and the lesson ended up being more fun (Şimşek et al., 2012).In another study, the students' willingness and motivation to speak turned out to grow, and even the students who were reluctant to the lesson appeared to have been encouraged to participate in it. With the lesson becoming more fun, the self-confidence of the students increases (Buyruk et al., 2018).Jagger (2013), on the other hand, reported that classroom discussions allowed a setting with a high level of participation through interactive group discussions, and that students can gain experience in terms of respect, empathy, and tolerance. The lack of discussion skills in students and their unwillingness to agree to different perspectives are,however, considered as a weakness with respect to discussion methods (Clark et al., 2003). The prospective teachers included in this study appeared to be willing to use the debating method in their professional lives, especially in the context of teaching socio-scientific issues. Socio-scientific activities used in a science environment are likely to help students develop both decision-making and discussion skills (Osborne et al., 2004; Ratcliffe, 1996). In a similar sense, the development of students' discussion skills helps them comprehend social issues (Nussbaum, 2002).

When the quantitative and qualitative data from the research are evaluated together, it can be concluded that the debate activities exert a positive influence on the willingness of prospective teachers to argue. The use of discussion activities in the lessons will definitely increase the active participation of the students and ensure that the lessons will become more efficacious. During the preparation stage for a debate, students' ability to make use of different sources and gather information about the subject matter will help them learn to use the necessary research steps. Through debating activities, students are likely to learn to work in cooperation as a team, which is indeed one of the most important life skills. Such activities will also enable them to learn to respect different ideas as well as developing empathy and tolerance.

Limitations and Recommendations

The present study examined the debate technique and variables as regards the willingness to argue. The study is, therefore, limited to those variables. Future studies can be conducted on different variables (critical thinking, democratic attitude, and speaking skill, etc.).Moreover, since this study was limited to a five-week period with the participation of 27 prospective science teachers studying in the second year, further studies may be conducted with larger sample groups in extended time periods. In conclusion, it is a fact that science course is rich in that it is composed of various socio-scientific issues. Debating technique can,thus, be used as a teaching method in different subjects and at different educational levels.

References

Akbaş, Melike., and Pinar Seda Çetin. "The Investigation of Gifted Students' Argumentation Level and Informal Reasoning Related to Socio Scientific Issues." *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education*, vol. 12, no. 1, 2018, pp. 339-60.

Bilasa, Pinar, and Mehmet Taşpınar. "The Effect of Argumentation-Based Science Learning Approach on Pre-Service Teachers' Critical Thinking Skills and Willingness to Discuss: Example of Gazi University." *Ahi Evran University Jounal of Kırşehir Education Faculty*, vol. 19, no. 1, 2018, pp. 555-77.

Bonwell, Charles C., and James A. Eison. *Active Learning: Creating Excitement in the Classroom*. ERIC Digest, 1991.

Buyruk, Arzu Arslan, et al. "The effects of Understanding by Design (UbD) Model enriched with Model of Motivational Design on the Students' Speaking Skills and Motivation in English: A Design based Research." *Journal of Higher Education and Science*, vol. 8, no. 1, 2018, pp. 82-94.

Büyükdinç, Nesibe Feyza. *Munâzara as a Teaching Method in Ottoman Colleges and Ahmad*

Cavdat Pasha's Work named ÂDâb-i Sadâd. Marmara University, 2007.

Carr, Malcolm, and Valda Kirkwood. "Teaching and Learning about Energy in New Zealand Secondary School Junior Science Classrooms." *Physics Education*, vol. 23, 1988, pp. 86-91.

Chen, Yu, and Winnie Wing Mui So. "An investigation of Mainland China High School Biology Teachers' Attitudes toward and Ethical Reasoning of Three Controversial Bio Ethics Issues." *Asia-Pacific Science Education*, vol. 3, no. 1, 2017.

Clark, Ann-Marie, et al. "Collaborative Reasoning: Expanding ways for Children to Talk and Think in School." *Educational Psychology Review*, vol. 15, no. 2, 2003, pp. 181-97.

Cohen, Stewart, and Diane Horm-Wingerd. "Children and the Environment: Ecological Awareness among Preschool Children." *Environment and Behavior*, vol. 25, no. 1, 1993, pp. 103-20.

Creswell, John W., and Vicki L. Plano Clark. *Mixed Methods Research Designs*, translated by Y. Dede and S.B. Demir, Anı Publishing, 2014.

Curtin, J., et al. "Quantifying Stranding Risk for Fossil Fuel Assets and Implications for Renewable Energy Investment: A Review of the Literature." *Renewable and Sustainable Energy Reviews*, vol. 116, 2019.

Demiral, Ümit, and Salih Çepni. "Examination of Pre-Service Science Teachers' Argumentation Skills on a Socio Scientific Issue." *Ahi Evran University Journal of Kırşehir Education Faculty*, vol. 19, no. 1, 2018, pp. 734-60.

Demirbaş, Ayhan. "Global Renewable Energy Resources." *Energy Sources*, vol. 28, no. 8, 2006, pp. 779-92.

Durkin, Kathy. *Adapting to Western Norms of Academic Argumentation and Debate: The Critical Learning Journey of East Asian Masters Students in the U.K*. Bournemouth University, 2004.

Erduran, Sibel, et al. "Tapping into Argumentation: Developments in the Application of Toulmin's Argument Pattern for Studying Science Discourse." *Science Education*, vol. 88, no. 6, 2004, pp. 915-33.

Gülhan, F. *The Investigation about the Effect of Argumentation on Socio-Scientific Issues in Scientific Literacy for Eighth Grade Students, Tendency in the Argumentation, Decision making Skills and Science-Social Problems of Sensitivity*. Marmara University, 2012.

Jagger, Suzy. "Affective Learning and the Classroom Debate." *Innovations in Education and Teaching International*, vol. 50, no. 1, 2013, pp. 38-50.

Ji, Qiang, and Dayong Zhang. "How much does Financial Development Contribute to Renewable Energy Growth and Upgrading of Energy Structure in China?." *Energy Policy*, vol. 128, 2019, pp. 114-24.

Kaya, Osman Nafiz. *The Effect of Teaching based on Argumentation Theory on the Achievement of the Students related to the Particulate Nature of Matter and Conception of the Nature of Science*. Gazi University, 2005.

Kennedy, Ruth. "In-class Debates: Fertile Ground for Active Learning and the Cultivation of Critical Thinking and Oral Communication Skills." *International Journal of Teaching & Learning in Higher Education*, vol. 19, no. 2, 2007, pp. 183-90.

Konstantinidou, Aikaterini, and Fabrizio Macagno. "Understanding Students' Reasoning: Argumentation Schemes as an Interpretation Method in Science Education." *Science & Education*, vol. 22, 2013, pp. 1069-87.

Lazarou, Demetris, et al. "Argumentation in Science Education as a Systemic Activity: An Activity-Theoretical Perspective." *Learning, Culture and Social Interaction*, vol. 14, 2017, pp. 51-66.

Linn, Marcia C., et al. "Organizing Principles for Science Education Partnerships: Case Studies of Students' Learning about 'Rats in Space' and 'Deformed Frogs'." *Educational Technology Research and Development*, vol. 47, 2019, pp. 61-84.

MoNE. *Primary Science and Technology Curriculum (6, 7 and 8 Grades)*. Ministry of National Education, 2006.

MoNE. *Primary Science and Technology Curriculum (6, 7 and 8 Grades)*. Ministry of National Education, 2013.

Nussbaum, E. Michael. "Scafollding Argumentation in the Social Studies Classroom." *The Social Studies*, vol. 93, no. 2, 2002, pp. 79-83.

Okumuş, Seda. "The Effect of Argumentation Supported Cooperative Learning Model on Academic Achievement, Critical Thinking Dispositions and Attitudes towards Socio-Scientific Subjects." *Ondokuz Mayis University Journal of Education Faculty*, vol. 39, no. 2, 2020, pp. 269-93.

Osborne, Jonathan, et al. "Enhancing the Quality of Argumentation in School Science." *Journal of Research in Science Teaching*, vol. 41, no. 10, 2004, pp. 994-1020.

Osborne, Jonathan. "The Role of Argument in Science Education." *Research and the Quality of Science Education*, edited by Boersma, Kerst, et al., Springer, 2005, pp. 367-80.

Öztürk, H. *Renewable Energy Sources*. Birsen Publishing, 2013.

Ratcliffe, Mary. "Pupil Decision-making about Socio-scientific Issues within the Science Curriculum." *International Journal of Science Education*, vol. 19, no. 2, 1997, pp. 167-82.

Simşek, Huseyin, et al. "Primary Science and Technology Teachers' Selection of Using Teaching Methods and Techniques and the Levels of their Applications: The Sample of Şanlıurfa City." *Mustafa Kemal University Journal of Social Sciences Institute*, vol. 9, no. 18, 2012, pp. 249-68.

Yalçın Çelik, Ayse. *An Analysis of the Influences of the Teaching Approach based on Scientific Argumentation on High School Students' Conceptual Understanding, Attitudes, and Willingness for Argumentation and the Quality of Argumentation*. Gazi University, 2010.

Yeşil, Rustu. "The Human Rights Foundations of Democratic Educational Environment." *Gazi University Journal of Kırşehir Education Faculty*, vol. 4, no. 2, 2003, pp. 45-54.

Zakhidov, R.A. "Central Asian Countries Energy System and Role of Renewable Energy Sources." *Applied Solar Energy*, vol. 44, 2008, pp. 218-23.

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