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Science Teachers' Views towards Argumentation

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Abstract. The aim of this study was to determine science teachers' views about argumentation-based science lessons. 6 science teachers, work in middle schools at the city centre of Aydın, were chosen via the typical case sampling technique, as a purposeful sampling technique. Before argumentation based lesson implementations in middle schools, science teachers attended to pre-service education program about how teachers integrate argumentation in their science lessons. Semi-structured interviews realized with participants who successfully completed this education program and perform argumentation based science lessons in their school. The findings of the interview data pointed that teacher did not know the meaning of argument before attending this study, took a long time to prepare argumentation based lessons but this lessons was enjoyable in practicum. They stated that it is hard to teach students about evidence and justification of argumentation but students attend lessons actively. Teachers explained that they selected type of activity according to topics given in science lessons but they did not implemented argumentation based lesson except for argumentation based activities used in study. Junior teachers take attention to teach students argumentation based activities and inquiry based science lessons in order to improve inquiry skills.

Keywords. Argumentation, science teachers, science education.

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One of the aims of science education in recent years is that each individual is science literate (MoNE, 2018). In order to make students science literate, it is an important factor to enable them to understand science concepts and ideas. Trying to give these concepts to students only through experiments and observations is not enough for them to have knowledge about the concepts. It is important to give students inquiry skills in order to enable them to access constantly changing scientific knowledge (Trend, 2009). In the development of these skills, students should be provided to "interact with ideas" (Osborne, 2002). Differences in the perspectives towards education have brought along some pedagogical studies on activities carried out in the classroom. Argumentation efficiency has an important place in these studies (Trend, 2009). Scientists rely on the soundness of the arguments when deciding which of the competing theories to accept, arising from the difference in interpretation. In this context, individuals who think scientifically evaluate theories according to the evidence that leads to the formation of theories. The argument helps students, teachers and prospective teachers to make decisions using scientific evidence in the decision process. Similarly, students should have the skills to question arguments and make decisions in order to express their perspectives. Argumentation plays an important role in gaining this perspective. At the same time, students' participation in scientific discussion also supports their scientific writing skills. In this sense, if the discussion in the classroom environment advances the norms of scientific argumentation, students produce stronger scientific writings (McNeill, 2011).

Researches show that conscious discussions are inadequate in science lessons in primary schools and this is related to questioning structures (Günel, Kıngır, & Geban, 2012). Therefore, meeting with argumentation requires a change in the prescriptive nature of speaking in class (Namdar & Salih, 2017). However, in order for the change to take place; science teachers need to be aware that argumentation is an important component in science education. In addition, if they adopt argumentation in the classroom, teachers need a certain amount of pedagogical strategies in order to both initiate and maintain argumentation (Yıldırır & Nakiboğlu, 2014).

Yakmacı Güzel, Erduran, and Ardaç (2009) investigated to what extent and how candidate chemistry teachers use the argumentation technique. As a result of the research, the chemistry teacher candidates successfully integrated argumentation into their lessons and they were able to successfully apply what they learned during the training to their lessons. Tümay and Köseoğlu (2011) showed that argumentation-based chemistry teaching based on open-thinking teaching approach will improve pre-service chemistry teachers' thoughts about argumentation, gain scientific

thinking and questioning skills, support conceptual change and meaningful learning, develop understandings about the nature of science, and increase interest in the lesson.

Aktamış and Atmaca (2016) took the opinions of the third year science teaching undergraduate students about argumentation. The students stated that it provides permanent learning, provides a free environment where they can present ideas, and encourages research and questioning, but that it will cause time problems to prepare. In addition, the students had problems in the discussions within and between groups. The communication skills are not gained in argumentation and that students do not evaluate their own ideas and opposing views at the desired level (Apaydın & Kandemir, 2018; Erduran & Jimenez-Aleixandre, 2007). The students of chemistry teachers and chemistry teacher candidates were successful in describing the argument, in listening and speaking patterns during argumentation, in using evidence, but their students were weak in terms of encouraging discussion and reflecting on the argumentation process (Yıldırır & Nakiboğlu, 2014). In another study, teachers' question structures in argumentation-based science lessons positively affected students' participation in negotiations and there was a significant change in the quality of students' questions (Günel, Kıngır, & Geban, 2012). For this reason, it is recommended to design classroom environments according to an inquiry-based approach and to create classroom environments based on inquiry-based education that includes argumentation.

Many science education studies (Günel, Kıngır, & Geban, 2012; Yakmacı Güzel, Erduran, & Ardaç, 2009; Yıldırır & Nakiboğlu, 2014; Tümay & Köseoğlu, 2011) showed that argumentation is both a necessary scientific thinking skill and an effective teaching method in science education. However, studies have revealed that argumentation practices in science education are insufficient and draw attention to the necessity of teacher education (Erduran & Jimenez-Aleixandre, 2007; Osborne, Erduran, & Simon, 2004). Pre-service teachers see argumentation as a basic element of science and to see it as a tool to develop conceptual development in science education. The creation of an inquiry-based classroom environment supported by critical discussion provided argumentation-supportive science teacher candidates with an opportunity to negotiate (Özdem, Ertepinar, Çakıroğlu, & Erduran, 2013). In addition, teachers who participate in argumentation-integrated teaching tend to include argumentation in their classrooms (Demiral & Çepni, 2018; Erduran & Jimenez-Aleixandre, 2007; Özdem, Ertepınar, Çakıroğlu, & Erduran, 2013). In the light of these studies, the views of science teachers on argumentation-based teaching can be examined and the opportunity to have information about the advantages and limitations of argumentation in

classroom practices and in-service and pre-service trainings about argumentation that will be given to them.

At the same time, when we examine the NRC (2012) programs, "creating and evaluating scientific evidence and explanations" and "writing the arguments to support the evidence, using appropriate and sufficient evidence to make valid reasoning" were seen as the gains aimed to be gained by the students. In the last science programs, students are expected to participate in verbal and written argumentation by using the rules of reasoning and evidence in scientific discussion. When the changes made by the Ministry of National Education (2018) in Science courses are examined, argumentation is shown as one of the learning environments in which the student will be active and the teacher will be a guide and guide in the planning and implementation of the lessons in the strategy and methods section adopted in the basic approach section of the program. In addition, skills are expected about the argumentation of the teachers. The importance given to argumentation has increased in the changes made in the science curriculum. In this context, the science teachers have acquired the skills of argumentation and at the same time, it is necessary for their students to have sufficient equipment to gain these skills. However, when the literature is examined, the fact that there are not many studies on improving the argumentation skills of science lesson teachers reveals the necessity of this study. In this study, it was aimed to get the opinions of the science teachers about the argumentation education given and its application in their lessons.

Method

Research Model

In this study, basic qualitative research design was used to examine the views of science teachers about argumentation-based science lessons and the argumentation processes. Since the basic qualitative research study aims to examine the researched subject in depth, it requires a small number of participants (Metin, 2014). Basic qualitative research studies are more economical than other studies. Also, it is effective in revealing effective data in understanding the causes or consequences of events (Flyvbjerg, 2006). For this reason, in this study, the views of the teachers on the argumentation education given and the argumentation-based practices in the lesson were examined in depth by interviewing the science lesson teachers.

Study Group

The study group of the research consists of a total of 6 science teachers, three male and three female teachers, who practice in secondary schools located in the city center of Aydın. In the study,

the real names of the teachers were not used, instead pseudonyms were given. Ayşe has been working as a Science teacher for 6 years, Ahmet for 8 years, Rıza for 6 years, Galip, Gamze and Banu for 1 year. These teachers were educated in the science education department of a university in Türkiye at the graduate level in science education. While choosing the teachers, attention was paid to the fact that they were volunteers and that they had not received any argumentation-based training for a long time before and did not practice in their own lessons. In the study, participants were determined among the teachers who practiced in public secondary schools with the typical case sampling method. Students in schools where teachers work are individuals from middle-class families in terms of socio-economic level. It is necessary to have a library in these classrooms, to have at least one computer with internet access for research purposes in the classroom, to have the necessary classroom organization for group work, etc. attention was paid to the availability of facilities. The purpose of using typical case sampling is to have an idea about a particular field by studying average cases or to inform those who do not have sufficient knowledge about this field, subject, practice or innovation (Patton, 2002). Based on the results of such a study, it is possible to get an idea about the argumentation education given to science teachers and their views on its application in the lesson.

Data Collection Tools

A semi-structured interview form was used as a data collection tool in the study. The questions in the semi-structured interview form were prepared by examining the literature (Knight & McNeill, 2011). Through semi-structured interviews, teachers' views on their practices and argumentation were collected. In order to ensure the internal validity of the interview questions, the interview questions were examined by a field expert. Written data obtained from the interview with the expert were examined, and it was asked to examine whether the answers reflected the answers to the questions asked, whether they covered the researched subject, whether they were clear and whether they provided the requested information. Some expressions were simplified in order to understand the questions that were not understood as a result of the pilot interview conducted during the formation of the interview questions. Some of the interview questions were excluded because they did not serve the purpose of the study. In this way, it was decided that the research questions were valid and reliable for the study, and the data collection process was started. In order for the participants to be comfortable and to give honest and correct answers during the data collection process, the following questions were asked:

1. What do you think about the practice of argumentation? What parts were you good at or where you had difficulty during the lesson?

a. How was the participation of the students in the lesson?

b. Did you feel that the students were worried or afraid?

2. How did you design the activity that you will implement during a lesson, did you use additional resources? Can you tell me what you did during a lesson?

3. Which technique did you use in the worksheet you prepared? Can you explain why you chose this?

a. Did you use other resources while preparing it?

4. Considering the general framework, which part do you think is the most difficult for your students?

5. How would you teach the same subject to students if you weren't teaching your class by using argumentation?

6. Was it difficult for you to apply the activities you learned during the argumentation training?

a. Which part is difficult? Preparing the worksheet or teaching them?

7. Do you think that the argumentation training you received while designing the lesson was beneficial for you? Can you explain?

8. When you consider the process before you get argumentation based training, do you think argumentation based training will have an impact on your lecture?

Process

In the study, six science teachers were given a total of 15 hours of training, three hours a week for five weeks, on what argumentation is and how to practice it in the lesson. Argumentation teaching was given to volunteer teachers during the postgraduate education process through presentations, which includes the definitions of argumentation, argument structures, functions, the application of arguments and the criteria used in the evaluation of the validity of the arguments and their evaluation. Within the scope of the training they received, the teachers developed sample activities to apply in their lessons and applied the activities they developed in their classrooms. At

the end of the process, the teachers collected and evaluated the students' written arguments for the activities (Table 1).

Table 1.

Argumentation Program

Weeks	**Topics**
1. Week	What does argument and argumentation mean?
2. Week	Scientific argumentation and the importance of using argumentation in science education
3. Week	Components of argumentation
4. Week	Techniques that can be used to improve argumentation
5. Week	Evaluating written and oral arguments

The teachers were asked to use the components of the argumentation given in the third week within the scope of the program during their own lessons. After the techniques given in the fourth week, each teacher was asked to prepare a topic chosen from the 5th, 6th, 7th and 8th grade Science course topics according to this technique, using one of the techniques. Teachers were free to choose the science topic they wanted to use in the activities. They presented the activity sheets they had prepared to each other before the training in the fifth week and evaluated each other's effectiveness and gave feedback. Through the feedback and corrections they received from their classmates and instructors, they were asked to see the development and deficiencies of argumentation-based science education lesson plans. They were asked to apply their finalized activities in their own classrooms and to evaluate the written argumentation of the student groups about the activity at the end of the application. After the end of the application, the opinions of the teachers about the application and argumentation were taken.

Data Analysis

The data obtained at the end of the interview were written separately by two researchers in the same way in order to ensure the internal reliability of the research, and it was checked whether there was any difference between them and the differences were corrected. As a result of the descriptive analysis of the transcripts, they were evaluated separately by two researchers and divided into themes. The themes of disagreement were discussed and a common view was reached.

Before the data was coded, the data units were examined in detail, the data with similar content were coded, the concepts that emerged from the data were determined, and the related

concepts were grouped according to the previously determined themes. In the descriptive analysis process, the data can be organized as questions or dimensions revealed by the research questions, or it can be presented by considering the questions or dimensions used in the interview and observation processes (Yıldırım & Şimşek, 2013). Therefore, the themes were decided on the questions determined before the interview. In the analysis of the data, the voice recordings of the teachers were taken and turned into a text and a Microsoft Word raw data document was created. The texts on these pages were coded as words and meaningful structures based on the research questions determined. In the study, direct quotations of teachers' answers were given in quotation marks and without any changes. The purpose of descriptive analysis studies is to present the findings to the reader in an organized and interpreted form (Yıldırım & Şimşek, 2013). The findings were systematically and clearly described; the descriptions were arranged and interpreted on the basis of the literature. Direct quotations were included in order to reflect the views of the interviewed individuals in a striking way. The findings were analysed by two researchers in order to ensure the internal reliability of the research. The interview data were coded and grouped according to the themes given below.

1. The meaning of the argument
2. Components of the argument and its application
3. Attendance of the students to the lesson
4. Used technique
5. Alternative activity instead of argumentation
6. The professional skill of the teacher

Results

The previously determined themes and quotations from the statements of the teachers suitable for the themes are given.

The Meaning of the Argument

It was observed that the teachers did not know the word meaning of the argument, they had difficulties and they encountered it for the first time. Teacher Ahmet said, "We had some trouble with the word meaning of argumentation and argument. When we say argument in the first sense, it sounds foreign to you. Because it is a new concept, a new concept in Türkiye, a new concept in Turkish. In that sense, we struggled…"

Teacher Rıza said, “I just learned about argumentation. First, I thought of it as a term used in law. I have not seen examples of it being used in science education.”

Teacher Banu said, “We were thinking of argumentation more as a question and answer, I wouldn't have prepared such an activity.”

Teacher Galip “I knew the definition of argumentation only as scientific justification while studying KPSS”

Teacher Gamze said, “I had a background from the university, I heard it. I had brief information and even prepared it at the event at the university. The most difficult parts were the reason, the supportive ones were sometimes confused.”

Most of the teachers have just started the profession learned the argumentation from the KPSS books while studying for the exam, while Gamze stated that they did a little practice in the last year of her undergraduate education, but she did not have much knowledge. Teachers working in the profession for five years or more did not know or even hear the meaning of the word.

Components of the Argument and Its Application

When the answers given to the question about the difficult or easy parts of the argumentation, the duration of the application and the components of the argumentation are examined;

Teacher Ahmet said, “I will not say that the application part is very difficult, but the preparation phase requires some process. This is what teachers fear… It requires at least 1 hour of preparation before…. What is the claim from the proving processes, what can be the evidence, what are they supported by, what is the name of these supporters and what is rebuttal, I have told them. I specifically explained it by giving an example. Afterwards, they answered one by one as they were not unfamiliar with the subject anyway.”

Teacher Ayşe said, “The most enjoyable part was taking her guesses. Frankly, I took it verbally first, and I said write down your guesses. It was so much fun getting your guesses. Different things came out. Apart from this, there was a part of my activity to express with shapes. It was a lot of fun for them to express with shapes. They wanted to draw it themselves, 'we'll draw it,' I said, okay, you draw it… It took a long time to explain it to the children.”

Teacher Rıza said, "Since they are not very familiar with the concepts, we spent a lot of time in guiding them with claims, data, and reasons. We had to spend three or four lesson hours on what we would normally do two lessons. There was such a problem with time; otherwise the children had fun in practice."

Teacher Banu said, "…it happened when we had difficulties because we are just learning, we have never applied it, we have never seen it… In the last activity we did, it was more settled in our minds, we couldn't get it right at first, it's fine now... Here at first, those structures were similar to each other, I had a hard time distinguishing the concepts, but now they are seated… They are having a hard time with the promoters."

Teacher Galip said, "Since I went directly through the study form, there was nothing to force me, the worksheet mostly did what I was going to do. I just preferred to ask questions that will make you wonder or make you doubt. Apart from that, it was revealed that the students misunderstood the concept of Archimedes."

Teacher Gamze "…the most difficult parts are justification, supportive. They were confused sometimes at first, now it sits a little better. Actually, I didn't have much difficulty. Just this one; evidence and justification. Very confused there. I had to expend an extra amount of energy while describing it. We agreed on the claim, we agreed on the rebuttal. Confused in evidence and reasoning, many even wrote in different places. Then "Shall we take out an arrow and fix it?" they said. When I reminded them again and again, they always thought they were wrong, they got into a mess. "I wonder if we change places," they said. I said that if you want to change a lot, you can fix it by removing the arrow. I had a lot of confusion in those two… Since the students did not understand, I was more bored, I thought a lot about how I could explain. I tried to explain it in different ways many times... The hardest is the proof... If we compare the justification with the proof, the most difficult one is the proof. Since our people naturally do not reject something with scientific things or prove it with scientific things. I think so or so I heard, this is our evidence. Children also had hard time giving evidence as they were generally used to using it like this. For example, one of my students wrote it, because I read it that way in the encyclopaedia... this is the proof. Behold, it cannot develop or provide a scientific basis. There was a problem in that direction."

They stated that they had difficulties while preparing the activities related to argumentation, but they enjoyed it very much during the implementation. They stated that the application took a long time and this situation created a problem in terms of time. Both teachers and their students had difficulties regarding the components of argumentation. Teachers generally had difficulties in the preparation phase and idea development phase. They had difficulty in understanding the concepts at the beginning of the training on argumentation, since the implementation of the activities in the lesson took a long time, but they understood better especially when they practiced. In addition, they had difficulty in comprehending the concepts they had difficulty in comprehending, especially the concepts of proof and justification, during their practices in the classroom. However, they stated that the application process was enjoyable and fun in the classroom, and that the application in the classroom was very comfortable, especially with the activity sheets they prepared.

Attendance of the Students to the Lesson

When the answers given by the teachers about the students' participation in the lesson and their anxiety or fear are examined;

> Teacher Ahmet said, "…I mentioned that this is not an exam, that we are doing an activity, that it will be positive, whether it is good or not. The children felt very comfortable with that sense of trust. There were even some of us who were illiterate. He even answered a few questions. It was beautiful in that sense."
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> Teacher Ayşe said, "The students' participation in the lesson was good. They even did their own experiment, they reached their own observations, and they wanted to draw on the board themselves. Their participation was good, there was no boredom, and it was good in general."
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> Teacher Rıza "…in fact, there is a chance for everyone to express themselves… The children had fun in the application."
>
> Teacher Galip "the students enjoyed it"
>
> Teacher Gamze said, "My students were very happy, something different is being done. Something they miss after all… Some students… I had one successful, ambitious student. He directly said, "This is ridiculous." Why? He saw the concept cartoon for the first time in his life. It was probably very difficult for him, it all seemed right. "This is all true, it's ridiculous, I can't comment on that." said. He was very biased at first. But

the others were very enthusiastic, here's how we're going to do a concept cartoon? There are cute ones, we're going to comment. So they actually liked it in general."

Teacher Banu said, "It was good, we already directed it. Since we were constantly asking questions, at least we got guiding questions and answers from them."

The teachers gave information to the students before the implementation. Teachers stated that the argumentation was enjoyable, pleasant and happy for both them and their students, and that the students actively participated in the lesson. However, as Gamze teacher stated that some students were getting bored in activities that are based on interpretation and lead to thinking, and they did not want to do it because they have difficulty. This showed us that we accustom students to ready-made information and that they take a negative attitude when faced with situations that lead to thinking.

Used Technique

The answers given by the teachers to the question about which technique they applied the argumentation in their lessons, why they chose this technique, in which part they had difficulty, and whether they used other sources in addition to the argumentation in the lesson;

Teacher Ahmet said, "Concept cartoons… I acted according to the location. Especially considering the biological balance in the 7th grade 6th unit human and environment unit, since I am a village school, based on the daily lives of the children there. For example, the situation was the killing of snakes, the killing of hawks, and the proliferation of mice. Since I know that the children know this personally, I acted by including the village headman, explaining in a paragraph that they were doing research, and putting their pictures into it... The part I had difficulty with is, frankly, I can't say that I had much difficulty in doing them... If I need to do my activity differently, I increase the visuals a little more. So I would create an entire page from images. I used to get people talking. More thought bubbles or speech bubbles. I would get the kids to see more of the things… The important thing was the argumentation issue. I acted with the data I got from here."

Teacher Ayşe said, "Predictive observation… Of course, you don't directly tell them to guess, you want them to find out for themselves… I saw it in more detail, I wanted to do it because it is a more detailed thing based on explanation… The most difficult part is the explanation part. Compare your observation and prediction, right or wrong, why? I

said write your explanations in your own words… It wasn't difficult… The most enjoyable part was getting the guesses. Frankly, I took it verbally first, and I said write down your guesses. It was so much fun getting your guesses. Different things came out. Apart from this, there was a part of my activity to express with shapes. It was a lot of fun for them to express with shapes. They wanted to draw it themselves, 'we'll draw it,' I said ok you draw… There were no other resources, only worksheets.

Teacher Rıza said, "Assess the evidence… Children think of changes as physical or chemical, but they were not aware that chemical change also includes a physical change. I chose it to emphasize this a little bit… I thought it would be more appropriate for the subject we are dealing with. They'll evaluate the facts on a case-by-case basis and evaluate the evidence; they'll need to catch some clues... I used the additional source we usually follow in class…"

Teacher Galip said, "Predictive observation and explanation. There were other strategies, but I chose it because this study was based on experimentation and POE (Predict-Observe-Explain), was more open to discussion or explanation, and because it included the scientific process."

Teacher Gamze said, "Concept cartoons… Concept cartoons are effective in eliminating misconceptions. It's also a fun thing... There are pictures, there are visuals, and I have a color printout. Students like it, cartoons are something that everyone likes anyway. I wanted to draw their attention more. It is more difficult to conceive the idea. After finding the idea, the rest comes. What subject should I do, for example, it is a very difficult thing. Also, I think sentences are very important. It is important to choose the sentences that students will be stuck in dilemma. While preparing this, I benefited from the book of the National Education, and I also benefited from the teacher's book, what are our achievements, how should I ask, how should I explain. I used them to take them into consideration."

Teacher Banu said, "He had evidence, he had a claim, and I tried to capture the data in the evidence. I had no rebuttals and no backers. It was important for the children to distinguish when explaining their data or justification after presenting their claim, so I chose the molecule and element model. I chose compounds and elements. Because when they said compound, they would be able to provide proof very easily, or when I

said element, they would be able to present their proof very easily, so I chose this and it was a subject they learned and it was a subject that I needed to work on. Since it will be after the topic, I did it to reinforce it. If I had the chance to repeat it, I would change my activity a little. Because I saw that the children did not go into too much detail while writing. At least when presenting his proof, I saw that his data was missing. Frankly, I thought they could write a little more detail. The children also wrote without going into too much detail, as they were meeting for the first time. If I had a second application, I would like some more detailed sentences because we use them in the evaluation. They thought, but they did not write, I would say something like write everything you think. At the moment, I will face his difficulties in the evaluation. I did not use additional resources, but I applied it to the 6th grades in national education, I benefited from the national education textbook and workbook. I chose the pictures I took or the sentences I chose from there, at least I wanted them to be subjects and pictures with which the children were somewhat familiar. Later, after learning about the evaluation process, I made some more changes. I asked for a sample directly from the children or, for example, because I could not distinguish the evidence from the data, I asked for an extra sample and had the supporter found. After learning the evaluation, I changed the process a little so that clearer expressions could emerge."

The teachers selected activities related to concept cartoons, POE (Predict-Observe-Explain), and evidence generation. They selected these techniques because they were suitable for the subjects and that they enjoyed a lot while applying the techniques. However, teachers gave clues during argumentation process when the students that they had difficulties when they used expressions such as direct evidence and supportive. Teachers used the book of ministry of national education as an additional source.

Alternative Activity Instead of Argumentation

Before learning argumentation, teachers were asked which techniques they preferred in their lessons.

Teacher Ahmet said, "If I hadn't seen the argumentation course, I would have explained the same subject through the direct expression in national education, as far as he saw from the book or based on the achievements. I would just go through these by giving examples."

Teacher Ayşe said, “It would be different because I would not have promised the children so much. I would do the experiment, I would do my activity, but I wouldn't want them to question it that way."

Teacher Rıza said, “It would be different, we would probably do those experiments. The children again observed the physical change, the chemical change. But they wouldn't justify it this way; we wouldn't be able to scrutinize their reasoning so much."

Teacher Galip said, “I wouldn't take any guesses, I could have done an experiment and asked them to write down the results. I would use the experimental technique because the topic of surface tension lends itself to experimentation.”

Teacher Gamze said, “I used to have an experiment done. The most logical thing to do is to live by doing…”

Teacher Banu “I taught toothpicks to make models with play dough.”

When the teachers were asked how they handled the subject, they stated that they did an experiment or they completed the subject by doing the activities and explaining but they did not discuss.

The Professional Skill of Teacher

The answers given by the teachers to the question posed to the teachers to find out if they are considering making changes in their next science lesson;

Teacher Ahmet said, “It definitely happened. While I used to act with the old order, tell late idea, now I acted with the idea of seeing and hearing things and showing them one-on-one to the children… From now on, it will be full of activities and experiments.”

Teacher Ayşe said, “…we didn't elaborate on the lesson before. Now you want him to question, you want his proof, his claim, it becomes a little more fun for children… I ask more questions, under the name of claim or evidence, but I can ask questions that can make them say.”

Teacher Rıza said, “...because without this course, even I would not have looked at the changed 2018 MoNE program in such detail. We examined the emphasis on argumentation there. He constantly guides children about their argumentation skills.”

Teacher Galip said, "We knew before that science should be based on an inquiry system, and the system requires it. In this respect, argumentation also requires questioning; you question your own guesses or knowledge. That's why argumentation becomes one of my favourite techniques."

Teacher Gamze said, "Of course it did. We know how inquiry-based science has always been, or how open a lesson it is to activities, students' research. I'm a believer in this, that's exactly the argumentation. Even if they see something from daily life, argumentation talks a lot about scientifically justifying it, they are intertwined. In that respect, I liked it a lot. I do, I mean, it is a topic that the students confuse a lot, or it is a very current issue, but everyone has different opinions on this subject, so I make students argue about it. Because they need to be open to different ideas, or they need to have real proof when disproving someone, a scientific proof. It's nice to have this. I try to be such a person; I use argumentation so that my students are such people.

Teacher Banu said, "Actually, there was no direct change in my thinking. Because we always said in science that they should question, build a foundation and present their reasons. I say the same thing again, but in the implementation of a lesson, this process was a little more planned, together with the structures of argumentation. It contributed to the ability to use it in the lesson during the application phase"

When we examined the statements given by the teachers regarding their contribution to their professional skills, all of the teachers stated that they contribute. Teachers who have just started their profession gave importance to questioning and stated that they can gain their students the skills of questioning through argumentation. Teachers with a seniority of 5 years or more in the profession stated that they discussed and experimented in the lesson, but they did not have a discussion for questioning. In addition, teachers said that with argumentation, students can improve their inquiry skills and therefore they will use it in their lessons.

Discussion and Conclusion

In this section, the findings obtained as a result of the interview in the study were discussed and suggestions were given on how to improve the argumentation-based teaching process, teacher education and learning environments.

According to the results obtained from the research, the teachers generally stated that they heard the concept of argumentation for the first time, that both they and the students had difficulties

in presenting evidence and supporting, one of the components of argumentation, that it was enjoyable to apply the activities in their classes, that they had done lectures and experiments before, they did not do different activities, the students participated more in the lesson. According to Sampson et al. (2010), participating in the argumentation process and producing verbal and written arguments increased scientific knowledge and scientific skills. From this, science teachers did not have an awareness of how to apply argumentation in their classrooms before the training, and their awareness increased after the training. According to the results obtained from this study, it is recommended to increase awareness about argumentation and to give techniques for how to use them in their lessons with in-service seminars to be given to teachers. Many studies also emphasized the importance of pre-service and in-service teacher training to support argumentation in science education in parallel with our study (Zeidler, 1997; Newton, Driver, & Osborne, 1999; Erduran & Jimenez-Aleixandre, 2007).

In most of the studies in the literature, the pre-service teachers and teachers were not adequately trained on what argumentation-based teaching is and how to apply it. Therefore, according to the results of this study and other studies, it was necessary to conduct studies on argumentation-based education for in-service science teachers and pre-service science teachers.

In the interviews conducted with the teachers in order to get their opinions on what the argument is, the teachers who have just started the profession heard the argument only as a word and memorized the meaning from the test books during the preparation for the public personnel selection exam, and a teacher who was working in the first year in the teaching profession was familiar with the meaning of the word from the courses given within the scope of undergraduate education. However, it is a remarkable result that more experienced teachers with more than five years of professional experience have never heard of the argument. It has also been revealed through previous studies in the literature that teachers have difficulties in defining the argument for their students and explaining the components of argumentation to them (Crippen, 2012; Sampson & Blanchard, 2012; McNeill & Knight, 2013; Sadler, 2006; Zembal-Saul, 2009; Günel, Kıngır & Geban, 2012; Yıldırır & Nakiboğlu, 2014). It was also supported by studies showing that students have difficulties in defining the argument and understanding and applying the argumentation components (Berland & Reiser, 2009; Osborne, Erduran, & Simon, 2004; Sampson & Clark, 2011; Sandoval & Millwood, 2005; Aktamış & Atmaca, 2016). When the science education program published by the Ministry of National Education was examined, it is noteworthy that the program is inquiry-based and besides, the place of argumentation in the adopted strategies section. According

to the science education program, students cannot enter the research-inquiry process only by experimenting and discovering, and it also emphasizes the importance of making explanations and arguments (MoNE, 2018). In the light of the results of the study, teachers, both experienced and new to the profession, stayed away from argument words and the argumentation process and did not have sufficient knowledge, revealed the importance of reconsidering the place of argumentation in in-service and pre-service trainings and integrating argumentation into these trainings. In addition, considering the difficulties experienced by students in defining the argument and understanding the argumentation components, it was recommended to carry out studies that take into account the needs of students and teachers. In addition, teachers' pedagogical deficiencies in argumentation were also striking. Also, the teachers talked about the difficulties in transferring the argumentation to the students and in the lesson. National studies in the field (Çetin, Erduran, & Kaya, 2010; Erduran, Ardac & Yakmaci-Guzel, 2006; Günel, Kıngır & Geban, 2012; Maloney & Simon, 2006) and international studies (Erduran & Jiménez-Aleixandre, 2007) supported this. For this reason, it was supported by the results of this study that researching the pedagogical content knowledge of teachers about argumentation and conducting argumentation-based science education studies by conducting studies on this will significantly eliminate the deficiencies in classroom argumentation practices. The teachers stated that thanks to the argumentation training they received, they would use the activities that they were not aware of before and that they did not use in the textbooks more effectively from now on.

The teachers stated that the practice of argumentation is time-consuming, pre-preparation necessity and they have difficulties in explaining the components to the students regarding the difficulties they experience in their classroom practices and in introducing the components to the students. However, they stated that in-class practices were enjoyable and in-class participation was at a good level. Science education program supports student-centered inquiry-based science education and emphasizes the necessity of student-centered classroom environments for better science education (MoNE, 2018). Teachers saw argumentation as advantageous due to its student-centered nature, social interaction and group solidarity, as well as its aspects such as providing collaborative work. Argumentation concepts are not fully understood by the teachers, as the reason for this is that the components of the argumentation are mixed with each other. Considering teachers' pedagogical content knowledge about argumentation, students should be supported on how to support their claims using evidence and how to justify them by associating evidence and claim (McNeill, Gonzalez-Howard, Katsh-Singer & Loper, 2014). Within the scope of the study,

the teachers had deficiencies in the pedagogical content knowledge of argumentation. Because, during the argumentation process, it was important for the students to show how the claims are questioned and justified as a role model to their students in the classroom (McNeill & Pimentel, 2010, Yıldırır & Nakiboğlu, 2014).

Although the argumentation was enjoyable for the students in the classroom practices, the students were accustomed to receiving ready-made information, which is their usual habit in teacher-centered classrooms. Since, in the argumentation process, the classroom environment should be an environment where the student is at the center, the knowledge is questioned and the claims are justified with empirical evidence (Günel, Kıngır, & Geban, 2012; McNeill & Knight, 2013; McNeill & Pimentel, 2010; Osborne, Erduran & Simon, 2004; Özdem, Ertepınar, Çakıroğlu, & Erduran, 2013; Sadler, 2006). The necessity of applying vocational training programs in order to move from teacher-centered discussion to student-centered discussion in the successful realization of argumentation-based science lessons and to encourage teachers to student-centered argumentation was also supported by the studies conducted and the results of this study (McDonald, 2008). Munford and Zembal-Saul (2002) examined what their experiences were when they participated in the argument construction process in a science lesson and what factors affected the participants' perceptions of the argument construction process in the prepared lessons. In the study, they determined that some of the pre-service teachers had difficulty in separating evidence and justification and thinking of more than one explanation. In the light of this study and the results in the literature, teachers have difficulties in using argumentation components such as evidence, justification, and claim (Erduran & Jiménez-Aleixandre, 2007; Yakmacı Güzel, Erduran & Ardaç, 2009; Yıldırır & Nakiboğlu, 2014; Zohar, 2008). It has been demonstrated that the argumentation-based professional development program implemented by Maloney and Simon (2006) to improve pre-service teachers' experience of argumentation is beneficial for teachers to practice argumentation in lessons.

The teachers preferred cartoons, activities related to prediction-observation-explanation and evidence creation in their classroom practices. While showing the suitability of the subject as the main reason for choosing these types of activities, they also expressed their happiness from implementing these activities. They explained that they did not want to add a new structure to the type of activity they used, but the difficulties they experienced when they asked the students about the existing components. The reason for this is related to the fact that students meet for the first time in science class with components such as claim, evidence, justification and counter-claim. In many

studies conducted in this area, it has been revealed that students have difficulties in defining the components of argumentation and express them difficult (Çetinkaya & Taşar, 2018; McNeill, Lizotte, Krajcik, & Marx, 2006; McNeill, 2009; McNeill & Knight, 2013). The students do not use the existing argumentation components much in daily life, therefore they have problems due to their lack of experience in the operational use of words. Similarly, when students and teachers are asked to use evidence and data, it has been observed that they have difficulties in integrating theoretical knowledge, that is, scientific knowledge, into the argumentation process (Çetin, Erduran, & Kaya, 2010; Knight & McNeill, 2011; McNeill, 2009; McNeill & Knight, 2013). Instead, it has been seen in the light of studies that students tend to use data and evidence that have no scientific basis in daily life (Ecevit & Kaptan, 2019; Sampson & Blanchard, 2012; Erduran, & Jiménez-Aleixandre, 2007; Aktamış & Atmaca, 2016).

Teachers did not have knowledge about argumentation, they used plain language in the previous periods, and they also included activities such as experimentation and model making in their lessons. They explained that they did not encourage students to question while making experiments and models, and they accepted the information in the lessons without questioning it. In studies conducted with teachers and students, it has seen that traditional lectures are generally used in classroom environments and teacher-centred lessons are carried out (Günel, Kıngır, & Geban, 2012; Tümay & Köseoğlu, 2011; Aktamış & Atmaca, 2016). However, after being introduced to argumentation, it has seen that argumentation activities aimed at raising individuals who question, express themselves and argue are included in the lessons and this situation is reflected in the classroom question structures (Günel, Kıngır, & Geban, 2012). In addition, it has seen that by integrating argumentation education into science lessons, it will increase discussions that enable effective communication among students, create permanent and meaningful learning, and facilitate learning by making students establish a cause-effect relationship and using reasoning and evidence (Aktamış & Atmaca, 2016). It was found as a result of an experimental study that students who participated in argumentation-based education had higher academic scores, formed and wrote better arguments than those who participated in teacher-centered classrooms (Demirbağ & Günel, 2014).

The argumentation-based training teachers received provided significant support for their teaching professional skills. New teachers stated that learning argumentation would help students gain inquiry skills, since the current science curriculum is inquiry-based. Experienced teachers, on the other hand, stated that they were not aware of the fact that the current science program was based on inquiry and that they were not aware of the importance of argumentation before they

joined the argumentation-based education. However, they stated that they would use argumentation in their lessons to help students gain questioning skills after the training. Studies conducted with teachers and students in the literature also reveal the positive effects of argumentation-based education or professional development programs on both teachers and students and ensure the dissemination of argumentation (Aktamış & Atmaca, 2016; Boğar, 2020; Erduran, Ardaç, & Yakmacı-Güzel, 2006; Tümay & Köseoğlu, 2011; Yakmacı-Güzel, Erduran & Ardaç, 2009; Yıldırır & Nakiboğlu, 2014; Zohar, 2008).

Recommendations

In the light of the results obtained, it was concluded as a result of the interviews that the teachers did not create a classroom environment where the teacher was the guide and the student was the center and did not include activities for questioning in their lessons. For this reason, teachers have problems in understanding the argument and transferring the argumentation component, the evidence and the justification, to the students. Based on this information, it can be suggested that teachers should conduct argumentation-based science education in their classrooms, where the student-centred teacher is the guide. In order to achieve this, teachers need to plan their classroom education methods according to argumentation-based teaching, have knowledge about argumentation and define the needs for this. Therefore, it is recommended that teachers receive pre-service or in-service training on argumentation before changes in the classroom. It can be suggested that the duration of the argumentation-based education and professional development programs planned to be given to the teachers should be designed according to the criteria, considering the differences between the argumentation-based education and the education methods used by the teachers. In addition, since it will be a long-term work for teachers and students to gain argumentation skills, it is recommended that professional support and training is long-term in order to implement and disseminate argumentation in the classroom. As it is understood from the interviews of the teachers, it is recommended to carry out studies taking into account the needs of the students, taking into account the difficulties experienced by the students in acquiring the argumentation components and the habits of the students towards a teacher-centred lesson approach in the classrooms. In this way, it can be ensured that students produce more qualified arguments in classroom dialogues and develop their argument writing skills. Considering the difficulties experienced by teachers in conveying and applying the argumentation components to students, and in order to have information about the argumentation training that will be prepared for teachers, it is recommended to measure teachers' pedagogical content knowledge (PCK) in future studies. As

Shulman (1986; 1987) stated, PCK concept is defined as necessary information about how teachers can make content knowledge understandable for students. Identifying the needs of teachers in their professional lives will play an important role in programs designed to teach and learn argumentation.

Based on the results of this research, it was suggested that professional development programs to be given to teachers will be effective in teaching argumentation components such as evidence and justification for argumentation. It was recommended to increase the activities for the application of argumentation components in the professional development programs to be given to the teachers and the science lessons given to the students, and to include practices on how to use the theoretical scientific knowledge as evidence in the argumentation process in practice. Argumentation education should be expanded among teachers and students, considering both the current program's being based on questioning and the benefits of in-class applications of argumentation.

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It has been reported by the authors that there is no conflict of interest.

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Ethical Standards

We have carried out the research within the framework of the Helsinki Declaration. The consent forms were utilized. The participants were informed about the study and volunteered to participate.

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