Are We Ready for Argumentation in Science Classrooms? An Investigation into the Scientific Discussion Climate in a Turkish Elementary School

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Abstract

In recent years, the trend in science education is toward scientific processes rather than scientific knowledge. An effective science education not only requires the active involvement of students in scientific investigations, but also the development of engagement in discussions about scientific and social issues. To develop students' discussion and argumentation abilities, we can integrate these approaches to our science lessons, but what are our teachers, students and administrators' attitudes concerning these approaches? This study was undertaken to determine (a) the views of science teachers toward usefulness and effectiveness of scientific discussions, (b) how students participate in scientific classroom discussions, and (c) the roles of teachers and students in the discussion process. This study used qualitative design, and content analysis was carried out for both the interviews and observation data. Data was obtained from teachers and students at a private elementary school located in Ankara, Turkey. The results showed that scientific discussion processes are generally dominated by science teachers and student engagement in discussions is at a very low level.

Keywords: *science education; classroom climate; scientific discussion*

Introduction

Over the past decade, trend in science education is on the road to scientific processes rather than scientific knowledge. Most researchers (Bell & Lederman, 2003; Settlage & Southerland, 1998; Martin, 1997) argue that learning scientific processes and undertaking science are more important than learning scientific content. According to this view, providing students with skills, abilities and attitudes about science is more effective than scientific content itself. To achieve this, science education programs have been reorganized or changed to be more appropriate with scientific literacy (Sampson and Clark, 2008; Yılmaz, 2007; Turkish Elementary Science Education Program, 2005; NRC, 2012; NGSS, 2013). Increasing scientific literacy can help students to develop a better understanding of science subject matters related with the physical and life sciences. Also, it helps students to understand how this knowledge is generated, justified and evaluated by scientists and how to use such knowledge to engage in inquiry in a manner reflecting the practices of the scientific community (Sampson & Clark, 2008). Erduran, Ardac and Yakmaci-Guzel (2006) emphasize that science education should focus on: (1) "how evidence is used in science for the construction of explanations—that is, on the arguments that form the links between data and the theories that science has constructed; and (2) the development of an understanding of the criteria used in science to evaluate evidence and construct explanations" (p. 3). Scientific discussion or argumentation is not only an important tool in learning but also a constituent element of scientific basis; it contributes to the growth of scientific knowledge, as well as being an important component of scientific discourse (Erduran, Simon, & Osborn, 2004). Van Eemeren and Grootendorst (2004) defined argumentation as a verbal, social and rational activity aiming to support a reasonable criticism or to refute a proposal to reveal a solid basis for the acceptability of propositions. In argumentation, participants are given explicit instructions to argue for different positions using an in-depth critical discussion, to provide justifications, and to persuade each other why one position may be better than another (Simon & Richardson, 2009).

Although undertaking science activities such as inquiry-based, discovery learning or process skills instructions can encourage students to engage in scientific processes, they may not provide the students with efficient abilities to evaluate and advocate for scientific theories or findings (Sadler, 2006; Driver et al, 2000). However, Sampson and Clark (2008) stated that fostering scientific argumentation is difficult because of students' inability to propose, support, critique and refine ideas, but these problems can be solved through collaborative groups (Sampson & Clark, 2008). Additionally, Yılmaz (2007) commented that science education teachers have some problems such as "lack of equipment, inadequate, practice opportunity, insufficient time, uninteresting topics, over population in classroom, some problems in the organization of trips, the students' indifference to the science course, no application opportunity like practice garden, and low success rate in science course" (p. 1). Furthermore, there is another problem in terms of the beliefs of elementary science teachers and their attitudes toward scientific discussions.

Though classroom discussions may involve a variety of interactive practices, usually the teacher starts the discussion by presenting the idea to be discussed—it tends to progress in the students' responses and the teacher's assessment cycle (Tharp & Gallimore, 1991) and this approach is conceptualized as *recitation* (Alvermann, Dillon, & O'Brien, 1987) or *triadic dialogue* (Lemke, 1990). Lemke (1990) argued that in the triadic dialogue the teacher preferred to identify the subject, start the discussion, and control the direction in which the discussion developed. In this approach, students are not very effective in guiding the discussion or challenging the views of the teacher. In the form of this classroom communication, teachers inform students about the topics and there is little opportunity for student contributions (Wells & Mejia-Arauz, 2006); For this reason, the discussion model can be accepted as a monologue approach, despite the possibility of many people talking (Scott, Mortimer & Aguiar, 2006). In this respect, it does not support students' conceptual development and structuring of knowledge (Wells & Mejia-Arauz, 2006). Students need to understand the perspectives of all participants in discussions for meaningful learning. In dialogue-based interactions, teachers encourage students to express their ideas and to explore and discuss different perspectives. In addition, in this approach, students' expressions and answers are often based on original and sincere questions and are spontaneous (Chin, 2007). The effective scientific discussions in science classrooms allow rising new questions to be explored to further investigate related topics. On the other hand, some students do not see science classrooms as appropriate for discussions and they are reluctant to participate in discussions on a scientific topic. As students develop their scientific discussion skills, they pass from an inactive position to an active position and become active members of the scientific discussion community (Polman, 2004). In safe classroom settings, students' participation in discussion becomes routine and will lead to more interaction between students and teachers. Students are often curious and ask surprisingly insightful questions, but students should be asked to ask questions about different perspectives to other students also (Grover, 2007). Newton et al. (1999) stated that "'the' answers to 'the' questions need to become 'their' answers to 'their' questions. Through practice in posing and answering scientific questions, students become active participants in the community of science rather than just passive observers" (p. 556).

Elements of effective scientific discussions include relationships, attitudes and engagement; therefore, in science education classrooms, activity and relationships between students and the teacher are very important. To increase the quality of scientific discussion in science classrooms, first of all science teachers' attitudes and beliefs about scientific discussions is needed. For this purpose, the aim if this study is to determine (a) the science teachers' views toward scientific discussions' usefulness and effectiveness, (b) how do teachers manage scientific classroom discussions? and (c) the roles of teachers and students in this process.

Methodology

Concerning science teachers' attitudes and beliefs about scientific discussions in science classrooms, we primarily have to understand relationships between teachers and students and make sense of the scientific discussion context. To achieve this, one of the private schools (K-8) in Ankara, Turkey, was determined as the case to be studied. Case study "…is a detailed examination of one setting, or a single subject, a single depository of documents, or one particular invent" (Bogdan & Biklen, 2007, p.59). In case studies, different data collection sources, such as document analysis, interviewing, and some forms of observation are used to capture the big picture and gain a deeper understanding (Marshall & Rossman, 2006; Yıldırım & Şimşek, 2005). To collect the data, I observed science classes in different grades and interviewed all science teachers in the school.

Participants and Case Context

This study was conducted in the first semester of the 2014 – 2015 academic year in a private school with 30 teachers and nearly 400 students, located in Ankara (Turkey). When I discussed the school's vision and mission with school administrators, I learned that, in particular, their general aim was to prepare students for the national placement test, which is used for student selection for successful high schools. The school administrators often mentioned their students' success in this exam, and they preferred to concentrate on problem solving with multiple choice questions in science and mathematics as well as other courses.

There were five female science teachers in the school, who had teaching experience in the range of two to 10 years. Teacher 1 was also as an educational coordinator. All the teachers had graduated from educational faculties from different public universities. In parallel with the school vision, the teachers believed that students' achievement in national exams was very important. Despite the fact that they had a grasp of scientific literature, their beliefs about student success were based on the idea that "…a successful student should be a good problem-solver, make inquiry, and transfer the knowledge to his/her daily life and real life situations…" (Teacher 2).

In the school, there were five grades (4-8) of science classes and all grades had two sections (labeled A and B). The class size ranged from 23 to 27 students and with a similar number of female and male students. The physical design of classrooms was classical with the students' desks being ordered and the teachers generally being located in the front of classroom.

Data Collection

I used interview and observations for the data collection process. The aim of the observations was to describe the patterns in the classroom discussions concerning science and to define the relationships between students and teachers as well as between the students themselves. These observations also helped me to determine students' discussion abilities. I observed five classrooms across the fourth to eighth grades. Each observation took one class hour (40 minutes) and I was not involved in the classroom discussions; my position was a non-participant observer (Marshall & Rossman, 2006) at the back of the classroom. I did not use a checklist or instrument in these observations and I preferred taking free notes about the patterns and used the following research questions I had prepared to guide the observation process:

1. How do students participate in scientific classroom discussions? (personal/group, interest, curiosity)
2. What kinds of reasoning do the students use in the discussions? (Personal experience, academic literature, teacher's opinions, etc.)
3. What are the roles of teachers and students in this process?

The interviews were designed as semi-structured, and I used 10 open-ended questions (a total of 20 questions including the sub-questions) to determine elementary science teachers' views concerning the efficiency and usefulness of the classroom discussions (see the Appendix). I interviewed all five science teachers in the school. Interviews took 35 – 45 minutes and were audio-recorded.

Before the data collection process, from the argumentation and scientific discussion literature (Driver, Newton, & Osborne, 2000; NRC, 2012; Osborne, Erduran, & Simon, 2004), I determined the codes and categories shown in Table 1 related to the purpose of the research.

Table 1: Pre-coding List

Teacher's activities	Student's activities
Guiding	*Participation*
Questioning	*Argumentation abilities*
Feedback	*Claim*
Reinforcement	*Evidence*
Classroom controlling	*Justification*
Relationships	*Qualifier*
	Backing
	Rebuttal

The data collection process took nearly two weeks. Although the interviews and observations were done concurrently, I chose to observe and interview the same teacher in one day to avoid any possible effect on them. During the data collection, I also took field notes and observed the school climate, an example of which is given in the extract below:

> The teachers' behavior was very remarkable in the observations. Generally, teachers don't want strangers in their classroom. Although they tolerated me during the

lessons, I explicitly felt their timid manners. In one of the interviews, teacher told me, “all classrooms have different climates, so discussions in these classrooms are also different.” I liked this view so much and I wanted to observe this differentness.

Data Analysis and Limitations

In this study, I applied content analysis (Yıldırım & Şimşek, 2005) to both the interview and observation data. The basic aim of this method is to make sense of the data by finding hidden codes and themes. In the coding process, the observation and interview data were analyzed concurrently, and I worked on the analysis with a colleague who has qualitative research experience. After the coding process, we shared the outcome with another colleague in order to discuss the meaningfulness and importance of the codes. Then, we reviewed the data again. Some of the coding examples are shown in Table 2.

Table 2: Coding Examples

Well, after a while, managing the classroom is difficult because children tend to start an emotional debate, and it is obviously the time to intervene.	Process controlling & Respect for different views
…students can undertake new data mining by adding their own ideas and comments, if coherent. So, I think that you do not have to rely on a source.	Discussion Based on Students’ Ideas
Well, what would happen if you press this key? The open circuit would be closed, right? (this statement belongs to one the teachers)	Respond to own question (ROQ)
... another student showing one of the biggest of the two small water bottles on the table asked, "Did you say the larger one was a molecule?" In the meantime, another student asked, "where is the sulfur?". Teacher became angry with this irrelevant question.	Curiosity & Classroom Controlling
…for example, the debate still continues when the bell starts ringing. It may not be completed, or at the end of the day, there may be people who do not change their opinion. Usually children ask, “so what?”. They expect a result. But for a debate, this does not matter. Everyone's idea may be true.	Ending Discussions
Teacher: "So, my tea is cold. Has it lost its temperature? No. Because the temperature cannot be lost; heat is lost“. The second question was read. A student answered the question correctly. The response to the teacher was noted. (Observer Comment: I cannot say that all of the class listened to the student’s answer.)	ROQ & Guiding

Within the scope of analyzing data, we reached the following six themes: teachers' actions, students' actions, discussion process, process difficulties, contribution of students and program efficiency. The codes and themes are given in Table 3. These themes gave us the big picture of the discussion climate in science classes, but to ensure internal validity, the codes were confirmed after asking the teachers their views of these.

Table 3: Coding List

- **Student Acts**
  - Student Readiness
  - Student Pre-knowledge
  - Student Interest
  - Gender Differences
  - Participation
  - Student Questioning
  - Curiosity
  - Respect for Other Views
- **Teacher Acts**
  - Guiding
  - Feedback
  - Reinforcement
  - Classroom Controlling
  - Partiality
  - Process Controlling
    - Ending Discussion Guiding
- **Discussion Process**
  - Finding Topics
    - Connection with Program
    - Connection with Outside Sources of Knowledge
    - Connection with Student Life Experiences
  - Discussion Arguments
  - Discussion Based on References
  - Discussion Based on Examples
  - Discussion Based on Students' Idea
  - Respond to Question with Question (RQQ)
  - Unanswered Questions (UAQ)
  - Respond to Own Question (ROQ)
  - Disallowed from Asking Question (DAQ)
  - Frequency
- **Process Difficulties**
  - Respect for Different Views
  - Age Group Differences
  - Administrative Mentality
- **Contribution of Students**
  - Cooperative Learning
  - Motivate Each Other
  - Recension Mislearnings
  - Memorability
  - Ability to Express
- **Program Efficiency**

In this study, the data was collected only from the science teachers due to time limitations and problems with gaining permission. I observed the teachers' attitudes, behaviors and classroom relationships, and I interviewed the teachers to determine their beliefs and ascertain their points of view toward scientific discussions. Thus, students' views and comments about scientific discussions are the weak side of the study. Another weakness of the study was the number of data collectors. Although I worked with my colleagues in the coding process and I returned to the field to ensure teacher reliability of these codes, there was only one observer and interviewer in the study. My involvement as a data collector in research as both a researcher and a teacher experienced may have caused some limitations in the research because of my perspective. For example, in the following observation note, it is likely that notes about my own experience have affected the viewpoint at the time of observation:

> ... teacher looked at the solutions. At this time, students were very quiet. (**O.C:** When I was a teacher, I also checked what all the students did) The teacher gave only feedback to

students as “correct” or “wrong”. It took a while (**O.C:** I think is a positive situation for slow-learner students.) [O.C: observer comment]

Findings

The analyses revealed that the pre-knowledge and readiness of the students were the most important issues for the science teachers. Most of the time, the teachers preferred to give homework for students to prepare for discussions because they believed that for effective scientific discussions, students should have pre-knowledge. For example: “... the readiness of classroom should be enough. In the classroom discussion environment, the students must be ready to discuss about scientists or any topic” (Teacher 3).

Pre-knowledge and readiness were also related with the age of the students. For example, in scientific discussions, I observed that the eighth-grade students were able to engage more effectively than the sixth-grade students because of the former having cumulative knowledge about science issues. But science teachers dissented from my opinion:

> I had prejudices, what experiments I could do with fourth and five grades, what thoughts I could discuss, but I also saw very nice ideas open up in small classes. I mean, in the first year of my profession, I was very prejudiced first, the minors do not know what science is, they do not know the lives of scientists. But now the older ages are becoming more closed to me, more precisely. I see that the little ones look more creative from a wider perspective. (Teacher 1)

In the discussion process, the students’ interests are also important. If the teacher was unable to draw their attention, the level of student response remains low level. This is a reason why teachers argue that except for student clubs, effective scientific discussions do not always succeed in all classes. Particularly in science clubs or environmental education clubs, in which the students contribute of own accord, the students mostly have a high level of interest in scientific discussions. My conversation with Teacher 3 supports this:

> **Researcher:** What are you expecting from your students in scientific discussions?
> **Teacher 3:** First, they should get serious (laughs). because when they be serious nice ideas emerge. we generally catch this atmosphere in the clubs.
> **Researcher:** Clubs?
> **Teacher 3:** Science club, for example. these are elective courses which done twice a week and consists of students from fifth to eight grade students. They are so serious and willing in this clubs, and there are very good results, of course, I anticipate from the children that they will not lost this emotionally.
> **Researcher:** Are students come to these clubs voluntarily?
> **Teacher 3:** Of course, students are given the preferences form, and they choose clubs such as librarianship, science, space, echo schools. students must choose three of them. According to this choices, clubs is set up usually paying attention to the fact that each group is consist of students from all grades.
> **Researcher:** Then we can say that if the student interested in…
> **Teacher 3:** Discussions are more efficient, yes.

The teachers in the current study commented that elementary students were generally interested in space and wondered about how the universe was created. When the discussions centered on the earth and the universe; then, the students' interest in the discussions reached a high level. However, if a student likes science, they will be interested in all science topics, and the student's social environment, particularly their parents, has an effective role in developing a liking for science. For example, Teacher 4 described the relation between students' interest and school science,

> …in television, for example national geography channel, if they watch some broadcasts about space and animals, the they cannot to be unconcerned. They tell me what they hear from their family, or watch in discovery or in national geography channels. They ask me "you know that?", or "do you have any information about this?" Sometimes I say that "I can't tell you". I just wonder what he learned, what he watched, what he took in his inner world, I listen to him. (Teacher 4)

In the classroom, students' curiosity is not always supported. For example, if the student's question is off topic; then, the question may go unanswered. In this study, the teachers sometimes unintentionally did not hear the students and did not respond. Rarely, these questions were answered by other students, and sometimes these responses were wrong; so, some erroneous learning occurred. The field note below exemplifies this situation:

> Teacher went to the board, and said "the smallest building block of the compound is the molecule", and drew a molecule model. She asked who can explain this drawing. A student got up and explained (O.C: I think it was very good). A student asked the question, "if the molecule consists of atom, then how is the smallest particle is molecule?" The teacher tried to explain, but I think the student was completely uninterested and he wanted to ask something again. Another student wanted to respond him and repeated the teacher's explanation again. Then teacher continued to study (O.C: but the problem did not find a solution, the students did not solve the atom and molecule relationship)

In addition to this situation, when the teachers wanted to finish the discussion or lesson, they did not allow new questions, saying "ask later", but I observed that they did not return to the student's question. The lack of response to the students' questions is one of the reasons why students' interests and curiosities remain at a low level. During the discussion, the teachers generally did not participate to reveal their opinions but preferred to ascertain most of the students' ideas in the classroom. The teachers directed the discussion, and at the end, they explained conclusions. They usually described their roles as being a guide, not sharing their opinions but they had the "final word" when they ended the discussion:

> **Researcher:** How do you define your own role during scientific debates?
> **Teacher 3:** I prefer to be quiet. I leave it to them, "what do you think?", "what is your opinion?"
> **Researcher:** And then…
> **Teacher 3:** Well, lastly, at the end of the discussion, I summarize the discussion topic, so that to hinder wrong learning. I prefer to say final word.
> After the final word was spoken, the teachers did not allow the discussion to continue. In some cases, the students were not convinced and tried to sustain the discussion but the

teachers prevented this because they wished to use the time effectively. Sometimes, if there was doubt, even though the teacher ended the discussion, the students continued to discuss the issue together and this continued throughout the lesson break or other lessons.

Teachers usually responded to the student questions with questions. Their purpose was to encourage the students to find the correct answer. When these questions were not understood by the students, the teachers responded with their own questions; they did not wait for students' answers or they did not explain the questions again. According to the science teachers, all scientific discussions should have one correct answer and they should end on time. The teachers did not choose to engage in open-ended discussions and this view was passed to the students; so, if the discussion was open-ended, the students said, "so what?"

In discussions, students who propounded opinions closer to the correct answer (according to teacher) were reinforced by the teachers, and thus the teachers did not give feedback to students who were far from the correct solution. I observed that some students gave up asking questions and proffered the teacher's opinions rather than their own. Probably, these students tended to behave according to the teacher's request. The observation note from a discussion below helps explain this:

> …when a student insisted on his own opinion, the teacher explained by raising his voice tone, (O.C: but the other students did not understand the question nor the answer). A student stood up and tried to explain his own idea. The teacher said "we are going to have a break for five minutes to discuss." But the students continued to argue. The teacher also returned to the discussion and said "I am putting the last point" and said the own explanation again. Then she allowed to speak some students who have the same idea, so other students raised their voice and the teacher completely end discussion.

Although most of the students were enthusiastic to participate in scientific discussions and they wanted to share their opinions and ask questions, sometimes they abstained from responding to the teachers. This is probably because the teachers were disposed to focus on the statements that were close to their own opinions, and they did not pay attention to any other response.

Teachers generally used the national elementary science education program as a source of discussion topics such as determining the factors of buoyancy of water. They argued that the program was efficient for discussions in terms of attracting the students' attention and appropriate for their developmental level. Other sources of discussion topics were television programs, news and students' daily experiences. In particular, television programs, such as the National Geographic and Discovery Channels, were watched mostly by the students and this pleased the teachers because the students were showing their interest in science. In the discussions, the teachers expected students to propound arguments by references. These references were sometimes based on reference examples from life or students' ideas. But according to science teachers, academic references were more valuable:

> **Teacher 4**: If they know it in advance, they should express what they know and suggest it as a genuine knowledge. That is, knowledge must be based on the source. He/she may add his own opinion, but he should say as "this is my opinion." But it is necessary to base it on a source.
> **Researcher:** Need to show a source first?

> **Teacher 4:** Absolutely. "I learned the following knowledge, learned from this source." I do not want their own opinion directly; I want more students to say that they have which resources. I want them to base their opinions on facts.
> Although the teachers in the current study believed in the efficiency of scientific discussions, they did not use them often. Generally, there were one or two discussions in one week (or four science lessons), which each took a maximum of 15 or 20 minutes.
> **Researcher:** How often do you include scientific discussions in your lessons?
> **Teacher 5:** It depends on the structure of the subject. If I only solve the problems, well, I try to go through with the problem solving. (O.C: this attitude is based on school vision) I have a five-hour lesson per week, discussions occur in one or two of them.

The science teachers used these discussions to begin the course and draw attention to the topics in the course. Discussions almost began with science teachers' questions such as "what do you think about…?" or "how would it be, if…?" It is remarkable that although there was agreement about discussions increasing learning and understanding, for various difficulties, the frequency of the discussions was very low. According to some science teachers, there were some of the difficulties involved in using scientific discussions, such as the students' ages and behavior. Concerning the ages of the elementary students, the teachers believed that the ability to participate in scientific discussions was generally related to a child's mental development level, which increases from the fourth to eighth grade. For example, Teacher 2 claimed,

> I can defend the idea that it is not very effective for the fourth-grade level, but there are so many creativities in five grade that I think that imagination is very strong and therefore effective. But I cannot say the same thing for fourth graders, they are in transition stage, they are new students who come from third grade, and first two units are abstract, students are having difficulties.

However, in student clubs attended by the students who had a high interest in science, these age differences were invisible. According to science teachers another difficulty in using scientific discussions was that elementary students did not have respect for different views; so, the teachers were generally obliged to end any discussion. This problem was so prominent that one of the first comments that the teachers mentioned was that students should respect the views of others. But in classroom observations, I saw that teachers had no intention to continue the discussion with opposing views, such as,

> Teacher, "ok, while the tea was cold, gave the temperature, or the heat?" asked. A student replied, "the temperature is not shared, the heat is shared." There were some buzzers in the classroom; a few students said similar answers. The teacher picked up the answer. (O.C: I cannot say that she listened to the other views in the class.)

Even if there are some difficulties, scientific discussions have many benefits for children. According to some science teachers in this study, when students participate in discussions, learning can be more permanent: "…discussions increase the permanence, well, I think that if the students have the wrong ideas, they have the chance to change it, because they are participating in an individual debate, because they defend their own thoughts."

Discussion

Undertaking science is one of the most important ways for children to gain an understanding about science (Martin, 1997; NRC, 2012; Bell & Lederman, 2003; Settlage & Southerland, 1998). This engagement consists of inquiry processes, such as discussion and experimentation. Most research in the literature (Driver, Newton & Osborn, 2000; Sadler, 2006; Sampson and Clark, 2008) argues that scientific discussions allow students to undertake scientific reasoning and help them to understand the nature of scientific knowledge. It is stressed in the NGSS (2013) that students are expected to use argumentation to listen, to compare, and evaluate opposing views and methods.

In this study, I aimed to describe the patterns of scientific classroom discussions in science courses, and I investigated the five science teachers' attitudes about discussion process. According to first research question of the study, it can be said that all the teachers who participated in the research had opinions about scientific discussions that would make positive contributions to students' meaningful learning and persistence of knowledge. They believe that students' active participation in discussions will help them gain different skills. According to Jimenez-Aleixandre, Rodriguez and Duschl (2000) students use various communication activities, such as argumentative and epistemic, when they are giving the opportunity to discussions; thus, develops additional skills of communication and discussion. But, given the second problem of the research, it can be say that the teacher's positions were the dominant authority in the science classrooms. We can describe this approach as triadic dialogue (Lemke, 1990) which teacher preferred to identify the subject, start the discussion, and control the direction in which the discussion developed. Similarly, Duschl and Osborn (2002) found that classroom discourse was largely dominated by didactic monologues presented by the teacher, with little opportunity for students to engage in dialogical argumentation. Additionally, science teachers mostly want to say the final word in discussions and this attitude prevents active participation of some students in the discussions. Additionally, some teachers claimed that effective discussions could not be made at lower levels, while others claimed that younger children had more creative ideas and that more effective discussions could be made. Observations showed that students were willing to participate in the discussion at all class levels. This situation can be interpreted as the inability of the teachers to direct the discussions, so teacher training plays a critical role in ensuring students' active participation in class discussions (Caravita & Hallden, 1994).

One of the interesting findings of the research is that students participate more in scientific discussions in club work. The main reasons for this situation are the participation of those who are interested in science subjects and not worrying about course grade. Additionally, based on the observations, it is possible to say that the teachers gave more time to the discussions in their club works. According to Grover (2007), in safe classroom settings, students' participation in discussion enhance and will lead to more interaction between students and teachers. In the interviews, some teachers stated that some students did not prefer to participate in classroom discussions. It may be stated that the reason of some students' reluctant to participating discussions is that they are not feel themselves in safe.

As researchers and science educators, one of our primary aims is to encourage students' interest in science. They should understand how evidence is used in science for the construction of explanations which are the links between data and the theories that science has constructed, and the development of an understanding of the criteria used in science to evaluate evidence and construct explanations. In this study, it is claimed that science education perspectives emphasize that science education is not only the accumulation of knowledge about how the world is, but also scientific thinking skills needed for scientists engaging in science. Although the science teachers who construct the sample of the study expressed their awareness of the importance of the discussions, they were disturbed by the prolonged classroom discussions and discussions longer than planned, and they chose to end the discussions in such cases. To maintain effective science education, we need to understand what is important and lasting for students, as well as why. We need to also consider how students can better engage in discussions, which discussions processes are effective or motivating, and which topics in the science education program are appropriate for students. But the findings of this study show that the orientation of teachers and the curriculum leads to the interests and curiosity of the students.

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Appendix

Interview Form

I want to interview you to determine your beliefs and attitudes about the effectiveness and significance of using scientific discussions in elementary science classrooms. The data obtained from this interview will never be used to judge your efficiency; it will be analyzed for general trends about discussions in science classrooms. Thank you in advance for your contributions.

Date:_______________ Hour: _______________ Location: ________________

Graduate: ...…………………………………………………………………………......

Experience: ………………………………………………………………………..

Questions:

1. How often do you use scientific discussions in your classes?
   a. Do these discussions constitute an obstacle to following the curriculum?
2. Have you ever observed a remarkable effect of scientific discussions on your students?
   a. Could you measure these effects from the point of view of the students' retention of learning?
3. What are your expectations from your students in scientific discussions?
   a. Which sources, such as books, journals or personal experience do you prefer that your students to use when giving examples? Please explain your preference(s)?
   b. What is your opinion about using arguments or reasoning?
4. How do you describe your position or role in scientific discussions?
   a. Do you prefer to participate in the discussion directly or lead students' discussion?
5. Which learning area(s) do you think as being more suitable to apply during a scientific debate? (Organisms and Life, Physical Events, Matter and Change, the Earth and the Universe)
6. What do you think about using scientific discussions in different age groups? For which age group do you think scientific debate is more productive?
   a. Do you think there is a relationship between the stages of the students' cognitive development and when to conduct scientific discussions?
7. What is your students' interest in scientific discussions and approaches?
   a. Does this vary according to the subjects of interest?
   b. Have you observed any relationship between gender and interest?
8. The types of discussion do you prefer? (group / class) What are the reasons for your preference?
9. How do you conclude a scientific debate?
   a. By providing an argument to connect it to a conclusion?
   b. By determining the most powerful debate?
10. How much time you spend on scientific debate in each class?

Duration: _____________