

Science teachers' perceptions toward discrepant events applied in science education

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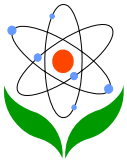
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Abstract

Discrepant events, contrary to previous to be true, are events which has unexpected results used to compare students together with their beliefs and to attract their attention They are used for the purpose of attracting students' attention, encouraging them to think about a topic, stimulating them to work out a contradictory case by changing usual way of thinking (creating cognitive imbalance) and make them research to find a reasonable explanation, improving their inquiry



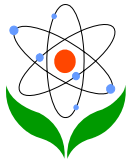
abilities, helping them to be mentally more qualified in cases of curiosity and the unknown. The aim of this research is to study science teachers' perceptions of discrepant events and level of awareness. For this purpose, phenomenology, one of the pattern of the qualitative research methodology, is applied in the research. Working group consists of 10 science teachers continuing the profession in Nevşehir Province with varied professional experience during 2014 -2015 academic year. Data related to the research are collected through observation, interview and analyzed in accordance with descriptive and contextual approaches. As a result of data analysis, it is quite obvious that science teachers are familiar with discrepant events, but there has been incompetence in handling of them in practice. To sum up, science teachers' understanding of discrepant events has reached substantial levels. However, it is clear that they are not qualified enough to decide how to apply discrepant event or which class levels it should be applied.

Keywords: Discrepant Events, Science Teachers, Professional Experience, Perceptions, Science Education

Introduction

There has been a common view that motivating students at the beginning of a lesson is an important factor for classroom management because their attention is distracted easily by unnecessary things. So teachers should be able to arouse interest on lessons, accordingly, on them. At the beginning of a lesson, they may talk about a discrepant event to draw attention, determine concepts students already have and encourage participation. If discrepant events are arranged properly, conditions are provided for active participation to lessons.

Discrepant events which come from an idea that “Two things that usually pique the interests of students in science classes are sports (1) and observing the unexpected (2)” (Mason, Griffith, Hogue, Holley & Hunter, 2004) and come from Festinger's(1957) theory called Theory of Cognitive Dissonance can be defined as; contrary to previous experience believed to be true, are events which has unexpected results used to compare students together with their beliefs and to attract their attention (Misiti, 2000). They are used for the purpose of attracting students' attention, encouraging them to think about a topic, stimulating them to work out a contradictory case by changing usual way of thinking (creating cognitive imbalance) and make them research to find a reasonable explanation,

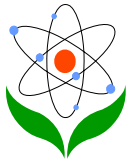


improving their inquiry abilities, helping them to be mentally more qualified in cases of curiosity and the unknown (Weller, 2008).

Discrepant events which have been identified as a valuable tool for students to cause cognitive conflict because they represent a kind of abnormal experience that forces students to focus on previous concepts, a necessary step for conceptual change (Pintrich, Marx & Boyle, 1993) are those developing against learners' ideas in mind and contribute to their enthusiasm to learn principles and concepts related to science (Wright & Govindarajan, 1992). As it is known from literature, students come to science courses beliefs about the phenomena and concepts to be taught or pre-instructional knowledges (Duit & Treagust, 2003) and and these concepts can be called as misconceptions, alternative frameworks, naive theories, naive conceptions, or preconceptions (Clement, 1993; Dykstra, Boyle, & Monarch, 1992). An important term which should be focused here to show importance of discrepant events in courses is conceptual change which has become a term that shows learning science from constructivist perspectives (Duit, 1999) and uses on learning and instruction in many studies (e.g., Guzetti & Hynd, 1998; Mason, 2001; Schnotz, Vosniadou, & Carretero, 1999; Vosniadou, 1994). For this reason, it is undeniable that discrepant events play a part in assuring the conceptual change that is cognitive aspect of science education and have been a focus of interest for many years (Park, 2006). In order to realize the conceptual change, it is required to meet 4 conditions based on constructivist approach developed by Posner, Strike, Hewson and Gertzog (1982): students find concepts already in use in adequate, but new ones comprehensible, rational and useful. Discrepant events are effective methods used for creation of cognitive dissonance which then becomes consistent as emphasized by Piaget, realization of conceptual change, arousing curiosity, interest and motivation, cases of brain based experiments and demonstrations (Longfield, 2009; Gonzalez-Espada, Birriel & Birriel, 2010).

Discrepant events increase scientific understanding and natural sense of curiosity for brain based experiments and demonstrations, film, explanation of a series of events, laboratory tests and a natural event through school trip by providing a deep thinking and discussion of the results (O'Brien, 2011; Weller, 2008). In order to provide education through discrepant events, it is also important to decide how to present them to students after choosing one of the ways listed above.

When the related field is searched, it is quite obvious that discrepant events are based on different strategies. It is stated that discrepant events are in compliance

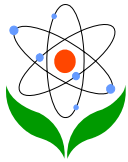


with the method called GOE (Guess, Observe and Explain) which is defined on constructivist approach and a demonstration was prepared depending on this method (Baddock & Bucat, 2008). In some researches, we may find presence of discrepant events taught through learning cycle, one of the most important approaches in science education, developed by Karplus and Their (1967). Learning cycle is a student oriented approach based on 3 main parts: Exploration, Term introduction and Concept application. In the exploration step, guidance is subordinate to experiment, observation and trips including new cases, ideas which are gained through students' observations and evaluations. In the next step, students are required to explain and define scientific terms gained through experiment, activities and observation carried out under the guidance of their teachers and through discussion. In the concept application step, students are expected to apply scientific concepts to new cases and the support they need is provided (Türkmen, 2006; Wright & Govindarajan, 1995). However, Friedl suggests 3 general steps to use discrepant events: Presenting discrepant events, including students to the event to conclude contradictory case and solving problems faced when applying discrepant events within scientific knowledge.

In this study, examples given by students to discrepant events are to be evaluated according to learning cycle approach (3E) because it includes concept application step allowing students to use knowledge and skills acquired at lessons in different cases.

To sum up, main advantages of applying discrepant events in science education can be stated by Mason, et al. (2004) as: Discrepant events lead individuals to feel discontent about conceptional knowledge and in some cases reconsider their pedagogic practices. At the same time, they ensure to correct controversies between accepted scientific explanation and individuals' misconceptions, additionally attract their attention, keep them engaged, motivate and provide mental development related to their scientific knowledge.

In this context, applying discrepant events in science lessons has a variety of advantages. In science education, to stimulate interest and motivate students to challenge their covert science misconceptions, to provide higher-order thinking skills, discrepant events are very effective (-Espada, Birriel, & Birriel, 2010). Especially, in some subjects such as pressure, nervous system/reflex, acids and bases, air friction force, the concept of species in genetic unit and electricity, teaching subjects theoretically doesn't allow the students to structure these

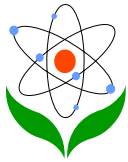


knowledge in their minds. Discrepant events enable science subjects to transform from abstract concept to concrete conception. In many studies, it was shown that science demonstrations which are main part of discrepant events are very effective for promoting understanding, generating interest and students attention, (e.g., Buncick, Betts, & Horgan, 2001; Callan, Crouch, Fagen, & Mazur, 2004; Manaf & Subramaniam, 2004; Meyer, Schmidt, Nozawa, & Panee, 2003).

In the science curriculum published in 2013 in Turkey, inquiry based learning was determined as basic approach of the science lesson and it is aimed to educate science literate individuals (Ministry of National Education [MONE], 2013). Although a holistic viewpoint has been adopted in terms of teaching and learning theories and practices in the science curriculum, this approach allows the student to be responsible for his / her own learning, enabling active participation in the learning process, and structuring the knowledge in his / her mind. Consequently, discrepant events which take place in this study are in accordance with the basic approach of the science education. On a detailed study of international literature of discrepant events in science education, it is important to draw attention to limited number of practical works including discrepant events and a research group at institutional level (e.g., Baddock & Bucat, 2008; Espada et al., 2010; Longfield, 2009; Mancuso, 2010; Willis, 1999; Wright & Govindarajan, 1992), but we haven't found a discrepant event at national level. What makes this study important is that there hasn't been a discrepant event practice and because of the reasons listed above. Teachers should be able to be qualified enough in terms of knowledge and skills to apply in the lessons.

The purpose of the study is to examine science teachers' perceptions of discrepant events and level of awareness. So in this research, teachers' views and practices applied in lessons were examined to evaluate their perceptions on discrepant events and their level of awareness. There are several research questions guided the study.

1. What do science teachers provide as discrepant event examples?
 - a) What are the reasons why they consider these examples as discrepant events?
2. What do the science teachers give examples toward the discrepant events in terms of the unit / theme?
3. What are the scientific concepts or processes that science teachers want to explain when they use examples of discrepant events they give?
4. Why do science teachers use discrepant events in their lessons?



5. What are the purposes of use of discrepant events in the class in terms of science teachers' perceptions?
6. Do science teachers use discrepant events in the class?
7. What are science teachers' expectations from students in case of using discrepant events?
8. What do science teachers think about skills developed with a discrepant event?
9. What do science teachers think about advantages and disadvantages of a lesson taught with discrepant events?

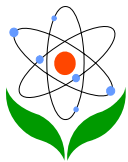
Methodology

Research design

In this research, in order to designate discrepant events perceptions of secondary school science teachers with different experiences, phenomenology, one of the qualitative research designs, was applied. Phenomenology design focuses on how people perceive phenomenon, describe, judge, remember, make sense of, talk about it with others and what they feel about it (Patton, 2014). Phenomenology study defines the common meaning of life experience of several people on a phenomenon or concept (Cresswell, 2013). The research is defined as study of phenomenology since this study aims to determine science teachers' perception, level of awareness regarding discrepant events and how they use discrepant events in lessons.

Participates

Working group of this study consists of 10 science teachers working in Nevşehir province in Turkey with different professional experience. On deciding samples, the method of maximum diversity and criterion sampling, among purposeful sampling, was chosen. Main purpose of purposeful sampling is not generalization of research findings from sample to population, but is to select cases including richness in terms of information to deepen the research (Patton, 2014). In order to create working group, two criteria were taken into account depending on criterion sampling: being volunteer to participate in the research and working as science teacher while maximum sampling is to choose large scaled cases purposefully to get differences on related dimensions (Patton, 2014). In this research, preferring science teacher with a variety of experience is considered an appropriate criterion for maximum diversity. In this research, data obtained from limited number of participations toward discrepant event perception was analyzed in detailed. In Table



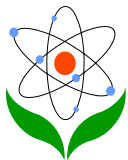
1, demographic characteristic of science teachers participating the research group are shown:

Table 1. Demographic characteristic of science teachers participating the research group

Teachers	Experience	Department of Graduation
T1	1-5 year	Faculty of Education- Science Education
T2	1-5 year	Faculty of Education- Science Education
T3	6-10 year	Faculty of Education- Science Education
T4	6-10 year	Faculty of Education- Science Education
T5	11-15 year	Faculty of Science and Letters- Chemistry
T6	11-15 year	Faculty of Science and Letters - Biology
T7	16-20 year	Faculty of Engineering- Chemistry
T8	16-20 year	Faculty of Science and Letters - Biology
T9	More than 20 year	Faculty of Education – Chemistry Education
T10	More than 20 year	Faculty of Education – Biology Education

Instruments

In this research, interview and observation were used to determine perception of discrepant events of science teachers. Interview was conducted to find out things that can not be observed directly and to reveal what people have in mind and to collect their stories (Patton, 2014). For this purpose, an interview form consisting of 6 open-end questions was prepared. Two academicians who are expert on the issue presented their ideas about interview questions. Questions were also asked to two science teachers who aren't among participants and a pilot study was just started. As a result of expert opinion and pilot study, 4 questions were added to interview form, and some questions in the form were rearranged. With the latest changes on the interview form, the type of interview form approach that the researcher is independent was determined directly with subtitles or headlines related to a talk, to ask questions spontaneously and to form a speech course abiding by focal point (Patton, 2014). Interviews were recorded and written as transcript. In order to understand whether answers science teachers give regarding discrepant events are compatible with lesson teaching performance, some of the data were collected through observation of classroom activities. Validity and reliability of the research was developed by checking analyses through videos

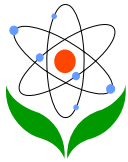


recorded during observation. An observation form was prepared by the researcher within the scope of this research as there is no study related to topic. Two expert academicians finalized the form. The language of having interview was Turkish, while findings of the study are stated in the study in English. In the research, nonparticipant observation method was applied in which the researcher doesn't participate the research interactively to collect data (Creswell, 2013). Five volunteer teachers were chosen considering participation of teachers with each group in classroom observation (Table 2). In this research, the researcher watches a lesson chosen in spring semester by a teacher recording it and taking notes during a lesson period.

Table 2. Information concerning the teachers' classroom observation

Teacher	Observation date	Class level	Unit	Subject
T2	Mar 06, 2015	6th grade	Reproduction, Growth and Development in th Living Things	Reproduction, Growth and Development in animals
T3	Mar 03, 2015	8th grade	The states of matter and heat	Heat and temperature
T5	Mar 10, 2015	7th grade	The properties and structure of matter	Elements and symbols
T8	Mar 02, 2015	7th grade	Electricity in our lives	Electrostatic
T9	Mar 09, 2015	8th grade	The properties and structure of matter	Acids and bases

The qualitative data obtained from this study were analyzed according to the descriptive and content analysis approaches suggested by Strauss and Corbin (1990). Within the context of the research, a conceptual framework was created for the descriptive analysis from the literature and the coded data correlated to each other and the themes were formed in the direction of the interview questions. Themes were rearranged by being re-examined similarity and differences of coded data. Under the interview questions (the themes), code lists were created taking into account the theoretical structure of the discrepant events. Within this framework, the data were subjected to content analysis and coded. After the checks are done, the code list was given the final form. In the first question asked discrepant events examples, it was compared that whether examples given by the teachers are considered as a discrepant events and coherence of inter-encoder reliability was examined. When the inter-encoder reliability was calculated, the formula



Reliability= [Number of agreements / (Total number of agreements + Total number of disagreements) x 100] proposed by Miles and Huberman (1994) was used and calculated as 80%. In addition, the perception rubric used in the evaluation of the observations was filled by watching video recordings of the lectures by another researcher. The reliability between the two researchers was calculated as 87% (Miles & Huberman, 1994).

The data obtained from the teachers' views have been tried to be diversified by observation data. The analysis results of the data were described in detail with citations obtained in observations and interviews by showing with tables.

Results

In this section, findings obtained by the analysis of qualitative data collected in order to determine teachers' perceptions about discrepant events are given in separate titles based on interview questions. In addition, findings from classroom observations are presented as table.

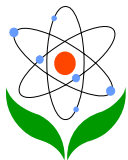
1. a. Discrepant event examples according to science teachers

When the data obtained from interviews with teachers were analyzed, T2 with 1-5 years of experience talked about examples of activities made with different methods which are not generally regarded as discrepant events, while T1 gave examples correct examples which are suitable for discrepant events.

*"We had an activity on reflexes. The students hold a ruler on their hands and we measure the time they leave the ruler. We measure reflexes and response times."
(T2)*

*"For example about pressure, we put a flat wooden plate on 4-5 balloons. Normally, students say "Balloons cannot lift any heavy thing, as they explode." They see that a few students cannot explode when they mount on the wooden plaque, and they are very surprised. It is an ideal example to teach the press in gases."
(T1)*

T3 teacher who had 6-10 years of experience gave an example which is not considered as discrepant events saying that he has not known ever before. But, T4 gave correct example.



"Hmm I do not know. Hmm. It's very difficult." (T3)

"For example, they do not know the solution reagents in chemistry-related acids and bases. Students only know that Turnusol paper acquires red color in acid, while blue in base. But they only know this as theoretically, don't know how colorants such as phenolphthalein and methyl azide color with acids and bases. They don't know these reagents either. When you drop it, they realize the difference, for example, the acid is red, the base is yellow, and they see it and they are surprised ... "(T3)

"If I asked the time of falling of cotton and ball which are same weight, when they are left in a stuffy environment, they said that ball would fall before the cotton. We discussed it and watched a video because we don't have any chance to apply it. The video showed that both of them fall at the same time and students were very surprised. "(T4)

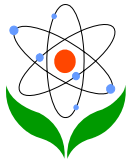
T5 from the teachers have the experience of 11-15 years has given an example that will take place in the direction of the expectations when the students are ready before the lesson .T6, on the other hand, gave an example as discrepant events even though it is not correct example which constitutes misconceptions for students.

"... It is interesting that the substance we prepared as an indicator of activity related to acid bases takes different colors according to acid and base. The markers we prepared with savoy cabbage, lemon and baking soda attracted the attention of the students. "(T5)

"In the 8th grade, we discussed in what conditions species are formed. It is not the species that wolf and dog constitute wolf dog and horse and donkey constitute hinny."(T6)

From the teachers having 16-20 years of experience, T7 and T8 described an experiment with discrepant events.

"When nail is wrapped with wire, it gets magnetism feature. Prior wrapping, it didn't pull. But then it started to pull. This situation is indicated as discrepant events. "(T7)



"We use aluminum foil instead of cable when preparing simple electrical circuits. We cut the pipes of the stove thinly from the bends and we make two ends of the pipe. They are very surprised when they see that the ampoule is burning. "(T8)

From the teachers who have 20 years or more of experience, T9 gave discrepant events example. T10 has described an experiment which is a discrepant event.

"... ..I give many examples such as gold and silver while I describe metals and elements. But they think they are jewelery. But they do not think we have gold and silver in our body. They say where they are. I say that we take from the food we eat and they are very surprised. "(T9)

"... When we use the Gravzant ring, the sphere is passing through the ring. I ask to children that Is it going to pass when we heat? they say Of course. They see that they do not pass after the heat, and they are very surprised. Because they are surprised at how metal can expand that much. "(T10)

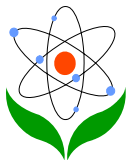
b. The reasons why they consider these examples as discrepant events

T1, among the teachers, explains that the reason to consider the example given as a discrepant event is a different way of attracting the interest of the students.

"Earlier times, orbital were used to draw on board and the electrons were placed there, and some of the students had difficulty in understanding them. But this method used to become interesting for the students and I think it is more permanent, they attract other students' interests and they try to understand what it is. I think it's an effective method. "(T1)

With the discrepant events given by the teachers according to T2, T3, T7, T8 and T9, the students have become interesting and different because they have never met in their daily life or lessons. For this reason they stated that they defined these incidents as discrepant events.

"It is something different from what they normally know, or something they know, but they do not notice they ask Was it such a thing? There is a different activity during the lesson and it takes students' pleasure. "(T2)



"They do not use these materials in the chemistry laboratory, and they do not encounter these materials in everyday life and it is interesting to them. It looks like different for them. "(T3)

"They were surprised that their magnetization was not directly on the wire." (T7)

"They have never heard of this time. It is difficult to prove it even if we tell the older people. And he will not believe. Perhaps it is the knowledge he will never hear in his life. "(T8)

"It's actually a simple cluster calculation. In mathematics, you do this kind of cluster as well. However, there is a visualization of an invisible atom model in children's eyes. They will never see it. They will not see the atomic model with their own eyes unless they are a scientist. We're trying to visualize it. It's a bit funny and it's like a game. "(T9)

"He sees what he cannot see with eyes. Electricity is a big event, but students cannot see with eyes. It's surprising since students see it on the electroscope. "(T10)

T4 and T5, among the teachers, thought that the students were interested because they saw the scientific explanations of the events they experienced in daily life and thus they stated that they saw the examples they gave as discrepant events.

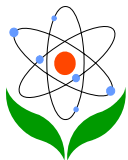
"... it is of interest to see the scientific reasons for the events that lived in everyday life." (T4)

"According to the children, the information in the book is more theoretical. It is effective when we tell them in practical terms that they will be useful for everyday life, and when they consider them interesting thing they know what they need "(T5).

T6, on the other hand, explains that example he gave is discrepant event in accordance with students' reactions.

"Responses and creative thinking that children have given in discrepant events." (T6)

2. Distribution of the discrepant events examples teachers give in terms of the unit / theme



Teachers' examples toward discrepant events are listed as followings. T1, pressure; T2, nervous system / reflex; T3, acids and bases; T4, air friction force; T5, acids and bases; T6, the concept of species in genetic unit; T7, electricity; T8, electricity; T9, elements; and T10, expansion.

Table 3. Distribution of the discrepant events examples teachers give in terms of class level

Teachers	Unit/theme	Grade level
T1	Pressure	8th Grade
T2	Nervous System / Reflex	7th Grade
T3	Acids And Bases	8th Grade
T4	Air Friction Force	8th Grade
T5	Acids And Bases	7th and 8th Grade
T6	Genetic / Species	8th Grade
T7	Electricity	8th Grade
T8	Electricity	All the grades
T9	Elements	8th Grade
T10	Expansion	6th Grade

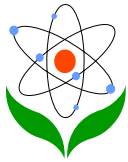
"Because it attracts people's interest, it will be applied to the first class as well. An unknown event and any interesting information are surprised and it is not right to evaluate it as a class level. They can be applied to every class." (T8)

3. Scientific concepts or processes that teachers want to explain when they use examples of discrepant events they give

Teachers stated that they use discrepant events examples to describe concepts related to the unit / subject.

"I usually use it when I teach the subjects, I do not remember the names of the themes, but I use it when I give the objectives that are related to the units, and I usually use it during the lessons." (T1).

"In the example of the air friction force, when we throw paper as flat and crumpled separately, the crumpled paper fell down earlier because the air has friction force. And since the surface is small, it will have less effect on the crumpled paper. They found themselves, and I wanted them to reach knowledge



with reasons through discovery and problem solving. I want them to find by giving them hint. "(T4)

4. Reasons for teachers to use discrepant events in their lessons

Since the teachers respond positively to the question "Do you use discrepant events in your lessons?", this section contains findings about the reasons for using discrepant events in their lessons.

Teachers generally prefer to use it to attract the attention of students, to ensure that it is permanent and effective and to motivate students. In addition, a few of the teachers prefer it since it takes part in the curriculum and the discrepant events are involved in new methods and techniques.

"Yes I use. I try to apply it when I see discrepant events example. I also think it's useful. If the students confuse, I do not apply them to next year. I do not want to be adhering to old methods and I want it to be permanent. Even when time passes, it's easy to remember this type of event. "(T1)

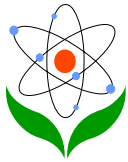
"Yeah. Providing persistence and attracting attention. In the learning process, it is better noticed. They don't forget and it sticks in the mind for a long time. "(T2)

"We had that experiment. They saw that the nail did not pull the needles first, They saw when wire is wrapped and they are surprised. They found it strange. They thought nothing would happen. I used it because it was in the curriculum of the course. "(T7)

"Yes, I use it so that the course will not be monotonous and to attract students' interests. These children are future scientists, artists and politicians. I use it to do our job well and to love things. "(T8)

5. Purpose of use of discrepant events in the class in terms of teachers' perceptions

Teachers' views related to purpose of using discrepant events in the class are similar to their views on the reasons for using discrepant events in the previous question. Practice skills and gaining life skills are given as purpose of use in class differently.



"to attract their notice, especially in small classes. In terms of permanence. Even in the exam, the activity comes to mind." (T2).

"To attract the attention of the learner, to explain scientifically that they live in daily life. If they know why they live in everyday life, they become more motivated." (T4)

"Attention, arouse interest, develop the concentrate to the top level." (T6)

"Practice skills. They may never see concepts related to acids and bases again. But this gains life skills. They may not pay much attention to pressure. They can think as 'what the press is doing in our lives?' but there are things that they will be aware of. It looks like different." (T9)

6. The usage of discrepant events in the class

The way in which teachers apply discrepant events has been evaluated according to the learning cycle approach developed by Karplus and Thier (1967). For this purpose, the ways in which teachers use discrepant events were evaluated whether it is appropriate for the learning cycle approach steps by forming a checklist. When the checklist is examined in detail, T4, T7, T8, T9 and T10 do not pay attention to the application steps according to the learning cycle approach although they give an example according to the discrepant events. Although T5 and T6 cannot give a proper example to discrepant events, they are striking to pay attention to the stages of "exploration" and " term introduction". It is also noteworthy that the total score of the teachers received from the control list is quite low (9) compared to the full score of 30.

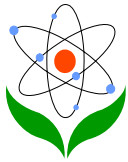
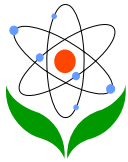


Table 4. Checklist for the use of discrepant events

TEACHERS	Exploration New situation and ideas obtained from experiments, observations and measurements are structured by the students.		Term Introduction The concepts of science obtained from experiments, activities and trips are explained and defined by the students based on group discussions and teacher guidance.		Concept Application Students are expected to apply science concepts to new situations and the support they need is provided in this regard.		Total score
	Yes (1)	No (0)	Yes (1)	No (0)	Yes (1)	No (0)	
T1	✓		✓		✓		3
T2		✓	✓			✓	1
T3		✓		✓		✓	0
T4	✓		✓			✓	0
T5	✓		✓			✓	2
T6	✓		✓			✓	2
T7		✓		✓		✓	0
T8		✓		✓		✓	0
T9	✓			✓		✓	1
T10		✓		✓		✓	0
Total							9

7. Teachers' expectation from students in case of using discrepant events

Among teachers who expect from students in case they use discrepant events in class, T1, asking questions and curiosity; T2, being surprised; T3, preventing students have the misconceptions; T4, they should be able to make scientific explanations about the events they meet in daily life; T5, participation in the course; T8 and T10; They will be more careful and willing to lecture; T9 expects to listen carefully. T7 has no anticipation because students are not prepared for the lesson;



T6, on the other hand, stated that when student give an example that is not considered as an discrepant events, it would appeal to the other friends.

"... I want them to ask a lot of questions, I want them to ask questions and wonder" (T1)

"They will wonder, they will be willing to learn what they wonder." (T2)

"If there is a concept that is already intermingled with, I expect that the confusion of concepts of students will disappear first, and I expect concepts in students mind to settle" (T3)

"The ability of the learner to make a scientific explanation of the subject. I want scientific explanations of an event in everyday life. "(T4)

"... The interpretation of the children is very important, and even if it is faulty, it is expected that they will reveal their own thoughts on how much they understand the interpretation they have made." (T5)

"The first reaction that children usually give is laughing. They like it. They are trying to give an example."(T6)

"The students are not interested in the background because they do not know what to see. I did not have any anticipation because they did not study lesson. "(T7)

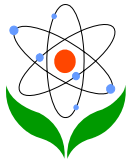
"I expect following things; listening carefully when the topic is told, motivation, curiosity, to do research assignments. "(T8)

"Within the lesson, they were fully alerted and listened. This course is different from other courses. ... attracts attention. " (T9)

"They listen with curiosity and quieter. They pay attention to the class. If there is something that interests them, they all listen carefully. "(T10)

8. Skills developed with a discrepant event

Teachers in the study explained skills developed with a discrepant event as; According to T1, ability to ask questions and make comments; according to T2, the ability to conduct research; According to T3, Analytical thinking skills; According



to T4, Scientific thinking skills; according to T6, Ability to think and comment; according to T8, Imagination and thinking skills; according to T9, skills toward implementation; According to T10, visual, auditory, and tactual skills can develop. According to T5 and T7, a course that taught with discrepant events becomes permanent because it makes abstract concepts concrete.

"The ability to ask questions and interpret them." (T1).

"... they are discovering the feeling of research. At the end of the course, we are missing what we have done and they are investigating. They enjoy learning better because they are doing it themselves." (T2)

"If the student does, it increases the thinking ability of the students. For example, if you are asking a question, it is expected that everybody will give an answer in brainstorming method by asking an open-ended question. Gain analytical thinking skills." (T3)

"It is important to obtain scientific thinking skills. Problem-solving and thinking skills develop." (T4)

"There is a problem of distraction. There is a system in which abstract concepts and theoretical knowledge are predominant. It is therefore necessary to make it concrete." (T5)

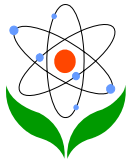
"Thinking skill. It is a situation in which children should not memorize just by adhering to the book. It is important to be able to produce something in children' observations around them and to be able to comment." (T6)

"Some things are abstract, so they are not permanent. It's visually mindful because it's different." (T7)

"Imagination and thinking skills develop. It is possible to gain different ideas. Self-confidence of students develops." (T8)

"Practice skills. They may never see concepts related to acids and bases again. But this gains life skills. They may not pay much attention to pressure. They can think as 'what the press is doing in our lives?' but there are things that they will be aware of. It looks like different." (T9)

"skills such as visual, auditory, and tactual can develop" (T10).



9. Advantages and disadvantages of a lesson taught with discrepant events

According to the teachers, the advantages of a lesson taught with discrepant events; More permanent (T1, T7); It attracts curiosity, attracts attention, becomes willing to learn (T2, T7); It raises the curiosity of knowing the reason for an encounter in daily life (T4); It provides in-depth learning opportunities (T5); Motivation increases (T6).

"It is more permanent for students. I usually experience in fifth grade very often. When I started the first lesson, I experimented with them and they didn't understand it. Maybe, they could understand if I told them on the board. It may be related to cognitive levels. "(T1)

"It raises curiosity and attracts more interest." (T2)

"it is attracting students' interests. It is curiosity and happiness to know the cause of everyday events for them. "(T4)

"In fact, this matter is important, and it will be advantageous if it clarifies what is involved with the activity." (T5)

"Concentration of focus as an advantage of children can be at a high level and can be intriguing." (T6)

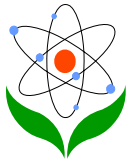
"It attracts attention of the child and shares their feelings around them, and it keeps their mind alive." (T7)

"I never thought it would be a disadvantage. Children will not have trouble and harm. But it will have positive benefits toward life ... "(T9)

"A more effective lesson is taught and becomes a colorful lesson." (T10)

According to the teachers, the disadvantages of a lesson with surprising events; Time is not enough (T3, T10); Students develop misconceptions beyond the expected results (T1, T2); Difficulty of class management (T3, T6); The presence of experiments involving dangerous situations, focusing on discrepant events and miss the whole thing (T5, T7, T8); and financial costs (T3); and T4 thinks it has no any disadvantage.

"I do not believe it has a disadvantage." (T4)



"Confusion can be formed on students mind. They can obtain a lot of wrong results. The student is reaching the wrong result and it is difficult to correct it because obviously I see it and we cannot correct it. It's easier to teach something when they do not know anything. Fifth graders have wrong inference obtained from experiments, observations and trips because their ability to comment does not develop. "(T1)

"Students face a situation they don't expect, and they are freaking out. If there is a lack of information and misconceptions about the subject, they can be confused. If they can not understand the lesson or they learn wrong, then they can also think wrong. "(T2)

"There may be a problem with classroom management. For example, it is difficult to brainstorm in crowded classrooms. It's hard to give everyone a word. In fact, for all the methods, you can reach anyone who is easy to apply for small groups. The Course duration is complicated. There is a financially problem "(T3)

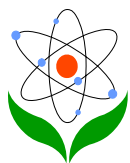
"If the students don't see the whole picture, depending on the duration of the entire unit explained, they just get stuck in the described example and misses the unit. This can be disadvantageous. "(T5)

"Children can use it extensively. Although the subject is over, they can bring it back to the agenda again and again. "(T6)

"The curriculum can not be followed because there is not enough time. If the test environments are not properly regulated, they may cause accidents. "(T7)

"Central heating is closed, windows are opened and mercury experiments are conducted in a cold environment. You bend a wire and metal. But you can't bend mercury which is liquid and can evaporate. It is curious and interesting because it is heavy and liquid. 5-6 years ago, Students were injured in a school by taking the mercury to their hand. There have been several accidents in this regard. it is needed to be careful. In electrical events, too, the child tried to establish an electrical circuit to establish a simple electrical circuit, which is very dangerous. "(T8)

"It takes a long time." (T10)



After the interviews, teachers were asked to plan a lesson time using discrepant events. First of all, It was determined whether teachers use discrepant events through experiment, activity etc. Findings obtained as a result of evaluating in-class observations with 'Discrepant Events Perception Rubric' are given in Table 4.1. T9 has already experimented with a topic (acids and bases) described during the course. However, the experiment was assessed in the perception rubric to determine how the teacher followed an experiment, observation, or activity that the teacher described as discrepant events, even though it is not (T9 stated that the H₂ gas was emitted when the acid are dropped on the zinc metal, and after a while, the zinc metal disappeared, that is, it was dissolved). T8 told an activity to the students from the unit of 'electricity in our lives' and since the activity makes minor changes, the event has the characteristics of discrepant events. "We rub balloon to jersey. Then the bulb light up, when we bring it closer to the bulb." This statement was used to explain the electrification by friction, but it was interesting for the students that balloon rubbed light the bulb. T2 made an activity which is described as a discrepant event in the breeding, growth and development unit to the students. In the event, some cards containing the names of some animals were distributed to the students and estimating of developmental period of animals, in the mother's womb, involved in the card was asked. In this activity, the teacher could draw attention to the students by finding out the contradictory situations. However, since such a classroom environment has not been established, this event has not been considered as a discrepant event. T5 explained to the students that the compounds do not have the properties of the constituent substances in the subject of elements and symbols and gave various examples for this situation. (e.g., H₂O is a liquid but it consists of O₂ gas which burn, and H₂ gas which is flammable). This example can not be regarded as a discrepant event. Lastly, T3 gave examples from daily life about heat exchange and it is discoursed that how these examples are performed according to the heat exchange. Relevant examples are of discrepant events.

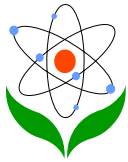
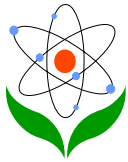


Table 5. Checklist for the use of discrepant events

'Discrepant Events Perception Rubric					
1. Exploration Step					
Criteria	Teachers				
	T2	T3	T5	T8	T9
“0” No observations were made about the ‘Exploration’					✓
“1” The knowledge, skills and behaviors that are desired to be gained from observations and measurements through discrepant events oriented experiments, activities and trips were transferred to the students by the teacher.				✓	
“2” The knowledge, skills and behaviors that are desired to be gained from observations and measurements through discrepant events oriented experiments, activities and trips were constructed mostly by the teacher.	✓		✓		
“3” The knowledge, skills and behaviors that are desired to be gained from observations and measurements through discrepant events oriented experiments, activities and trips were constructed partially by the teacher.		✓			
“1” The knowledge, skills and behaviors that are desired to be gained from observations and measurements through discrepant events oriented experiments, activities and trips were constructed by the students under the guidance of the teacher.					
2. Term Introduction					
Criteria	Teachers				
	T2	T3	T5	T8	T9
“0” No observations were made about the ‘Term Introduction’	✓				
“1” Discrepant events-focused science concepts targeted at the experiments, observations and trips are explained and described by the teacher.			✓		✓
“2” Discrepant events-focused science concepts targeted at the experiments, observations and trips are explained and described mostly by the teacher.					
“3” Discrepant events-focused science					



concepts targeted at the experiments, observations and trips are explained and described partially by the teacher.					
“4” Discrepant events-focused science concepts targeted at the experiments, observations and trips are explained and described by the students.		✓		✓	
3. Concept Applications					
Criteria	Teachers				
	T2	T3	T5	T8	T9
“0” No observations were made about the ‘Concept Applications’					✓
“1” The science concepts learned (or dealt with) through experiment, activity and trips were applied by teachers to new situations.	✓		✓	✓	
“2” The science concepts learned (or dealt with) through experiment, activity and trips were applied mostly by teachers to new situations.					
“3” The science concepts learned (or dealt with) through experiment, activity and trips were applied partially by teachers to new situations.					
“4” ” Students were expected to apply the science concepts learned (or dealt with) through experiment, activity and trips to new situations and supports students need were provided.		✓			

Average scores were calculated from the lectures planned by the teachers to use the discrepant events as seen in Table 4. The group spacing coefficient proposed by Kan (2009) was used to give the meaning to arithmetic averages obtained. When the group spacing coefficient is calculated, the difference between the largest value of 4 and the smallest value of 0, which is the scaling value, is divided to 5, which is the group number, and the evaluation range is set as .80. Group intervals in this direction are determined as 3.21 to 4.00 completely sufficient, 2.41 to 3.20 sufficient, 1.61 to 2.40 partially sufficient, 0.81 to 1.60 inadequate, 0.00 to 0.80 totally inadequate / unobserved and performed to give the meaning to arithmetic averages. As a result of this evaluation, when Table 5 is examined, it is found that only T3 is completely adequate according to the information obtained from the teachers' lectures.

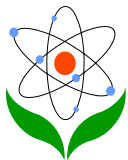


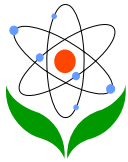
Table 6. Mean Scores and Proficiency Levels of Teachers obtained from 'Discrepant Events Perception Rubric'

Teachers	\bar{X}	Proficiency Level
T2	1.00	Inadequate
T3	3.67	Completely Sufficient
T5	1.33	Inadequate
T8	2.00	Partially Sufficient
T9	0.67	Totally Inadequate / Unobserved

Discussion

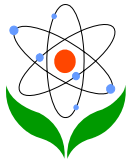
Phenomenology which is one of the qualitative research methodologies was used in this study in order to determine the perceptions and awareness levels of discrepant events of science teachers with different professional experiences. The results based on the findings of the research were discussed by taking into consideration the interview questions in the light of the theoretical bases regarding the discrepant events, since there were no practical studies.

When teaching a science concept or principle, it is important that the teacher awakens the curiosity of the students. The discrepancy in the use of discrepant events is a method by which students can take advantage of the curiosity of students by attracting attention and forcing them to seek a solution to "mystery". When the motivation of the students is high, learning conditions are suitable (Chin, 1992). Discrepant events are confronted as situations that attract students' interests and attentions, which constitutes a cognitive imbalance situation that is contrary to previous experiences that are believed to be true (Misiti, 2000; Weller, 2008). When assessed in this direction, many of the teachers (T1, T4, T7, T8, T9 and T10) gave examples of discrepant events in the form of an activity, experiment or demonstration that students did not encounter before in science lessons and contrary to the experiences of students. Among teachers, T1, T2, T3, T7, T8 and T9 explained the reasons for the fact that the examples they give are considered as discrepant events as because it is an activity that students do not encounter in their previous science lessons and daily life. T4 and T5, on the other hand, think the reason for the fact that the examples they give are considered as discrepant events is that students learn scientific explanations of the events they experience in daily



life in the lesson. However, this explanation is not sufficient reason for the fact that the given example is of a discrepant event. Another teacher (T6) regards the given example as a discrepant event according to the reactions of the students. As a matter of fact, according to the relevant literature, this is also true (González-Espada et al., 2010). T4, although he gives suitable for example for the discrepant event, justification of it is not correct. On the other hand, although T5 and T6 can not present correct examples toward discrepant events, they correctly explained why the examples they give are discrepant events. Teachers' awareness is high in terms of explaining the class level to be applied and their relationship with the subject specifying which unit / theme or class level the discrepant events instances they gave. Many of the teachers were able to explain which scientific concept or processes in the subject are related to discrepant events the teachers gave. Teachers explained the reasons for using discrepant events in their lessons as to attract the attention of the students and to ensure that the subject is effective and lasting. In addition, there are teachers who point out that the relevant activity is included in the curriculum, and that discrepant events are one of the new methods and techniques. When teachers were generally asked the reason of using discrepant events in their class, they stated similar reasons. They stated that it is used for application and for acquiring life skills. The methods by which teachers use discrepant events in class are evaluated according to the learning cycle approach developed by Karplus and Thier (1967). Obtained findings are the fact that the teachers who give examples of discrepant events are not familiar with the application steps in the class, and at the same time the teachers who do not give the appropriate examples to the discrepant events are moving towards the application steps. In summary, it can be reached that teachers do not have sufficient knowledge and skills to present discrepant events in the class. In case teachers use discrepant events in science lessons, they expect asking questions and wondering, being surprised, and removing misconceptions they have from students.

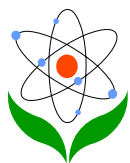
Besides, the expectations of T6 and T7, the problems arising from the failure of the student to prepare for the lesson, and the effect on the friends of a student who shares a situation which pleases him can not be considered within the scope of discrepant events. According to the teachers, in a course taught with discrepant events, students' skills including the ability to think and research at a high level usually develop. In addition, appealing more sense organs of students and acquiring the skills toward this is inevitable. The advantages of a course with discrepant events can be listed as; permanence, learning the reasons for events in daily life students face, curiosity, interest arouse etc. The disadvantages are the lack of time,



the possibility of developing misunderstandings other than the reactions expected from the students, classroom management, dangerous situations in some experiments, the student concentrate on the discrepant events and can't establish relationship with topic etc. According to the findings, many of the science teachers in the research are familiar with the discrepant events used in science lessons. However, some teachers seem to have experienced some problems in terms of their application to the class. From this point of view, compliance of lecture performances with data obtained from the interviews with the teacher and the application direction of the discrepant events require focusing on classroom observational data.

According to the classroom observations made with five teachers who volunteered to present an amazing event to their students at the school, only T3 presented discrepant events in accordance with the application steps. In the interviews, T3 didn't give a proper example to the discrepant events and he also didn't pay attention to the steps of using discrepant events in the class. According to interviews and observations data, it is obtained that T2 and T5 are not familiar with the discrepant events used in science education. T8 presented a discrepant event to the students by paying partly attention to the application steps of the discrepant events. Even though T8 gave the correct example to discrepant events in the interviews, he didn't properly address to the application process. T9 didn't give a correct example to the discrepant events during the course, it is also seen that his lecture is insufficient in terms of application steps. As a matter of fact, T9 in the interviews gave a correct example in accordance with discrepant event, but it was determined that he has deficiencies in the implementation steps. As a result, science teachers have no underestimated level of awareness to discrepant events. However, it appears that teachers do not have the expected level of knowledge and skill about what class level of discrepant events should be applied or how to apply it to class. When literature is reviewed it can be said that even though several studies give examples to discrepant events or describe in science courses what they are (e.g., Baddock & Bucat, 2008; Chin, 1992; Espada et al., 2010; Longfield, 2009; Mancuso, 2010; Willis, 1999; Wright & Govindarajan, 1992; Wright, & Govindarajan, 1995) as far as we know, there was no study which investigate science teachers' views related to topic.

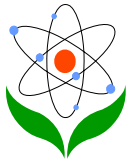
In order for teachers to develop knowledge, attitudes and experiences about discrepant events, which is an important element of the educational process, it may be advisable to organize seminars for science teachers working in the field



practiced by researchers on discrepant events. It is also advisable to add discrepant events both theoretically and practically to the content of the lessons given in teacher education. It may be advisable to incorporate the course content about discrepant events into primary and secondary education curricula both theoretically and practically. Since the number of the studies, especially in Turkey, about measuring awareness, knowledge and skills toward discrepant events are inadequate, researchers should conduct studies by using quantitative and mixed methods. Additionally, in this study, phenomenology, one of the qualitative research designs, was applied. Researchers could extend the design by using longitudinal researches. Even though the study was conducted with science teachers, researchers can, learn awareness at first and then they can use discrepant events method to teach courses.

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