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The Evaluation of Teachers' in-Class Practices and Opinions for Developing Analytical Thinking Skill of Primary School Students in the Course of Science *

Büşra Melis Kanyılmaz [1], Elif Özata Yücel [2]

Abstract

In this study, classroom teachers' in-classroom practices and opinions for development of analytical thinking skill of primary school students in the course of science are evaluated. Firstly one-to-one interviews with a third and a fourth grade teachers were conducted and then observations are made in the same classrooms through same units which were related to electricity. The third-grade teacher stated during the interviews performed prior to the observation that the science course should be taught by doing, experiments and observations; and brainstorming, method-techniques of question-answer should be used to develop the analytical thinking skill of students. However, it was determined that the teacher used predominantly teacher-centred practices throughout the unit. The results of research revealed that the third-grade teacher was aware of this situation but did not reflect this during his in-class practices. The fourth-grade teacher stated during the interview that s/he taught by paying attention to learning by doing, video and visual materials for developing the analytical thinking skill. Accordingly, s/he mainly used in-class applications with teacher-student interaction throughout the unit. In this manner, when comparing the practices of this class to the third-class ones, they are expected to contribute more to the development of analytical thinking skill of students.

Keywords

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[1] Private Atafen College, Kocaeli, Turkey, melis_kanyilmaz@hotmail.com
[2] Kocaeli University, Faculty of Education, Department of Primary Education, Turkey, elif.ozata@kocaeli.edu.tr

Introduction

In today's science and technology age in which rapid changes and advances take place, it is needed for the individuals with developed high level thinking skills who do not only memorize information but also know how to use knowledge, can adapt this knowledge to new situations, can think critically, can understand new ideas by analysing the knowledge, can solve problems, can take decisions (Partnership for 21st Century Skills, 2002). For this reason, it should be focused on developing high-level thinking skills in addition to academic information (Chonkaew, Sukhummek, & Faikhamta, 2016). This has been taken into consideration for the curricula of Turkey as it is valid for the curricula of many countries, and thinking skills have been added to the curriculum of the course of science, one of these programs, under the title of life skills (Ministry of National Education [MoNE], 2013, 2018).

Thinking skills, which affect an individual's learning skills, learning speed and learning performance, are one of the most important elements of the learning and teaching process. The thinking skills, which are important for a student to solve problems in the learning process, enable students to develop and help them prevent mistakes related to thinking (Heong et al., 2011). Thinking skills welcome us in various sources as the skills such as gathering and assessing data, remembering, comprehension, application, comparison, classification, organisation; thinking analytically, creatively and critically, questioning, decision-making, problem solving and metacognition (Burke, Williams, & Skinner, 2007; Irwanto, 2017; Marzano et al., 1988).

As one of the thinking skills, analytical thinking skill (Irwanto, 2017; Irwanto & Rohaeti, 2016; Wahyuni & Analita, 2017) is the high-level cognitive thinking that could be reached after achieving low-level cognitive thinking such as remembering, comprehension and application. Analytical thinking is defined as the skill of students' describing concepts as part of a more comprehensive concept and explaining the relationships between parts (Irwanto, 2017). Bloom (1969, as cited in Montaku, Kaittikomol, & Tiranathanakul, 2012) classified analytical thinking in three parts: analysis of elements, analysis of relationships, and analysis of organizational principles. Analysis of elements means classifying what is important, necessary, or has the greatest role, and determining which is the reason and which is the result. Analysis of relationships means investigating sub-relationships of situations or evidence, and detecting how they are related, and what their consistent and contradictory sides are. On the other hand, analysis of organizational principles is to search for the structure of the system or the nature of the situation and the different actions, and to see how they relate (Montaku et al., 2012).

Indicators of analytical thinking skills can be ranked as analysis of a situation, determining its elements and the relationship among them, suggesting organizational principles, proper evaluation of basis of ideas' validity and reliability and expressing them clearly, effective evaluation of the analysis conducted and arriving a conclusion (Akkuş Çakır & Senemoğlu, 2016). Analytical thinking in the dimension of conceptual comprehension includes analysing, reasoning, comparing, distinguishing, evaluating, organising and associating concepts (Anwar & Mumthas, 2014; Mayer, 2002; Irwanto, Rohaeti, Widjajanti, & Suyanta, 2017; Sternberg, 2002, 2006). According to Bloom's Taxonomy, analytical thinking involves the skills of analysing, organising, relating, division, separation, classification, comparison, addressing opposing aspects, selecting, ordering, calculating in detail, correlation, diagramming, concentration, distinguishing, exemplification, inferring, summarizing, ranking by precedence, subdividing and expressing (Demirel, 2005).

Analytical thinking is a skill which is considered to be developed in the learning process (Ramdiah, Mayasari, Husamah, & Fauzi, 2018). Because the analytical thinking skill is required so that students can define a problem, can divide this problem into smaller pieces, can generate solutions for each of these pieces, can find a solution to the whole problem (Robbins, 2011; Tsalapatas, 2015). It is also an important skill for questioning and reasoning processes (Robbins, 2011). Students need analytical thinking in order to evaluate their ideas and think critically (Sternberg, 2003; Wahyuni & Analita, 2017). Studies have revealed that analytical thinking has positive effect on knowledge level and academic success of students (Karenina, Widoretno, & Prayitno, 2020; Montaku, 2011). Analytical thinking is also associated with scientific process skills (Irwanto et al., 2017). In this manner, analytical thinking will

also contribute to the achievement of other objectives of the science curriculum. All life skills other than analytical thinking skill are common in all primary school curricula in Turkey, analytical thinking skill is only included in the science curriculum (MoNE, 2018). For this reason, it has more importance for the course of science.

It is observed that there are problems in various educational levels related to the development of analytical thinking skills in Turkey. When evaluating international scale research results such as Trends in International Mathematics and Science Study (TIMSS), Programme for International Student Assessment (PISA), Poisson Iteratively Reweighted Least Squares (PIRLS), it is understood that Turkish students' high order thinking skills, including analytical thinking skill, are unsatisfactory (Demirel & Yağmur, 2017; Martin, Mullis, Foy, & Hooper, 2016; MoNE, 2015; OECD, 2016). Akkuş Çakır and Senemoğlu (2016) reported in their studies that analytical thinking skill of primary preservice teachers were low, and this skill could be developed through university education, but they did not achieve the desired level. However, it was urged in different studies that analytical thinking skill can be developed with various educational processes (Chonkaew et al., 2016; Karenina et al., 2020; Olça, 2015; Puchumni, Tungpradabkul, & Magee, 2019; Siribunnam & Tayraukkan, 2009). Analytical thinking skill, related awareness and pedagogical proficiencies of teachers are important in order to achieve this (Chonkaew et al., 2016; Çelik, Gürpınar, Başer, & Erdoğan, 2015; Nuangchalerm, 2009).

The importance of analytical thinking skill in science course and this skill's being included only in science courses in primary school curricula gain importance for primary school teachers' having knowledge about analytical thinking skills and conducting studies to develop this skill. Accordingly, the goal of this study is to investigate the in-class practices of primary school teachers towards developing analytical thinking skills of primary school students in the course of science. In addition, the purpose of this study includes receiving teachers' opinions on the development of this skill before the observation, and examining the consistency between opinions and practice.

Method

Research Design

Holistic multiple case study from qualitative research designs was used in this study (Yin, 2002). The case study aims to analyze one or more cases in their own boundaries as holistic and in detail (Yıldırım & Şimşek, 2008). The reason for using multiple case design in this study is the existence of more than one cases which could be perceived holistically on their own. This research is multiple case as it involves two different class grades. However, there is a single units of analysis which was holistically examined since it was focused on analytical thinking skill at both grade levels (Yıldırım & Şimşek, 2008; Yin, 2002). Firstly one-to-one interviews with teachers and then in-class observations were conducted for the purpose of determining the teaching and learning activities applied and approved by primary school teachers to develop analytical thinking skill.

Study Group

Science course is taught in 3rd and 4th grades of primary school in Turkey. For this reason, only these grades were added to the study. This study was carried out in two classes, one was third and the other was fourth grade, selected from two primary schools in Kocaeli province located in the northwest of Turkey. First of all, both of the primary school teachers were interviewed, and then observations were performed in the same classes. Because of the long-term observations in the classroom, only one third class and one fourth class were included in the study. On this occasion, the feasibility of the study was ensured. The working group was determined through discussions with classroom teachers working in various schools. In these interviews, teachers who are aware of analytical thinking skills, who think that this skill is important and who volunteer to participate in the study were identified. A working group was formed considering the similar characteristics of the schools. Both schools are located in the district center. In addition, school facilities, class sizes and socio-economic levels of families are similar. While the teacher of third grade (T 1) had worked for eleven years, the fourth-grade teacher (T 2) had worked for twenty years.

Data Gathering Tool, Gathering Data and Analysis

Data were gathered through semi-structured teacher interview form and in-class observation form for analytical thinking skill by firstly interviewing teachers one to one and then performing observations in the classrooms.

In the first version of the teacher's interview form, which was prepared in order to get the opinions of the teachers about how to gain analytical thinking skills to the students, six questions were included. This form is presented for the opinion of a curriculum development, a classroom education and a science education specialist. According to these opinions, the research, due to the lack of purpose of testing teachers' knowledge of life skills, the question of "What does analytical thinking mean to you?" and the phrase of "Do teachers have an impact on students' ability to think analytically?" are excluded from the form because they are integrated to the question of "Does the science course contribute to the development of analytical thinking skills?" After the arrangements were fulfilled, a preliminary application was made with a volunteer classroom teacher and the interview form consisting of four questions was finalized.

The data were resolved by descriptive analysis. According to the questions prepared in the interview form, the views of both teachers were summarized and interpreted.

Through the observation form developed by the researchers, classroom practices of teachers were examined. In order to form the first version of this form, the literature review was conducted first and criteria were developed by considering the definition and scope of analytical thinking skills. The draft form was reviewed by two program development, two science teaching and one primary school teaching specialists. In line with the opinions received, the analytical thinking steps were arranged as "teacher centered" and "teacher-student interactive. In addition, "Always", "Occasional", "Never" expressions in which these behaviors were graded were abandoned. The table was converted into a frequency / percentage table. Two separate researchers conducted a sample lesson observation using the observation form. In the final of the sample lesson observation, because the comparison and classification skills in the analytical thinking steps were very close, these skills were combined in the same item and 11 teacher and student centered behaviors were determined and the form was finalized.

Observations were conducted by two researchers during the unit of "Electric Vehicles in our Life" lasting for 13 class periods in third grade; and the unit of "Simple Electric Circuit" continuing for 6 class periods in the fourth grade by considering the durations specified in the curriculum of science course (Table 1).

Table 1. Observed Unit and Lesson Durations

Grade	Unit	Recommended duration by the curriculum	Duration taught in the classroom	Subjects
3	Electric vehicles in our life	21	16	1. Electrical tools 2. Electric sources 3. Safe use of electricity
4	Simple electric circuits	9	6	1. Simple electric circuits

Both researchers attended the lessons took detailed note of what was done in the class, and they then created raw data by considering the notes they took. They analysed raw data using in-class observation form, and calculated percentages and frequencies. It was determined that the agreement percentage of both researchers' analyses was calculated as 88,5% in accordance with the formula generated by Miles and Huberman (1994) as Agreement/ (Agreement + Disagreement) x100. According to Miles and Huberman (1994), it is an acceptable value when the percentage of agreement is 70% and above. Disagreed in-class teacher practices were re-examined, and data analysis was completed by agreeing.

Results

Opinions of Teachers on Developing Analytical Thinking Skill in Science Course

While the third-grade teacher thought that the course of science contributed partially to the development of analytical thinking skill as this skill required abstract thinking skill, the fourth-grade teacher stated that it contributed positively to the development of this skill. Whereas the third-grade teacher expressed that the subjects of force and movement, electric were appropriate for the development of analytical thinking skill, the fourth-grade teacher stated that the subjects of measurable properties of the substance, force and movement, electric served for this goal. Sample teacher opinions are presented below:

> Analytical thinking can be somewhat abstract for this age group. (…) Family life is also effective in this. If there had been children experiencing more stimuli, more different things would have occurred. It changes from student to student. It could not be developed same for every student since individual differences are many. (…) For example, the subjects of electricity, light and sound will also be very effective for us. Students asked many questions about the subject of force and movement. (T 1)

> There is a contribution of the science course. Child will analyse. For example, s/he will perform the mass measurement. S/he will transfer this into daily life. For instance, s/he will measure the mass of liquids, (…) transfer this into his/her daily life, these are the things that s/he can use when going to the bazaar (T 2).

While the third-grade teacher thought that brainstorming, question-answer and questioning would be appropriate in developing analytical thinking skill, the fourth grade-teacher stated that the methods and techniques of experimenting and discussing the results of this were effective in this manner. Both teachers emphasized the importance of student-centred approaches. Both teachers stated that it would be appropriate to make observations in order to evaluate the development of analytical thinking skill.

> (…) They brainstormed and questioned much. It was very effective in supporting analytical thinking skill. (…) Observation could be used to evaluate the development of analytical thinking skill. However, I could not use it because the classes are crowded. (T1)

> (…) The most common method that we use in our classroom for analytical thinking skill is experimenting. They then analyse the results. Thus, we discuss and decide about it. It is like, what did you understand? (…) I think evaluating the development is appropriate for example when they play, do something outside, talk about what did they learn from lessons and in a normal conversation about daily life or observing their acts. (T2)

Teacher in-Class Practices for Developing Analytical Thinking Skill in the Course of Science

The third-grade teacher, who participated in the study, used more teacher centred practices that could support the development of analytical thinking skill in the subject of "Electrical Tools" that s/he taught during three class period (f=24, 60%). Only s/he frequently defined/explained a concept/situation/problem during the subject (f=7, 17.5%), and emphasized the relationship among these (f=7, 17.5%). S/he explained the properties of units of analysis of a concept/situation/problem for four times (10%) within the scope of this subject. S/he did not do anything for explaining the relationship between the units of analysis of a concept/situation/problem, choosing the solution way of problem and clarifying solution steps, solving the problem and showing concepts/situations/problems on the chart (Table 2). Sample in-class practices of teacher are as follow.

> Electricity is the most used resource in our daily life. Electricity is used in lightening houses, workplace and streets, and starting devices such as television, telephone, washing machine (Lesson [L]1, between the minutes of 06.50-07.10)

Our food is gone bad because the refrigerator will not work when the electricity is cut (L1, 1.10-01.18 minutes)

The refrigerator is one of the electrical tools that we use to cool our food and beverages (L2, 13.35-13.46 minutes).

Table 2. In-Class Practices of Third Grade Teacher for the Subject of Electrical Tools

Teacher-Centred	**f**	**%**	**Teacher-Student Interaction**	**f**	**%**
1. Only teacher defines/explains a concept/situation/ problem.	7	17.5	1. Teacher enables students to define/ explain a concept/ situation/problem with their own words.	1	2.5
2. Teacher shows concepts/situations/ problems with graphic or chart.	-	-	2. Teacher allows students to show concepts/situations/ problems with graphic or chart.	-	-
3. Teacher compares/classifies concepts/situations.	1	2.5	3. Teacher enables students to compare/classify concepts/situations.	-	-
4. Teacher explains the relationship among concepts/situations/subjects.	7	17.5	4. Teacher allows students to discover the relationship among concepts/situations/subjects.	2	5
5. Teacher divides a concept/situation/ problem into its units of analysis.	3	7.5	5. Teacher let students divide a concept/situation/ problem into its units of analysis.	-	-
6. Teacher explains the features of units of analysis of concept/situation/ problem.	4	10	6. Teacher enables students to explain/define the features of units of analysis of concept/situation/ problem.	1	2.5
7. Teacher compares/classifies units of analysis of concept/situation/ problem.	2	5	7. Teacher allows students to compare/classify units of analysis of concept/situation/ problem.	12	30
8. Teacher explains the relationship among units of analysis of concepts/situations/subjects.	-	-	8. Teacher let students explain the relationship among units of analysis of concepts/situations/subjects.	-	-
9. Teacher chooses how to solve the problem.	-	-	9. Teacher encourages students in choosing how to solve the problem.	-	-
10. Teacher explains the solution steps of problem.	-	-	10. Teacher asks students to explain the solution steps that they used.	-	-
11. Teacher solves the problem.	-	-	11. Teacher motivates all students in solving the problem.	-	-
Total	24	60	Total	16	40

The third-grade teacher used in-class practices with teacher-student interaction, which would support the development of students' analytical thinking skill, less during this subject (f=16, 40%). These practices are mostly in the form of students' asking questions to the teacher. When examining Table 2, it is observed that teachers concentrated on students' comparing/classifying the units of analysis of concept/situation/problem (f=12, 30%) and discovering the relationship among concepts/situations/problems (f=2, 5%). Some question samples addressed by the teacher for students are below.

What electrical tools do we use to communicate? (L1, 14.19-14.40 minutes).

What difficulties would we have if there was not electricity? (L2, 35.38-36.41 minutes).

Table 3. In-Class Practices of the Third Grade Teacher for the Subject of Electrical Sources

Teacher centred	**f**	**%**	**Teacher-student interaction**	**f**	**%**
1. Only teacher defines/explains a concept/situation/ problem.	6	15	1. Teacher enables students to define/ explain a concept/situation/problem with their own words.	-	-
2. Teacher shows concepts/situations/ problems with graphic or chart.	2	5	2. Teacher allows students to show concepts/situations/ problems with graphic or chart.	-	-
3. Teacher compares/classifies concepts/situations.	2	5	3. Teacher enables students to compare/classify concepts/situations.	-	-
4. Teacher explains the relationship among concepts/situations/subjects.	3	7.5	4. Teacher allows students to discover the relationship among concepts/situations/subjects.	1	2.5
5. Teacher divides a concept/situation/ problem into its units of analysis.	5	12.5	5. Teacher let students divide a concept/situation/ problem into its units of analysis.	3	7.5
6. Teacher explains the features of units of analysis of concept/situation/ problem.	1	2.5	6. Teacher enables students to explain/define the features of units of analysis of concept/situation/ problem.	3	7.5
7. Teacher compares/classifies units of analysis of concept/situation/ problem.	2	5	7. Teacher allows students to compare/classify units of analysis of concept/situation/ problem.	7	17.5
8. Teacher explains the relationship among units of analysis of concepts/situations/subjects.	1	2.5	8. Teacher let students explain the relationship among units of analysis of concepts/situations/subjects.	-	-
9. Teacher chooses how to solve the problem.	3	7.5	9. Teacher encourages students in choosing how to solve the problem.	-	-
10. Teacher explains the solution steps of problem.	1	2.5	10. Teacher asks students to explain the solution steps that they used.	-	-
11. Teacher solves the problem.	-	-	11. Teacher motivates all students in solving the problem.	-	-
Total	26	65	Total	14	35

The third-grade teacher used teacher centred practices, which could support to develop the analytical think skill, more during the subject of "Electrical Sources" that s/he thought for 5 class periods (f=26, 65%). It was observed that only teacher frequently defined/explained a concept/situation/problem in teacher-centred practices (f=6, 15%), and divided these into units of analysis (f=5, 12.5%) (Table 3). Some samples are presented below, respectively.

> Different electrical sources are used when electrical tools are in operation. The devices such as television, computer, iron, washing machine or refrigerator start with the electricity produced at power plants (L1, 08.22- 10.03 minutes).
>
> Electrical tools make our daily life easier (L1, 04.45- 05.20 minutes).

The teacher used to explain the features of units of analysis of concept/situation/problem (f=1, 2.5%), compare/classify units of analysis (f=2, 5%), explain the relationship between these (f=1, 2.5%), choose the solution way of the problem (f=3, 7.5%), explain the solution steps (f=1, 2.5%), show concept/situation/subject with graphics and chart (f=2, 5%), compare/classify (f=2, 5%) and explain the relationship between these (f=3, 7.5%) very few during this subject (Table 3). One of the explanations of

teacher that was evaluated in the step of comparison/classification of the units of analysis of concept/situation/problem is given below as an example.

> Telephone, laptop and camera are working with battery…battery comes into existence with the combination of more than one stronger cells with more energy… It is bigger than cell. While we can work wall clock with cell, camera does not start with it (L1, 13.17- 14.29 minutes).

Only 35% (f = 14) of in-classroom practices in this subject are teacher-student interactive applications (Table 3). In these practices, the teacher concentrated on students' comparing/classifying (f=7, 17.5%) the units of analysis of concept/situation/problem. An example question posed by the teacher for students is presented below.

> Are the electrical sources of laptop and ampule that lightens our room same? (L1, 07.18- 08.00 minutes).

The third-grade teacher used teacher centred applications, which could support to develop the analytical thinking skill, more for the subject of "Safe Use of Electric" (f=12, 66.7%). Only 33.3% of the teacher's classroom practices were teacher-student interaction. When examining teacher centred practices, it was observed that the features of units of analysis of concept/situation/problem were explained (f=4, 22%), and the problem was solved by the teacher (f=3, 16.5%) (Table 4). Samples are provided below, respectively.

> Electricity's crossing through the human body damages it. Burnt may occur on our skin and internal organs. It may even cause injuries, which may result in death, at our bodies (L1, 08.10- 08.32 minutes).

> When we see somebody getting electric shock, we should not touch that individual, who has been exposed to shock, by hand. Individual with electric shock should be taken away the electric source by the help of plastic, fabric, towel, wood… Nothing should be done other than the instructions given to us by 112 emergency services by phone. (L1, 11.43- 13.23 minutes).

The third-grade teacher performed the practices for defining/explaining a concept/situation/problem (f=2, 11%), dividing into units of analysis (f=2, 11%) and comparing/classifying the units of analysis of these (f=1, 5.5%) less. The third-grade teacher did not do any practice for explaining the relationship among the units of analysis of concept/situation/problem, choosing the solution way of problem and clarifying solution steps, showing/comparing/classifying the concept/situation/subject with graphics or chart and explaining the relationship between these (Table 4). In-class practices of the teacher are given below.

> We should not use electrical tools in wet areas. Because water transmits the electric… We must replace the electrical cables of which plastic has been cut, penetrated (L1, 08.45-11.09 minutes).

> We call the accident occurring as a result of city electricity's touching to the body of any living as an electric shock (L1, 08.02- 08.13 minutes).

Table 4. In-Class Practices of the Third Grade Teacher for the Subject Safe Use of Electric

Teacher centred	**f**	**%**	**Teacher-student interaction**	**f**	**%**
1. Only teacher defines/explains a concept/situation/ problem.	2	11	1. Teacher enables students to define/ explain a concept/situation/problem with their own words.	1	5.55
2. Teacher shows concepts/situations/ problems with graphic or chart.	-	-	2. Teacher allows students to show concepts/situations/ problems with graphic or chart.	-	-
3. Teacher compares/classifies concepts/situations.	-	-	3. Teacher enables students to compare/classify concepts/situations.	-	-
4. Teacher explains the relationship among concepts/situations/subjects.	-	-	4. Teacher allows students to discover the relationship among concepts/situations/subjects.	-	-
5. Teacher divides a concept/situation/ problem into its units of analysis.	2	11	5. Teacher let students divide a concept/situation/ problem into its units of analysis.	-	-
6. Teacher explains the features of units of analysis of concept/situation/ problem.	4	22	6. Teacher enables students to explain/define the features of units of analysis of concept/situation/ problem.	3	16.65
7. Teacher compares/classifies units of analysis of concept/situation/ problem.	1	5.5	7. Teacher allows students to compare/classify units of analysis of concept/situation/ problem.	2	11.1
8. Teacher explains the relationship among units of analysis of concepts/situations/subjects.	-	-	8. Teacher let students explain the relationship among units of analysis of concepts/situations/subjects.	-	-
9. Teacher chooses how to solve the problem.	-	-	9. Teacher encourages students in choosing how to solve the problem.	-	-
10. Teacher explains the solution steps of problem.	-	-	10. Teacher asks students to explain the solution steps that they used.	-	-
11. Teacher solves the problem.	3	16.5	11. Teacher motivates all students in solving the problem.	-	-
Total	12	66.7	Total	6	33.3

When examining Table 4, it is understood that the teacher focused mostly on enabling students to explain/define the features of units of analysis of concept/situation/ problem (f=3, 16.65%) as teacher-student interactive applications. Some of the activity examples of teacher are provided below.

Determine given sentences as true-false (L1, 18.35- 20.05 minutes).

Electric can cause loss of life and property when it is used carelessly (True [T]).

City electricity does not harm people's body (False [F]).

The accident caused by the contact of city electricity with the human body is called electric shock (T).

The third-grade teacher used teacher-student interactive applications, which could support to develop the analytical thinking skill of students, more (f=20, 90.91%) during three class periods in which s/he made a general review about the unit of "Electrical Tools in our Life". Only 9.09% of classroom applications are teacher-centred. The teacher asked students to explain/define the properties of units of analysis of concept/situation/ problem as teacher-student interactive applications during three class periods in which s/he made a review about the unit (f=14, 63%) (Table 5). Some question samples addressed by the teacher are below.

> Place the given words in the appropriate places in the sentence (L1, 11.58- 22.42 minutes).
>
> Devices such as television, iron work with …... .(city electricity)
>
> Vehicles such as automobile, the truck starts with..... (battery)
>
> Determine given sentences as true-false (L2, 28.00- 33.13 minutes).
>
> Student1: A battery is a nonconsumable electric source. (F)
>
> Teacher: Yes, false, because the battery will run down at the end, won't it? It is consuming, we put them into the box of waste batteries and then buy a new one.
>
> Student2: We should not use hair dryer on the wet floor. (T)
>
> Teacher: True, electric can shock, can't it children?
>
> Student3: We should not move electrical tools when they are in operation. (F)
>
> Teacher: That's a nonsense sentence.
>
> Students: However, my teacher, we move the vacuum cleaner.

The teacher performed the practices of enabling students to define/explain a concept/situation/problem with their own words (f=4, 18%), comparing/classifying the units of analysis of these (f=1, 4.5%) and showing concepts/situations/subjects with graph and chart (f=1, 4.5%) during the lesson in which s/he made review. What is more, the teacher did not perform any application for enabling students to divide the units of analysis of a concept/situation/problem, and explain the relationship between these; encouraging students to choose the solution way of the problem and solve it; asking students to explain the solution steps that they used; allowing students to show/compare/classify the concepts/situations/subjects with graph and chart and discover the relationship between these (Table 5). Sample in-class practices are given below.

> Place the given words in the appropriate places in the sentence (L1, 13.45 minute).
>
> Electric is a type of ..... . (Energy)
>
> Electric is produced from the sources of …….. (Natural)
>
> Electric energy is generated ……. . (Power Plant)

Table 5. General Review In-Class Practices of the Third Grade Teacher for Electrical Tools in Our Life

Teacher centred	**f**	**%**	**Teacher-student interaction**	**f**	**%**
1. Only teacher defines/explains a concept/situation/ problem.	-	-	1. Teacher enables students to define/explain a concept/situation/problem with their own words.	4	18
2. Teacher shows concepts/situations/ problems with graphic or chart.	-	-	2. Teacher allows students to show concepts/situations/ problems with graphic or chart.	1	4.5

Table 5. Continued

Teacher centred	f	%	Teacher-student interaction	f	%
3. Teacher compares/classifies concepts/situations.	-	-	3. Teacher enables students to compare/classify concepts/situations.	-	-
4. Teacher explains the relationship among concepts/situations/subjects.	2	4.5	4. Teacher allows students to discover the relationship among concepts/situations/subjects.	-	-
5. Teacher divides a concept/situation/ problem into its units of analysis.	-	-	5. Teacher let students divide a concept/situation/ problem into its units of analysis.	-	-
6. Teacher explains the features of units of analysis of concept/situation/ problem.	-	-	6. Teacher enables students to explain/define the features of units of analysis of concept/situation/ problem.	14	63
7. Teacher compares/classifies units of analysis of concept/situation/ problem.	-	-	7. Teacher allows students to compare/classify units of analysis of concept/situation/ problem.	1	4.5
8. Teacher explains the relationship among units of analysis of concepts/situations/subjects.	-	-	8. Teacher let students explain the relationship among units of analysis of concepts/situations/subjects.	-	-
9. Teacher chooses how to solve the problem.	-	-	9. Teacher encourages students in choosing how to solve the problem.	-	-
10. Teacher explains the solution steps of problem.	-	-	10. Teacher asks students to explain the solution steps that they used.	-	-
11. Teacher solves the problem.	-	-	11. Teacher motivates all students in solving the problem.	-	-
Total	2	9.09	Total	20	90.91

When Table 5 is examined, it is seen that the teacher explained the relationship among concepts/situations/subjects as teacher centred (f=2, 4.5%). An example is provided below related to this.

Electric shock can take place as a result of its careless use (L1, 17.09 minute)

The fourth-grade teacher, who participated in the investigation, used teacher-student interactive applications, which could support to develop the analytical thinking skill of students, more (f=32, 65.3%) during the four class periods in which s/he taught the unit of "Simple Electric Circuit". 34.7% (f = 17) of classroom practices are teacher-centred. The fourth-grade teacher mostly allowed students to explain a concept/situation/problem with their own words (f=6, 12.24%), explain/define the properties of units of analysis of these (f=8, 16.32%), explain the relationship between them (f=11, 22.44%) (Table 6). Some question samples that teacher posed are below.

Why did the ampule in the circuit prepared by student blow out? (L2, 17.28 minute)

What was the function of cable in the electric circuit?? (L2, 00.51 minute)

What should we do to raise the brightness of ampule in the circuit? (L2, 05.40 minute)

The primary school teacher performed the practices enabling students to divide the units of analysis of a concept/situation/problem (f=3, 6.12%), compare/classify the units of analysis of these (f=3, 6.12%) and show concepts/situations/subjects/ with graph or chart (f=1, 2.04%) less. The fourth-grade teacher did not carry out any practice encouraging students to select the solution way of the problem, explain the solution steps that they used; motivating them to solve the problem, letting them

compare/classify the concepts/situations and discover the relationship between them (Table 6). Sample in-class applications of teacher are provided below.

> What is required for a circuit to work? (L2, 00.07 minute)
>
> Why is the brightness of the ampules in the circuit different? (L2, 19.34 minute)
>
> Students present their electrical circuits that they prepared in the classroom. (L2, 03.10 minute)

Table 6. In-Class Practices of the Fourth Grade Teacher for the Subject of Simple Electric Circuit

Teacher centred	**f**	**%**	**Teacher-student interaction**	**f**	**%**
1. Only teacher defines/explains a concept/situation/ problem.	6	12.18	1. Teacher enables students to define/explain a concept/situation/problem with their own words.	6	12.24
2. Teacher shows concepts/situations/ problems with graphic or chart.	-	-	2. Teacher allows students to show concepts/situations/ problems with graphic or chart.	1	2.04
3. Teacher compares/classifies concepts/situations.	-	-	3. Teacher enables students to compare/classify concepts/situations.	-	-
4. Teacher explains the relationship among concepts/situations/subjects.	-	-	4. Teacher allows students to discover the relationship among concepts/situations/subjects.	-	-
5. Teacher divides a concept/situation/ problem into its units of analysis.	3	6.09	5. Teacher let students divide a concept/situation/ problem into its units of analysis.	3	6.12
6. Teacher explains the features of units of analysis of concept/situation/ problem.	5	10.15	6. Teacher enables students to explain/define the features of units of analysis of concept/situation/ problem.	8	16.32
7. Teacher compares/classifies units of analysis of concept/situation/ problem.	-	-	7. Teacher allows students to compare/classify units of analysis of concept/situation/ problem.	3	6.12
8. Teacher explains the relationship among units of analysis of concepts/situations/subjects.	2	4.06	8. Teacher let students explain the relationship among units of analysis of concepts/situations/subjects.	11	22.44
9. Teacher chooses how to solve the problem.	-	-	9. Teacher encourages students in choosing how to solve the problem.	-	-
10. Teacher explains the solution steps of problem.	-	-	10. Teacher asks students to explain the solution steps that they used.	-	-
11. Teacher solves the problem.	1	2.03	11. Teacher motivates all students in solving the problem.	-	-
Total	17	34.7	Total	32	65.3

When analysing the Table 6, it is observed that the teacher herself frequently defined/explained a concept/situation/problem as teacher centred (f=6, 12.18%), and explained the features of units of analysis of these (f=5, 10.15%). Some samples of activities used by the teacher are given below.

> Electric vehicles have electrical circuits. These circuits consist of circuit elements. (L1, 00.28 minute)
>
> Cables enable the transmission of energy in the circuit. (L2, 05.17 minute)

Discussion, Conclusion and Suggestions

In the development of the analytical thinking, one of the important high-level thinking skills that individuals are expected to have in the information society, it plays an important role that teachers should select appropriate teaching strategies and methods and should plan all teaching process in this manner (Areesophonpichet, 2013). The third-grade teacher stated during the interviews performed prior to the observation that the science course should be taught by doing, experiments and observations; and brainstorming, method-techniques of question-answer should be used to develop the analytical thinking skill of students. However, it was determined that the teacher used predominantly teacher-centred practices throughout the unit. Students were activated only by answering the information based questions of gap-filling, multiple choice, true-false during the lessons in which topics were reviewed. This approach is not sufficient for developing the analytical thinking skills of students. They should be encouraged to think in teaching processes and should be at the centre of teaching process (Chonkaew et al., 2016; Çelik et al., 2015; Montaku, 2011; Olça, 2015; Puchumni et al., 2019; Siribunnam & Tayraukham, 2009) and they should have the opportunity to practice analytical thinking skills (Areesophonpichet, 2013; Irwanto et al., 2017). In a teaching process based on analytical thinking skills, teachers are expected to encourage students to analyse, criticise, make judgement, compare and identify oppositions, to make assessment and evaluation (Sternberg, 2003). In this regard, Puchumni et al. (2019) determined that students researched the information and used it by questioning the accuracy of the information they obtained, and that the active learning process improved the students' analytical thinking skills. It is seen in various studies that student-centred methods and techniques such as brainstorm and concept map (Areesophonpichet, 2013; Montaku, 2011), problem-based learning (Chonkaew et al., 2016; Çelik et al., 2015; Karenina et al., 2020; Ramdiah et al., 2018; Olça, 2015) wh-questions, 6 thinking hats (Çelik et al., 2015), experimentation (Çelik et al., 2015; Wahyuni & Analita, 2017), inquiry-based learning (Siribunnam & Tayraukham, 2009) and think-pair-share technique (Ramdiah et al., 2018) are effective in developing the analytical thinking skill of students. The results of research revealed that the third-grade teacher was aware of this situation but did not reflect this during his in-class practices. The fourth-grade teacher stated during the interview that s/he taught by paying attention to learning by doing, video and visual materials for developing the analytical thinking skill. Accordingly, s/he mainly used in-class applications with teacher-student interaction throughout the unit. Besides using the question-answer methods such as multiple choice, true-false, the teacher created a discussion environment with open-ended questions that would lead students to think in the teaching process. In this manner, when comparing the practices of this class to the third-class ones, they are expected to contribute more to the development of analytical thinking skill of students.

Irwanto et al. (2017) suggested in their study that students' analytical thinking skill were generally low, especially, the association dimension was the weakest, and they urged that the reason for this was teacher's inability of allowing students to use their analytical thinking skill completely during the learning process. Teachers also neither applied some criteria, included in in-class observation form, for developing analytical thinking, nor did they let students in the study performed. While the third grade-teacher mostly used the teacher-student interactive analytical thinking steps such as defining/explaining the concept/situation/problem and explaining/defining the features of units of analysis of concept/situation/problem, the fourth grade teacher mostly used explaining the relationship between the units of analysis and explaining/defining the features of units of analysis and a concept/situation/problem. Problem-solving (Çelik et al., 2015; Karenina et al., 2020; Ramdiah et al., 2018) and relating (Güneş, 2012; Montaku, 2011; Sundari, Widoretno, & Ashadi, 2020) steps, which were stated as important for students' gaining analytical thinking skill, were used either very few or none. This will prevent the development of analytical thinking skill.

It was identified that teachers asked few questions at the level of analysis, synthesis, evaluation which would lead students to the high level thinking during in-class practices but they mostly asked questions addressing lower level cognitive skills such as knowledge, comprehension. This situation may prevent students to reach the desired level of analytical thinking skill. This is supported by Turkish students' having low success in high order thinking skill in international exams such as PISA and TIMSS. In addition, the goals of teaching for the development of analytical thinking skill is not only students' answering the questions, but also encourage them to form and ask question. For this reason, teachers should also encourage the students to ask them questions as much as answering questions on the subject being studied (Anwar & Mumthas, 2014).

Both teachers stated in teacher interviews that the most appropriate method-technique could be the observation to determine the level of development of analytical thinking skill in students. Sternberg (2006) emphasized that although it is attempted to be measured by traditional tests in school life, analytical thinking skill requires individuals to analyse both their and others' thoughts, producing new opinions and convincing other people. This can only be determined by observing the students both in and out of the classroom. However, contrary to what they stated in the pre-implementation meeting, both teachers performed assessment through gap-filling, multiple choice and true-false questions at the end of the unit in the level of knowledge and comprehension in our study. It is also seen in various researches in the literature that teachers avoid asking questions about analysis and synthesis steps (Ayvacı & Türkdoğan, 2010; Çepni, Ayvacı, & Keleş, 2001). Carrying out an assessment by asking questions only at the level of knowledge and comprehension will not result in a correct evaluation of the development at analytical thinking skills. In the learning process, solving the questions related to high level thinking and discussing answers of certain questions or problems will enable students to practice on using analytical thinking skills in addition to performing an accurate assessment (Ramdiah et al., 2018). Ayvacı and Türkdoğan (2010) indicated that teachers' asking high order questions including problems from life is important for the development of students' analytical, creative and critical thinking skills.

The results of the study indicate that the importance of the student-centred approach in gaining analytical thinking skill has been understood by the teachers who participated in the research. However, classroom observations showed that this awareness could be partially reflected in the classroom environment. Teachers' receiving in-service trainings about how they plan and implement teaching and assessment activities to develop and evaluate analytical thinking skills of students; how they can make applications in the classroom to make students more active, can provide them to reflect their thoughts to practice. The addition of more teaching and assessment activities to support the development of thinking skills in textbooks can also make significant contributions to classroom practice. What is more, taking this criterion into consideration in the selection of books to be taught in schools will help these activities take up more space in textbooks.

Including the development of teachers' ability to ask high-level questions to encourage students to think within the scope of the in-service trainings and project studies planned for the professional development of teachers can provide teachers with the support they need. In these trainings, it should be ensured that teachers realize the importance of asking and creating questions as well as answering the questions of students and adding such activities to their courses.

In faculties of education, prospective teachers should be made aware of the importance of analytical thinking and other thinking skills. It is important for prospective teachers to graduate by learning how to develop these skills in line with the course content, and how to apply teaching and assessment activities that can be used in the development and evaluation of skills. It will be useful to take these skills into consideration in the courses of the faculties of education in creating this awareness and competence.

It is seen that when the findings are evaluated, there are sometimes differences between the opinions of the teachers and their in-class practices. Administrating interview and classroom observation together is important due to teacher's giving information about how s/he can reflect his/her opinions, thoughts and knowledge to the classroom environment. In this regard, Kaya (2014) also urged in his study that although teachers expressed student centred opinions, they were teacher-centred in their applications. For this reason, it is recommended to include in-class observation process in the studies conducted on the basis of teachers' opinions. By doing so, carrying out a more accurate evaluation will be possible by ensuring the enrichment and strengthening of the results of research on practices in schools.

This research is limited to analytical thinking from thinking skills. It is important for individuals to have other thinking skills as well as analytical thinking skills in order to create a society that is compatible with today's science and technology age. For this reason, it is recommended that future studies focus on other thinking skills. Conducting similar studies with different age groups will provide the status of students at different levels regarding their thinking skills and take measures to eliminate identified problems.

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