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Evaluation of the Teaching Methods and Techniques Used by Science Teachers in Science Classes [1]

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Abstract

The purpose of this study is to reveal the teaching methods and techniques used by science teachers in their classes and the reasons for their use of these methods and techniques. Explanatory sequential design, one of the mixed methods research designs, was used in the current study. The study group from which the quantitative data of the study were collected consisted of 50 science teachers working in public schools in Muğla province and 600 7th-grade students attending these schools. The study group from which the qualitative data of the study were collected consisted of 15 science teachers working in public schools in Muğla province. In the selection of the participants, the convenience sampling method was used. The data of the study were collected by using the "Science Lesson Method-Technique Determination Teacher Questionnaire", the "Science Lesson Method-Technique Determination Student Questionnaire" and a "Semi-Structured Teacher Interview Form". In the analysis of the quantitative data, the SPSS program package was used. The frequency, percentage, arithmetic mean and standard deviation values were calculated for the methods and techniques preferred by the teachers. The qualitative data of the study were analyzed using the content analysis method. As a result of the study, it was found that the most preferred method-technique by the science teachers is the question-answer method, and the least preferred method-technique is the aquarium technique. It was concluded that while the science teachers are choosing their teaching methods and techniques, they pay most attention to class size, objectives and class hours. It was also found that the science teachers prefer traditional methods and techniques more and active methods and techniques less. The reasons why the science teachers prefer traditional methods more include crowded classes, insufficient class hours and their lack of knowledge of some methods and techniques.

INTRODUCTION

Science is ubiquitous in our daily lives, permeating everything from the living organisms that surround us to our own bodies and the air we breathe. Science encompasses the knowledge gained through observations, experiments, hypothesis formation, and scientific

[1] This study is derived from the master's thesis titled "Evaluation of Teaching Methods and Techniques Used by Science Teachers in Science Classes"

methods to understand the world around us and even the universe (Akçay, 2019). Engaging in science helps individuals develop their thinking skills, creativity and ability to interpret information. The main goal of science education is to make individuals conscious and responsible people in the future (Topsakal, 2005). Teachers are the key to successful science education as they are the ones who implement the science curriculum.

The most important reason for differences in achievement among students at the same school and grade level is the methods, techniques and approaches used by teachers (OECD, 2009). The teaching methods and techniques used in science classes are tools for fully achieving the course objectives. Therefore, for the learning and teaching process to occur effectively, teachers need to choose their instructional methods and techniques carefully. In addition, it is very important for the teacher to have mastery of the selected method and technique, because teachers choose the appropriate method and technique for the lesson and subject they will teach and plan the learning-teaching process accordingly. In this respect, it is very important to use the methods and techniques in the right place and in the right way. Implementing the methods in a student-centred manner is of great importance for students to learn effectively.

Science classes can equip students with skills such as inquiry, problem-solving and analytical thinking, in addition to teaching them about science. In addition, science education aims to provide opportunities for individuals to improve their quality of life and overcome their problems (Akçay, 2019). For effective science education, it is very important to know the teaching methods and techniques that teachers use in the classroom. In order to achieve the objectives of the science curriculum, student-centred methods and techniques must be used. Notwithstanding curricular reforms, empirical evidence suggests that these changes have frequently failed to translate into practice, with teachers exhibiting limited capacity to achieve the stated objectives of the new curriculum (Avcı, 2006; Bulut, 2010; Güven-Yıldırım, Köklükaya & Ayoğdu, 2016; Saraç, 2015; Şimşek, Hırça & Coşkun, 2012; Taşkaya & Sürmeli, 2014). Furthermore, it has been observed that there is a discrepancy between the teaching methods and techniques preferred by teachers and the objectives of the curriculum. While there is abundant research on teachers' preferences for methods and techniques, there is a scarcity of studies that delve into the reasons behind these preferences.

Science education is also crucial for raising a country's economic prosperity. Effective science education is possible by using methods and techniques that are in compliance with the goals and objectives of the curriculum and that keep students active in lessons. As seen in the literature, there are a number of problems related to the use of methods and techniques and the achievement of curricular goals in our country, including physical deficiencies in schools and teachers' preferences for methods and techniques (Avcı, 2006; Doğru & Aydoğdu, 2003; Kılıç et al., 2004). Teachers who are not well trained in methods and techniques cannot use correct and appropriate methods because they do not make effective and correct choices (Demirel, 1994).

Research in the literature has revealed that factors such as school physical conditions, class size, dense curriculum and the examination system hinder teachers from using active methods (Bulut, 2010). Research has found that science teachers do not use methods that make students active as required. The research conducted by Binler (2007) also revealed that teachers are incompetent in using methods and techniques that require individual skills. In the study conducted by Saraç (2015), it was determined that teachers adhered to traditional methods and could not use active methods well. This shows that there are problems with the training of science teachers. Therefore, science teachers' lack of knowledge about methods and techniques

causes problems in science education. For this reason, it is very important to determine which methods and techniques science teachers use and to reveal the reasons why they prefer these methods and techniques.

Purpose of the Study

The purpose of the current study is to determine the teaching methods and techniques used by science teachers in science classes and to reveal the reasons for using these teaching methods and techniques. To this end, answers to the following questions were sought:

- What methods and techniques do science teachers use?
- What are the teaching methods and techniques most frequently used by science teachers?
- What are the reasons why science teachers prefer the methods or techniques they use most frequently?
- What are the issues that science teachers pay attention to when choosing different teaching methods and techniques in science classes (objectives, economic conditions, physical conditions, etc.)?

METHOD

Study Design

The current study employed a mixed research model. The mixed research model involves collecting quantitative or qualitative data in a single study and analyzing and interpreting these data together (Leech & Onwuegbuzie, 2009, p.266). The mixed method design was defined by Tashakkori and Teddlie (1998) as a research design based on pragmatist philosophy. The mixed research model acts as a bridge between qualitative and quantitative research models (Leech & Onwuegbuzie, 2004, p.15).

In the current study, the explanatory sequential design, one of the mixed method research designs, was used. In the explanatory sequential design, data are first collected and analyzed with quantitative methods. Based on the analysis of the quantitative data, qualitative data are collected and analyzed. Then, quantitative and qualitative data are interpreted together and inferences are made (Creswell, 2021). This model is useful for better understanding the phenomenon being studied and developing different perspectives (Baki, Gökçek, 2012, p. 1-21).

Study Group

In the study, the convenience sampling method, one of the non-random sampling methods, was used in the selection of the participants. Convenience sampling involves selecting participants who are readily available to the researcher (Christensen, Johnson & Turner, 2020, p.172). While collecting the quantitative data of the study, the study group was composed of 50 science teachers who teach 7^{th} grade students from among the teachers who teach science courses in public schools in Muğla province and 600 7^{th} grade students who are taught by these teachers. While collecting the qualitative data constituting the second part of the study, the study group consisted of 15 science teachers who had previously participated in the survey study.

Data Collection

The "Use of Teaching Methods and Techniques in Science Classes-Teacher Questionnaire" developed by the researcher consists of 36 items. For the validity and reliability

studies of the questionnaire, expert opinions were received from two curriculum development experts, four science teaching experts, one measurement and evaluation expert and one Turkish teaching expert, and then a pilot study was conducted with the participation of 20 science teachers. In light of the expert reviews and pilot application, the necessary corrections were made and the questionnaire was given its final form.

The "Use of Teaching Methods and Techniques in Science Classes-Student Questionnaire" developed by the researcher consists of 36 items. For the validity and reliability studies of the questionnaire, expert opinions were received from two curriculum development experts, four science teaching experts, one measurement and evaluation expert and one Turkish teaching expert, and then a pilot study was conducted with the participation of 20 7^{th} grade students. In light of the expert reviews and pilot application, the necessary corrections were made and the questionnaire was given its final form. The questionnaire items were about methods and techniques accompanied by explanations to ensure understanding by both the teachers and students.

The science teacher semi-structured interview form prepared by the researcher consists of 8 items. These items aim to elicit data about what teachers pay attention to when choosing the methods and techniques they use in their lessons, whether they choose a method appropriate for the objectives of the science curriculum, and their knowledge of methods and techniques. For the validity and reliability studies of the interview form, expert opinions were received from two curriculum development experts, four science teaching experts, one measurement and evaluation expert and one Turkish teaching expert, and then pilot interviews were conducted with the participation of 5 science teachers. In light of the expert reviews and pilot applications, the necessary corrections were made and the interview form was given its final form. The interview form, which initially consisted of 12 questions, took its final form of eight questions after the necessary revisions were made.

Data Analysis

While analyzing the quantitative data of the study, the SPSS program package was used. While determining the methods and techniques most frequently preferred by the science teachers, frequency (f), percentage (%), arithmetic mean (X) and standard deviation values were calculated. The content analysis method was used in the analysis of the qualitative data. While analyzing the qualitative data of the study, the interview records were listened to and transcribed by the researcher. The data obtained from the interviews were read by the researcher and analyzed using content analysis. Codes were created from the analysis of the transcriptions. Similar codes were combined to create themes. With the themes created, it was made easier for readers to understand and interpret (Yıldırım & Şimşek, 2021). The data obtained are presented with direct quotations in the findings section.

FINDINGS

In the findings section, first, the arithmetic mean, frequency, percentage and standard deviation values obtained from the questionnaires completed by the teachers and then the teachers' opinions elicited through the semi-structured interview form are presented.

Findings on the Frequency of Science Teachers' Use of Teaching Methods and Techniques

Findings on the teaching methods and techniques used by the teachers in science classes are given in Table 1.

Table 1. Science teachers' frequency of using instructional methods and techniques

Methods & techniques	Never	Rarely	Sometimes	Usually	Always	$\bar{X}$	Ss
Question-answer	-	-	1.9	31.5	67.5	4.61	.51
Lecturing	3.7	3.7	22.2	44.4	25.9	3.85	.97
Discussion	-	7.4	24.1	40.7	27.8	3.88	.90
Buzzing	22.2	42.6	22.2	7.4	5.6	2.31	1.07
Opposite panel	24.1	42.6	22.2	7.4	3.7	2.24	1.02
Panel	16.7	40.7	22.2	14.8	1.9	2.51	1.11
Conference	40.7	42.6	14.8	1.9	-	1.77	.76
Debate	20.4	46.3	22.2	9.3	1.9	2.25	.95
Aquarium	51.7	29.6	13	3.7	1.9	1.74	.95
Experiment	9.3	7.4	16.7	38.9	27.8	3.68	1.22
Observation	1.9	7.4	27.8	3.33	29.6	3.81	1.37
Trip	11.1	31.5	29.6	20.4	7.4	2.81	1.15
Brain storming	-	9.3	16.7	37	37	4.01	.96
Cooperative learning	1.9	13	25.9	44.4	14.8	3.57	.96
Opinion development	22.2	35.2	27.8	11.1	3.7	2.58	1.07
Six thinking hats	50	29.6	9.3	5.6	5.6	1.87	1.15
Talking circle	31.5	37	18.5	11.1	1.9	2.14	1.07
Case study	3.7	3.7	24.1	35.2	33.3	3.90	1.03
Drama	18.5	29.6	29.6	13	9.3	2.64	1.19
Dramatization	31.5	31.5	25.9	5.6	5.6	2.22	1.12
Scenario-based learning	48.1	29.6	14.8	1.9	5.6	1.87	1.09
Tell-show-do	1.9	9.3	20.4	40.7	27.8	3.83	1.0
Demonstration	-	1.9	11.1	29.6	57.4	4.42	.76
Project	5.6	18.5	27.8	33.3	14.8	3.33	1.11
Problem solving	1.9	16.7	22.2	38.9	20.4	3.59	1.05
Fishbone	27.8	25.9	18.5	14.8	13	2.59	1.38
Role-play	25.9	29.6	25.9	11.1	7.4	2.44	1.20
Creating a story	37	31.5	24.1	5.6	1.9	2.03	1.0
Station	13	25.9	22.2	27.8	11.1	2.98	1.23
Educational game	22.2	33.3	24.1	11.1	9.3	2.51	1.22
Digital story-telling	25.9	24.1	22.2	12	14.8	3.16	1.38
Inquiry-based learning	1.9	-	18.5	29.6	50	4.25	.89
Snowball	38.9	33.3	20.4	3.7	3.7	2.0	1.04
Concept cartoons	42.6	29.6	7.4	14.8	5.6	2.11	1.26
Concept map	1.9	11.1	14.8	38.9	33.3	3.90	1.05

The frequency of use of teaching methods and techniques by the science teachers participating in the study is given in Table 1. As seen in Table 1, 1.9% of the science teachers sometimes use the question-answer method and 49.6% usually or always use it ($\overline{X}$=4.61).

It was seen that 3.7% of the science teachers never use the lecturing method, 12.95% rarely or sometimes use it and 35.15% usually or always use it ($\overline{X}$=3.85). It was also seen that 15.75% of the science teachers rarely or sometimes use the discussion method while 34.25% usually or always use it ($\overline{X}$=3.88).

It was observed that 9.3% of the science teachers never use the experimental method, 12.05% rarely or sometimes use it and 33.35% usually or always use it ($\overline{X}$=3.68). It was also seen that 19% of the science teachers never use the observation method, 17.6% rarely or sometimes use it and 33.35% usually or always use it ($\overline{X}$=3.81). It was seen that 13% of the science teachers rarely or sometimes use the brainstorming technique while 37% usually or always use it ($\overline{X}$=4.01).

It was seen that 1.9% of the science teachers never use the cooperative learning method, 19.45% rarely or sometimes use it and 29.6% usually or always use it ($\overline{X}$=3.57). It was also seen that 3.7% of the science teachers never use the case study method, 13.9% rarely or sometimes use it and 34.25% usually or always use it ($\overline{X}$=3.90). It was seen that 1.9% of the science teachers never use the tell-show-do technique, 14.85% rarely or sometimes use it and 34.25% usually or always use it ($\overline{X}$=3.83).

It was seen that 6.5% of the science teachers rarely or sometimes use the demonstration method while 43.5% usually or always use it ($\overline{X}$=4.42). It was also seen that 5.6% of the science teachers never use the project method, 23.15% rarely or sometimes use it and 24.05% usually or always use it ($\overline{X}$=3.33).

It was seen that 1.9% of the science teachers never use the problem solving method, 19.45% rarely or sometimes use it and 24.05% usually or always use it ($\overline{X}$=3.59). It was seen that 1.9% of the science teachers never use the concept map technique, 12.95% rarely or sometimes use it and 36.1% usually or always use it ($\overline{X}$=3.90). It was seen that 1.9% of the science teachers never use the inquiry-based learning method, 18.5% rarely or sometimes use it and 39.8% usually or always use it ($\overline{X}$=4.25).

It was seen that 22.2% of the science teachers never use the buzzing technique, 32.4% rarely or sometimes use it and 6.5% usually or always use it ($\overline{X}$=2.31). It was seen that 40.7% of the science teachers never use the conference technique, 28.7% rarely or sometimes use it and 1.9% usually or always use it ($\overline{X}$=1.77). It was seen that 51.7% of the science teachers never use the aquarium technique, 21.3% rarely or sometimes use it and 2.8% usually or always use it ($\overline{X}$=1.74).

It was seen that 50% of the science teachers never use the six thinking hats technique, 38.9% rarely or sometimes use it and 5.6% usually or always use it ($\overline{X}$=1.87). It was seen that 18.5% of the science teachers never use the drama method, 29.6% rarely or sometimes use it and 11.15% usually or always use it ($\overline{X}$=2.64). It was seen that 13% of the science teachers never use the station method, 24.05% rarely or sometimes use it and 19.45% usually or always use it ($\overline{X}$=2.98). It was seen that 22.2% of the science teachers never use the educational game method, 28.7% rarely or sometimes use it and 10.2% usually or always use it ($\overline{X}$ =2.51).

It was seen that the teachers use the question and answer ($\overline{X}$=4.61) and lecturing methods ($\overline{X}$=3.85) the most, and the aquarium ($\overline{X}$=1.74) and six thinking hats techniques ($\overline{X}$=1.87) the least.

Findings on the Instructional Methods and Techniques Used by the Science Teachers in Science Classes according to the Students

Findings on the methods and techniques used by the teachers in their classes according to students are given in Table 2.

Table 2. Frequency of use of teaching methods and techniques by science teachers according to 7th grade students

Methods & techniques	Never	Rarely	Sometimes	Usually	Always	$\overline{X}$	Ss
Question- answer	1.2	3.1	18.9	41.0	35.8	4.07	.88
Lecturing	1.2	1.5	3.5	14.9	78.8	4.68	.72
Discussion	11.7	17.2	30.7	23.7	16.7	3.16	1.23
Buzzing	51.2	24.3	16.1	5.5	2.9	1.84	1.06
Opposite panel	63.4	18.4	11.5	4.0	2.6	1.63	1.0
Panel	48.2	23.2	14.9	9.5	4.0	1.97	1.17
Conference	65.7	13.7	10.3	5.2	5.1	1.70	1.15
Dispute	59.4	19.2	12.1	5.7	3.5	1.74	1.09
Aquarium	72.2	13.2	7.8	4.5	2.3	1.51	.97
Experiment	28.3	20.7	26.6	14.0	10.4	2.57	1.31
Observation	15	20.9	27.6	20.6	15.4	2.99	1.28
Trip	55.8	19.0	12.7	7.4	5.1	1.86	1.19
Brain storming	15.2	16.9	23.8	23.8	20.3	3.17	1.34
Cooperative learning	37.2	21.2	17.1	13.1	10.9	2.38	1.38
Opinion development	50.8	16.0	18.1	8.4	9.7	2.10	1.36
Six thinking hats	81.6	5.8	4.5	4.1	4.0	1.43	1.03
Talking circle	64.8	11.7	10.8	6.1	6.6	1.78	1.24
Case study	19.5	18.7	24.6	19.0	18.1	2.97	1.37
Drama	55.3	18.0	12.3	7.2	7.2	1.93	1.26
Dramatization	66.8	12.6	10.0	6.1	4.5	1.68	1.14
Scenario-based learning	66.4	14.4	8.4	5.5	5.2	1.68	1.15
Tell-show-do	17.8	20.3	26.3	22.0	13.7	2.93	1.29
Demonstration	15.2	13.7	23.8	23.5	23.8	3.27	1.36
Project	23.0	20.7	22.7	18.6	14.9	2.81	1.37
Problem solving	18.6	18.3	21.0	21.7	20.4	3.07	1.39
Fishbone	54.1	19.8	12.0	8.6	5.5	1.91	1.22
Role-play	63.0	14.4	8.9	8.6	5.1	1.78	1.21
Creating a story	66.4	11.8	10.1	5.8	5.8	1.72	1.20
Station	41.5	20.6	19.7	10.6	7.7	2.22	1.29
Educational game	49.6	15.4	14.6	10.6	9.8	2.15	1.38
Digital storytelling	65.6	13.7	9.7	6.5	4.6	1.70	1.15
Inquiry-based learning	12.0	17.2	23.2	23.8	23.8	3.30	1.32
Concept cartoon	65.9	14.4	7.5	6.1	6.0	1.71	1.20
Concept map	22.3	15.4	21.0	18.7	22.6	3.03	1.46

The findings obtained from the opinions of the 7th grade students who participated in the study regarding the methods and techniques used by their teachers in science classes are given in Table 2. As seen in Table 2, according to the 7th grade students who participated in the study, 1.2% of the teachers never use the question-answer method, 11% rarely or sometimes use it and 38.4% usually or always use it ($\overline{X}$=4.07). According to the students, 1.2% of the teachers never use the lecturing method, 2.5% rarely or sometimes use it and 46.85% usually or always use it ($\overline{X}$=4.68).

According to the students, 11.7% of the science teachers never use the discussion method, 23.95% rarely or sometimes use it and 20.2% usually or always use it ($\overline{X}$=3.16). According to the students, 15.2% of the science teachers never use the brainstorming technique, 20.35% rarely or sometimes use it and 22.05% usually or always use it ($\overline{X}$=3.17). According to the students, 28.3% of the science teachers never use the experimental method, 23.65% rarely or sometimes use it and 12.2% usually or always use it ($\overline{X}$=2.57).

According to the students, 15.5% of the science teachers never use the observation method, 24.25% rarely or sometimes use it and 18% usually or always use it ($\overline{X}$=2.99). According to the students, 37.8% of the science teachers never use the cooperative learning method, 19.15% rarely or sometimes use it and 12% usually or always use it ($\overline{X}$=2.38). According to the students, 15.2% of the science teachers never use the demonstration method, 18.75% rarely or sometimes use it and 23.65% usually or always use it ($\overline{X}$=3.27). According to the students, 17.8% of the science teachers never use the tell-show-do method, 23.3% rarely or sometimes use it and 17.85% usually or always use it ($\overline{X}$=2.93).

According to the students, 23% of the science teachers never use the project method, 21.7% rarely or sometimes use it and 16.75% usually or always use it ($\overline{X}$=2.81). According to the students, the science teachers never use the problem-solving method, 18.6% rarely or sometimes use it and 19.65% usually or always use it ($\overline{X}$=3.07). According to the students, 12% of the science teachers never use the inquiry-based learning method, 20.2% rarely or sometimes use it and 23.8% usually or always use it ($\overline{X}$=3.30).

The students stated that 22.3% of the science teachers never use the concept map technique, 18.2% rarely or sometimes use it and 20.65% usually or always use it ($\overline{X}$=3.03). According to the students, 51.2% of the science teachers never use the buzzing technique, 20.2% rarely or sometimes use it and 4.2% usually or always use it ($\overline{X}$=1.84). According to the students, 65.7% of the science teachers never use the conference technique, 12% rarely or sometimes use it and 5.15% usually or always use it ($\overline{X}$=1.70).

The students stated that 72.2% of the science teachers never use the aquarium technique, 10.5% rarely or sometimes use it and 3.4% usually or always use it ($\overline{X}$=1.51). According to the students, 81.6% of the science teachers never use the six thinking hats technique, 5.15% rarely or sometimes use it and 4.05% usually or always use it ($\overline{X}$=1.43). According to the students, 49.6% of the science teachers never use the educational game techniques, 15% rarely or sometimes use it and 10.2% usually or always use it ($\overline{X}$=2.15). According to the students, 41.5% of the science teachers never use the station method, 20.15% rarely or sometimes use it and 9.15% usually or always use it ($\overline{X}$=2.22). According to the students, 55.3% of the science teachers never use the drama method, 15.15% rarely or sometimes use it and 7.2% usually or always use it. According to the students, the science teachers use the lecturing ($\overline{X}$=4.68) and question-

answer methods ($\overline{X}$=4.07) the most, and the six thinking hats ($\overline{X}$=1.43) and aquarium techniques ($\overline{X}$=1.51) the least.

Findings on the Reasons for the Science Teachers' Preferences for Methods and Techniques

Interviews were conducted with science teachers to determine the reasons behind their preferences for the most frequently used methods and techniques. As a result of the analysis of the interviews, various themes and codes were created. Table 3 shows the themes and codes.

Table 3. Reasons for science teachers' preference for instructional methods and techniques

Themes	Codes
Physical structure of the school	Insufficiency of materials Crowded classes Lack of laboratories
Characteristics of the course	Class hours Objectives Characteristics of the subject
Characteristics of the method	Ease/difficulty of implementation Time-consuming Cost
Student	Readiness Level of students
Teacher	Classroom management Knowledge of methods and techniques Whether taking in-service training

As seen in Table 3, the science teachers expressed their opinions regarding the reasons for their choosing the methods and techniques they use in their classes. As a result of the interviews, 5 themes were created regarding the reasons for the teachers' choice of methods and techniques: "physical structure of the school", "characteristics of the course", "characteristics of the method", "student" and "teacher" and 15 codes gathered under these themes were created. The teachers' opinions on the themes and codes are given below.

For the theme of the physical structure of the school, three codes were created: "insufficient materials", "crowded classes" and "lack of laboratories". Teachers' opinions on these themes and codes are as follows:

> *"I pay particular attention to materials, class size, and learning outcomes. Unfortunately, materials are insufficient, and our classes are very crowded, making it difficult to conduct experiments and similar activities." (ST-4)*

> *"If materials are available, I conduct all activities; however, we face issues arising from time constraints. In classes with a large number of students, I do demonstration experiments." (ST-3)*

When the opinions of the science teachers, it was seen that the majority of them indicated that class size, lack of materials and the physical conditions of the school are influential in their choices of methods and techniques. They stated that crowded classes and insufficient materials negatively impact their choice of methods and techniques. They stated that they conduct fewer experiments because the classes are crowded and the materials are not sufficient for students. The factor that affects teachers the most in terms of method and technique is crowded classes and inadequate materials. They also stated that they could use different methods and techniques if sufficient material and physical conditions were provided.

For the theme of the characteristics of the course, 3 codes were created: "class hours", "objectives" and "characteristics of the subject". Some of the teachers' opinions on these themes and codes are as follows:

> *"I pay attention to objectives, but the distribution of objectives is unbalanced. For example, 6th graders have a lot of topics, so I usually use lecturing to cover everything in time." (ST-3)*

> *"I pay attention to objectives and content because they are the key points that students need to learn." (ST-5)*

> *"The method I use should enable me to deliver the objective effectively; I try to choose methods that make the most efficient use of time." (ST-4).*

When the opinions of the science teachers were examined, it was seen that almost all of the teachers stated that they pay attention to the objectives when making their choices for methods and techniques. Teachers indicated that the primary purpose of education is to ensure students acquire the specified objectives. Therefore, they emphasized the importance of aligning instruction with these objectives.

In addition, teachers stated that they pay attention to the characteristics of the subject when choosing a method. They stated that not every method is suitable for every subject. Consequently, they make a conscious effort to select and apply methods and techniques that are most suitable for the specific content being taught. Another point that teachers highlighted is the limited amount of class time. Teachers indicated that there are too many objectives to cover in the limited class time available, leading them to prioritize methods and techniques that can efficiently deliver these objectives. As can be understood from these opinions, teachers pay attention to the objective, characteristics of the subject and class hours when choosing methods and techniques.

For the theme of the characteristics of the method, 3 codes were created: "ease/difficulty of implementation", "time-consuming" and "cost". Some of the teachers' opinions about the codes and themes created are as follows:

> *"The question-answer and lecturing methods are easier for students and us and are preferred more because they are easier to evaluate." (ST-1)*

> *"It takes a lot of time and has little applicability, for example, it is difficult to call an expert for the conference method, and the expert does not want to leave his/her work and come. The permissions, correspondence procedure take a long time and are also costly, which is why we cannot prefer these methods." (ST-3)*

> *"I prefer these methods, which are easier to implement, due to lack of materials, large class sizes, and insufficient class hours. In addition, class time is wasted with activities such as mock exams, centralized written exams, etc., and it becomes difficult to spare enough time for the objectives." (ST-5)*

When the opinions of science teachers were examined, it was seen that teachers pay attention to the characteristics of the method when choosing methods and techniques. Teachers stated that they do not prefer methods that are difficult and costly to implement. The majority of the teachers stated that they prefer easy-to-apply methods that do not require preparation due to lack of time. They also stated that they use methods such as trips and conferences less due to economic reasons and permission procedures. It was observed that reasons such as lack of materials and insufficient time allocated for preparation also affect teachers' method and technique preferences.

For the student theme, two codes were created: "readiness" and "level of the student". Some teachers' opinions on the determined themes and codes are given below:

> *"Science can be a difficult subject for students, particularly when they lack the foundational knowledge required to understand the concepts. In such cases, I use the lecturing method more frequently." (ST-9)*

> *"Most children cannot express themselves. I've seen this in the open-ended exams I've given. Instead of making sentences, they answered with keywords. These techniques require self-expression and since children have difficulty with this, I prefer easier methods. It is difficult to explain the method and teach the lesson at the same time." (ST-9)*

In the interviews conducted with the teachers, it was seen that some of the teachers make their choice by paying attention to the students' level of readiness, age and intelligence when choosing a method or technique. Teachers also stated that science lessons are sometimes difficult for students, so they choose methods that could help them understand the lesson. They stated that it is particularly difficult to explain contemporary methods and techniques to students and to make them understand the subject using these methods and techniques.

For the theme of teacher, 3 codes were created: "classroom management", "knowledge of methods and techniques" and "whether taking in-service training". Some opinions on these themes and codes are as follows:

> *"I don't know every method and technique, but I am open to learning new methods and techniques." (ST-2)*

> *"I participate in in-service training, but I still cannot say that I am qualified for all methods." (ST-4)*

> *"The large class size makes it difficult to manage the classroom; therefore, I prefer the lecturing method because it allows me to maintain better control of the class." (ST-12)*

"There are times when I feel inadequate. I participated in a TÜBİTAK applied education project in 2016, but I haven't had the chance to participate in another one since then." (ST-5)

When the opinions of the teachers are examined, it is evident that their mastery of methods, classroom management skills and whether they have received in-service training significantly influence their preferences for methods and techniques. It was determined that teachers prefer methods and techniques that allow them to maintain classroom control more easily. Although some teachers have received in-service training on methods and techniques, they do not see themselves as competent enough. It was also found that the number of teachers participating in activities such as the ones organized by TÜBİTAK and similar events is low. It was observed that teachers who have participated in projects or have a higher level of education diversify the methods and techniques they use.

CONCLUSION and DISCUSSION

In the study, the methods and techniques used by science teachers were examined. Based on the data collected through the questionnaires administered to the teachers and students, it was found that the most preferred methods by the teachers are the question-answer and lecturing methods, while the least preferred techniques are the aquarium technique, the six thinking hats technique, and the field trip-observation method. When the literature is reviewed, many studies reporting results consistent with the results of the current study can be found. In the study conducted by Bulut (2010), it was concluded that teachers use the question-answer method the most, and the field trip-observation method and the aquarium technique the least. In the study conducted by Saraç (2015), it was seen that teachers use the question-answer method the most. Ergani (2010) conducted a study on social studies teachers and concluded that social studies teachers prefer the question-answer method the most and the trip-observation method the least. The difference in the results obtained from teachers and pre-service teachers indicate that there are other factors affecting teachers' preferences for methods and techniques (Bulut, 2010; Gülnaroğlu,2019; Kaptan & Korkmaz, 2001; Saraç, 2015). In addition, Talaz (2013) concluded that active methods are used more in classes with less than 30 students. The similarity of results obtained in the current study and in the literature suggests that teachers' preferences for methods and techniques may be resistant to change or that updates made to the curriculum have little impact on teachers' choices of methods and techniques.

In the current study, it was found that teachers prefer the question-answer and lecturing methods the most, followed by the demonstration technique, inquiry-based learning method, brainstorming technique, discussion method, problem-solving method, experimental method, project method and cooperative learning method. However, it was observed that they use methods such as experiments and observations and cooperative learning, which would contribute the most to the development of the skills included in the science curriculum, relatively less. Yıldırım (2011) concluded that methods and techniques that tend to make students passive are used more frequently in science classes. To explore the reasons behind the findings collected with the questionnaires administered to the teachers and students, interviews were held with teachers. In the interviews conducted, teachers stated that they prefer the lecturing and question-answer methods for several reasons, including their being time efficient, the ease of application in classes with a large number of students, the need to allocate time for solving tests due to an exam-centred system, and class hours being insufficient to cover everything. Avcı (2006) concluded that teachers prefer the question-answer and lecturing methods because they activate students and facilitate the rapid transfer of a large amount of information.

The method most preferred by teachers after the question-answer method is the lecturing method. Many studies in the literature indicate that the lecturing method is highly preferred (Avcı, 2006; Bulut, 2010; Saraç, 2015). They also stated that they prefer the lecturing method for teaching topics that are difficult for students, as well as for teaching topics that involve principles and conceptual knowledge. The fact that teachers prefer the lecturing method when teaching concepts, factual knowledge, or theoretical topics indicates that traditional methods still have their place. As can be understood from here, the subject and objectives also affect the method and technique preferences of teachers. In the traditional lecturing method, the student is in a passive position. Teachers need to activate students by supporting the lecturing method with body language and various materials (Yulu, 2014).

Teachers participating in the study also stated that their preference for the lecturing method may vary depending on the grade level they teach. They stated that they prefer the lecturing method more in classes with relatively less successful students. One striking result from the study is that, while the lecturing method was the second most frequently used method according to the teacher questionnaire, it ranked first in the questionnaire conducted with the students. This indicates that the responses given by the students and teachers to the questionnaires differ. The reason for this may be that teachers are reluctant to admit that they frequently prefer the traditional lecturing method. Similar to this finding of the current study, in a study by Karamustafaoğlu et al. (2014), teachers reported using the lecturing method at a moderate frequency, whereas interviews with students and observations indicated that the lecturing method was used more frequently. This may be because teachers tend to avoid acknowledging their use of traditional methods.

The questionnaire results showed that teachers occasionally prefer contemporary instructional techniques such as brainstorming, case studies, educational games and demonstration. It is believed that teachers choose these methods and techniques to engage students, make the lesson more interesting, encourage students to generate new ideas, promote group work, and foster long-term learning. However, from the data obtained from the interviews, it was concluded that these methods are difficult to implement due to the large class sizes and inadequate lesson hours. Şahin and Güven (2016) concluded that teachers' method and technique preferences are limited due to reasons such as physical conditions and class size.

It was concluded that the experimental method was not used sufficiently by teachers. In the interviews conducted with teachers, it was concluded that the most important reasons for the experimental method being less preferred are insufficient materials, lack of physical conditions, lack of laboratories in schools and crowded classrooms. Karamustafaoğlu et al. (2014) found that although teachers conducted their lessons in the laboratory, they conducted few experiments and only included demonstration experiments. They explained that the reason for this is the lack of materials and inadequate physical conditions. In the study conducted by Bulut (2010), the rate of those who use the laboratory sometimes was found to be the highest. The similarity of results in the current study and in the literature suggests that the lack of materials, inadequate physical conditions and crowded classrooms in schools have not been addressed adequately.

Another reason why the experimental method is not adequately used in science classes appears to be the activities included in textbooks. Teachers noted that there are more activities than experiments in textbooks and that the number of experiments has been reduced in textbooks. For this reason, the experimental method is not used as frequently as it used to be. Bayır and

Kahveci (2022) examined science textbooks in terms of scientific process skills. They concluded that the terms "activity" and "science, engineering and entrepreneurship applications" were used instead of experiment in the textbooks examined at all the middle school levels. In the literature, it is stated that the use of the experimental method causes students to develop a positive attitude towards science classes, to eliminate misconceptions, and to increase their academic success (Taşkoyan, 2008; Telli et al., 2004; Uluçınar et al., 2008).

Some of the teaching methods that have an important place in science teaching are the problem-solving, project and cooperative learning methods. According to the results of the current study, teachers use these methods less in their classes than traditional methods. The reasons for this situation are shown as insufficient lesson hours, crowded classes, and the difficulty for students to understand the methods and techniques to be applied. From the opinions expressed by teachers, it was concluded that the use of the project method has increased with the changes made in the 2018 science curriculum, but it is still not preferred much. Similar results have been reported by Kayabaşı (2012), Karamustafaoğlu et al. (2014), Sözbilir et al. (2006) and Çepni (2010).

In the study, the least preferred methods and techniques by teachers were found to be the aquarium technique, the six thinking hats technique, the conference and the station technique, respectively. Teachers stated that the reason why they prefer techniques such as conference, six thinking hats, station, and aquarium less is that not every subject in science is suitable for using these techniques and it is difficult to explain these techniques to students. As can be understood from this finding, not every method and technique is suitable for every subject. Thus, it can be concluded that the characteristics of the subject are taken into consideration when choosing methods and techniques. It is also one of the results that methods such as aquarium, six thinking hats and conference are not preferred because of the cost and length of the procedure required for their implementation. As can be understood from the results, although it is emphasized in the curriculum that students should be at the centre and be active, it is thought that the necessary efforts have not been made to increase the use of the methods and techniques that can make students more active. In addition, some of the teachers stated that they did not have much knowledge about techniques such as the six thinking hats technique and the aquarium, and therefore could not use these techniques. Thus, it can be concluded that the knowledge and skills possessed by teachers in relation to methods and techniques can be influential in the selection of methods and techniques.

When the results of the study are examined, it is seen that among the factors affecting teachers' method and technique preferences are factors related to teachers and students. Many teachers expressed that they do not have the required competence for the effective use of some methods and techniques and indicated that they do not know how to implement some of them. A similar result was also reported by Tunga et al. (2021). According to the results obtained from the interviews conducted with the teachers, most of the teachers stated that they need to receive training on teaching methods and techniques and that the courses given at the undergraduate level are not sufficient. It can be concluded that teachers are willing to participate in in-service training on methods and techniques, but they cannot find enough opportunities to do so.

According to the results obtained in the current study, teachers generally use traditional methods more, but the reason for this is not their own preference but the physical conditions of the school, crowded classes, inadequate class hours and the fact that they have to teach in an exam-oriented system. In addition, it was concluded that in-service training on methods and techniques is insufficient. It was determined that teachers sometimes prefer contemporary and

student-centred methods. However, they also stated that they cannot apply some methods due to insufficient materials or crowded classes.

It is concerning that research findings clearly reveal issues such as large class sizes and insufficient class hours. Another notable finding in the study is that teachers do not feel confident in their knowledge of methods and techniques. It was also concluded that the in-service training provided is insufficient. The limited availability of in-service training on learning-teaching methods and techniques, which are one of the most important elements of the curriculum, is thought to hinder the effective implementation of the curriculum.

SUGGESTIONS

In light of the results of the study, the following suggestions can be made.

- The science curriculum should be updated, and the number of science class hours should be increased.
- Materials used in science classes should be maintained continuously. Materials that are depleted or damaged should be replaced.
- Class sizes should be reduced to allow active methods and techniques to be implemented.
- In-service training should be provided for science teachers on teaching methods and techniques so that they can use these methods and techniques more effectively.
- The content of the teaching methods and techniques courses given in university teacher training programs should be enriched and a more practice-based learning process should be structured.

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