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Chapter 6

SCIENCE TEACHERS' TENDENCY TO USE SOME TEACHING METHODS AND TECHNIQUES

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Eren SARAÇ²

INTRODUCTION

In teaching programmes based on constructivist learning theory, teaching strategies in which students are active are adopted. Teaching methods and techniques appropriate to these strategies should be used in teaching activities. When the teaching methods used in science teaching are examined, there are two types as “teacher-centred” and “student-centred” (Çepni et al. 2005). It was observed that in the science programmes, which were renewed based on constructivist theory, methods that make the teacher active such as lecture, question-answer, demonstration were emphasised less, and student-centred methods and techniques such as problem solving, project, cooperative learning, role-playing, discussion, laboratory, project, excursion-observation, brainstorming were emphasised more and recommended to be used more frequently (MoNE, 2006). When the latest science curriculum is examined, like the previous curricula, student-centred teaching activities such as problem, project, argumentation, collaborative learning, classroom / in-school and out-of-school learning environments, research-inquiry based learning, science, engineering and entrepreneurship practices should be used (MoNE, 2018).

The teacher is the person who directs the teaching process, ensures that the teaching is effective and complete, and at the same time affects the attitudes and behaviours of the students towards the lesson and is an important element because he/she is the main individual who provides learning in the classroom environment and outside the school. In the teaching process, the quality and personality of the teacher is very important (Sönmez, 2007). In addition, in the

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programmes based on constructivist learning theory, the main task of teachers is not to transfer existing knowledge to their students, but to provide them with the skills of accessing and using knowledge. It is possible to understand the importance of the teacher factor from the skill level and achievement differences between students in inter-class or intra-class measurements and observations in schools (OECD, 2009). The teaching method or attitude or character of the teacher may have a positive effect on the learning of one student but may not have a positive effect on another student.

In fact, although the student is seen as active or at the centre in the teaching process in the new programmes, the main task falls to the teacher. The skills that learners should acquire depend on the teacher's use of effective methods and appropriate materials in the teaching process and the ability to actively involve students in the lessons. Teachers should ensure students' conceptual learning, avoid rote learning, teach problem solving and use scientific processes in the face of new problems or situations. For these purposes, in the new curricula of recent years, the teacher's task is defined as guiding and showing students the ways of learning (MoNE, 2005).

Research on the new curricula reveals that curriculum development processes are easier than the implementation and use of the curriculum, but in practice, teachers do not adopt the renewed and developed curricula to the desired extent and think that they are more difficult to implement. (Karamustafaoğlu, 2006; Tekbıyık & Akdeniz, 2008; Yıldırım, 2011). For example, although teachers have a positive approach to the use of materials to enrich teaching in science lessons, there are studies that show that they are generally ineffective in using materials (Karamustafaoğlu, 2006). Another example is the results of Yıldırım's (2011) research in which he examined the data of the Programme for International Student Assessment (PISA) 2006, Trends in International Mathematics and Science Study (TIMSS) 2007 and Teaching and Learning International Study (TALIS) 2008. According to the findings obtained from these studies, it was determined that the teaching strategies suggested to be used by the new programmes were not sufficiently widespread in science lessons at the second level of primary education; the frequency of laboratory-supported experiments and the frequency of using computers was quite low, and the frequency of teaching practices in which students tended to remain passive rather than active was determined. In other studies, on teaching methods and techniques, explanation and question-answer are the most frequently preferred classroom teaching practices of Science and Technology teachers (Önen, et al., 2008). According to the results of another

study, a significant number of Science and Technology teachers stated that they used the lecture method in every subject and supported this method with question-answer, brainstorming and concept mapping (Aydede et al., 2006). Even teachers in Science and Art Centres, where active learning methods should be used more than in other schools, tended to prefer methods such as lectures and demonstrations in their lessons with gifted students (Aktepe & Aktepe, 2009).

Before introducing the teaching methods and techniques used in this research, it is necessary to define the concept of "method". The method, which has been defined with different expressions until today, is the most regular way that is consciously chosen and followed in order to achieve goals such as solving a problem, learning or teaching a subject or concluding an experiment, or in short, it is the shortest path that is predetermined or to be followed in order to achieve the goal (Demirel,1998). When teaching method is mentioned, the concept of teaching technique also comes to mind. The concepts of teaching method and teaching technique are different concepts and there is an inclusive relationship between these two concepts. In this inclusive relationship, teaching method is more general and comprehensive and includes teaching technique. Teaching method is more comprehensive than the concept of technique and is a way of teaching developed according to a certain view, principles and rules. Technique is the way the teacher puts the teaching method into practice in detail (Büyükkaragöz & Çivi, 1999). In the literature, while the same concept is named as method in some sources, it is named as technique in some sources. The same situation is also valid for concepts such as approach and model. It is essential to take a common decision about this situation. In this study, to decide which practices are methods and which are techniques, a comprehensive scan was made, and it was determined whether they were methods or techniques by naming them as the majority used.

One of the methods and techniques investigated in the research is lecturing. It can be defined as explaining the subjects planned to be taught in the lesson by speaking after forming a certain order. Lecture can also be defined as the teacher conveying information about a subject to the students who sit passively in front of him/her and listen (Büyükkaragöz & Çivi, 1998). In lecturing, it is understood that teachers convey a large amount of information to many students who are passive recipients. It represents a traditional teacher-centred understanding of lecturing, which is mostly used when introducing a certain subject, conveying information about a certain subject, or summarising a certain subject (Saban, 2000, p.185). According to Kaptan (1999), it is based on teacher-centred, presentational

learning approach and it is autocratic transfer of information to students who are passive listeners.

Another method most used in teaching is the question-answer method. This method is important because it enables students to gain thinking and speaking habits through questions and it can be used in every lesson. The question-and-answer method is also called the Socrates method because of Socrates' ability to find the truth by revealing the truth hidden in the mind of the other person with some pre-arranged questions (Demirel, 2008). The question-answer method is a method that should be preferred because it develops students' thinking skills, facilitates understanding, provides a review strategy, provides feedback in teaching, provides a connection between thoughts and increases students' curiosity (Gall, Dunnig & Weathersy, 1971 as cited in Filiz, 2002).

Argumentation method is a teaching method since more than one person puts forward their ideas in the form of mutual conversations to clarify a subject or two or more people exchange ideas and express their opinions on a particular subject (Akgün, 2001). When using this method, the teacher should be a guide and should have the ability to know and use the scientific argumentation method very well. The prominent features of the scientific argumentation method are that it enables interaction between students and the teacher, provides students with the opportunity to give examples from their previous experiences, and gives them the opportunity to think, speak and comment on a specific subject (Demirel, 1999 as cited in Arıcı, 2010).

The case study method is based on the principle of bringing a real or possible event to the classroom environment and solving it by examining it in depth in the classroom (Sönmez, 2007). The case study brings students face to face with real life and enables the link between theory and practice to be established. Some of the techniques used in the method are workshop, problem solving, brainstorming, decision making and talking circle (Stensmo, 1999 as cited in Şahin et al., 2010). Case study method is a method that enables the development of problem solving, critical thinking, reflective thinking, decision making, knowledge transfer, multicultural awareness and historical perspective skills (Şahin et al., 2010).

The demonstration method is a method based on the principle that the behaviour based on the acquisition is first performed by the teacher and watched by all students, then the student performs the behaviour, and the teacher guides this process (Arıcı, 2010). When the application principles of the demonstration method are examined, the first thing to be considered is that all students can see the

demonstration comfortably. Necessary preparations should be made by the teacher before the demonstration. The activity to be performed should be implemented in stages and each stage should be explained. It is important to ensure that the students apply each stage correctly and that the necessary corrections are made immediately by the teacher during the application phase. Students should be able to apply the information they have learnt to different situations, in other words, they should be able to transfer it. Each stage should be taken into consideration when evaluating and evaluation should be made (Oktaylar,2008).

Role-playing technique is the dramatization of a phenomenon or event, an idea or a situation by a group of students as a different person in front of their classmates or in front of a group. In this technique, communication is based on action rather than words. It is mostly used in the realisation of cognitive domain acquisitions at the level of comprehension and above. It is more motivating than traditional science teaching and more suitable for students' personal, affective and social development (Kutlu & Aldağ, 2005). The benefits of role-playing are that it is suitable for students' personal, affective and social development, it is effective in understanding abstract concepts, it contributes positively to the relations between society and students, it helps students to learn to be cool-headed in the face of negative events and to be prepared in advance for the real situations they will encounter, and it enables students' creative aspects to emerge and develop (Doğanay, 2007).

Cooperative learning method is a teaching method that enables students to solve a problem in small groups and learn the subject by working together for a common purpose to fulfil a task (Çepni & Çil, 2010). In cooperative learning, it is aimed to ensure the development of three basic events, which are to ensure that students are academically successful and develop socially, that everyone is different, that these differences are a richness, not a negativity. (Oktaylar, 2008). One of the most important benefits of cooperative learning is that students have the opportunity to work with different students in the lessons where cooperative learning is used, and the development of different skills as a result of interaction with their group mates is one of the most important benefits of cooperative learning (Aktaş, 2006). In addition, co-operative learning has three types of benefits: academic, social and psychological. Academic benefits include increasing achievement, developing high-level scientific strategies, increasing retention, improving verbal communication skills and enabling active participation in the lesson. Social benefits include improving social skills and friendship relations and increasing students' tolerance towards differences. Psychological benefits are that

it positively affects self-esteem, reduces anxiety and increases student satisfaction (Tonbul, 2001; as cited in Çepni & Çil, 2010).

Laboratory method is a teaching method in which students gain a positive attitude towards science by conducting experiments related to subject acquisitions using tools and equipment (Çilenti, 1985 as cited in Önder, 2007). Literature research have proved that the laboratory method is very important, with this method, students' academic achievement is increased, they are better able to construct concepts, they are more willing to learn, the knowledge acquired is more permanent, and cooperation and co-operation among students are more developed. (Telli et al., 2004; Taşkoyan, 2008; Uluçınar et al., 2008). This method is thought to be suitable for the nature of science education. The permanent trace of knowledge in a student depends on the experiences of the student and one of the best methods to provide these experiences is the laboratory method (Aktepe & Aktepe, 2009).

The problem-solving process in daily life is not very different from the problem-solving process in teaching. In the problem-solving method used in the lessons, the ways of coping with a problematic situation are taught to the students through the subjects in the lessons by giving practical activities step by step (Aksoy, 2003). Problem solving develops students' ability to use higher thought functions such as observation, thinking, analysis and creativity together (Ünsal & Moğol, 2007). In addition, this method affects students' higher-order thinking skills and academic risk-taking levels, increases students' cognitive target levels and is much more effective than the traditional method. (Çınar, 2007).

Project-based learning is a teaching method in which students actively participate in the learning environment, based on the principle of identifying, researching and finalising problems related to life that cause students' curiosity (Çıbık, 2006). In project-based learning, the student is in the leading role in the learning process by conducting research on the subject to be learned, collecting information, analysing and evaluating the data, and then synthesising the information with the experience he/she has. In this process, the teacher should present a subject that will arouse students' desire to learn and guide their studies (Öztürk, 2008). In many studies in the literature, it has been found that project-based teaching enables students to develop positive attitudes towards the course and increases academic achievement (Çıbık, 2006; Doğan, 2008; İmer, 2008; Öztürk, 2008; Yurttepe, 2007). In addition, this method ensures that students' attitudes towards science course change positively and learning becomes more effective and permanent (Keser, 2008).

The field trip-observation method is an entertaining method that enables many related elements in the learning environment to be examined together in accordance with the nature of science education (Göğebakan, 2009). It is seen that learning is easier and more permanent with the use of the excursion-observation method, students' desire and motivation to participate in the excursion-observation activity are high and thus they are more successful (Aycan, 2008; Ertuğ, 2007; Göğebakan, 2009; Özay, 2003; Özkan, 2009). At the end of the excursion-observation activity, feedback should be obtained from the students through activities such as narrating, drawing, writing about the excursion and the permanence of the learning should be ensured. Teachers are recommended to use the field trip-observation method more especially with the implementation of the new science programme (MEB, 2005). However, it is seen that many science teachers do not make use of the field trip-observation method, and those working in public schools make less use of this method than those working in private schools (Aktaş, 2006).

The homework technique is applied at all levels of education from primary school to university and is related to the subject to be taught at school and is the work done by the student outside the lesson. The points to be considered while doing homework are that it should not only be in the form of individual work and should also be given in the form of group work. Instead of just repeating the subject, students should be able to apply their achievements to different situations. Homework improves students' scientific thinking skills and their ability to conduct research and organise the information they collect. The student who presents his/her homework in the classroom also develops in the social field and students can make the subject discussed or to be discussed in the classroom more meaningful in their minds thanks to homework (Çepni & Çil, 2010). Family interest in homework and a good home environment play an important role in increasing academic success. Homework can have both positive and negative effects. For example, the positive effect of homework is that it improves study habits, while the negative effect is that it prevents leisure time activities (Türkoğlu et al., 2007).

Literature studies related to the teaching methods and techniques described above were analysed. It was observed that the most frequently used method by teachers was lecture. For example, Doğru and Aydoğdu (2003) determined the seven most frequently used teaching methods of science teachers, and the problems encountered by students while using these methods. A total of 545 secondary school students studying in Edirne province participated in the study. As a result of the study, it was observed that the lecture method was frequently used

by the teachers regardless of the class size, and the question-answer method was frequently preferred just like the lecture method. It was observed that laboratory, discussion, excursion-observation and demonstration methods were less preferred, while problem solving method was used more by teachers with large class sizes. In his study, Yilmaz (2017) analysed the opinions of 32 students enrolled in the department of science teaching who were able to observe in secondary schools by taking courses such as school experience and teaching practice. As a result of the analysis, it was revealed that “lecture” was the most preferred method among the strategies, methods and techniques preferred by science teachers and some new techniques were started to be used by teachers. Binler (2007) also found similar results in his study. As a result of the study conducted on 80 science teachers in Kars province, it was determined that teachers used lecturing frequently and could not use case study and problem-solving methods effectively.

Yıldırım (2011) investigated which teaching practices are used and how often they are used in science lessons at the second level of primary education in Turkey by using data from the Programme for International Student Assessment (PISA) 2006, Trends in International Mathematics and Science Study (TIMSS) 2007 and Teaching and Learning International Study (TALIS) 2008. The sample of PISA 2006 was 4942 students, the sample of TIMSS 2007 was 4498 8th grade students and 150 science teachers, and the sample of TALIS 2008 was 3224 science teachers. The teaching practices in the science course were analysed in two parts as passive and active, and at the end of the study, it was seen that the teaching practices that made the teacher active and the student passive were used more frequently by the teachers, and the focus was on teaching the concepts discussed in the classroom rather than developing scientific process skills in students. In a study conducted by TALIS (2010) with 4000 second level primary school teachers, the method preferences of 2200 female and 1800 male teachers were investigated, and it was found that female teachers preferred student-centred and structured practices more than male teachers. Karacaoğlu and Acar (2010) determined the problems encountered by teachers in the implementation of the renewed curriculum in their study on 82 teachers who participated in the “Teaching Practices in New Programmes” seminar. Eighteen of the teachers who participated in the study considered that the new curriculum was not suitable for village conditions, inadequacy of the necessary tools and equipment for the lessons, lack of infrastructure (computer, projection, laboratory, classroom) as the deficiencies of the new curriculum. Talaz (2013) investigated the use of active learning activities by 200 classroom teachers teaching 4th and 5th grade

science courses in Bergama district of İzmir province in terms of several variables including class size. It was found that in classes with less than 30 students, active learning activities such as experiment, excursion-observation, problem solving, creative drama and project were more easily implemented. Akkuş and Kadayıfçı (2007) investigated the level of change in the knowledge and skills of 23 teachers who participated in in-service training on laboratory use in Sinop province after the in-service training on new teaching approaches and laboratory use. As a result of the study, it was seen that in-service trainings had a positive effect on teachers in terms of knowing and applying new approaches and techniques. Önen et al. (2008) investigated the knowledge and application level of 43 science teachers working in Tekirdağ province who attended in-service training courses on teaching methods and techniques used in science courses before and after attending the courses. According to the results of the research, it was determined that teachers mostly used question-answer, lecture and experiment methods in their classes, and that teachers who participated in in-service trainings increased their knowledge about methods and techniques, and that teachers with low professional seniority had more knowledge about methods and techniques.

METHOD

In this section, information about the research model, population and sample, data collection tool and statistical methods used in data analysis are given.

RESEARCH DESIGN

This study was conducted to investigate the tendency of Science and Technology teachers working in secondary schools in Balıkesir and Manisa provinces to use some teaching methods and techniques in their lessons.

The study is a descriptive study in survey type. General survey models are survey arrangements carried out on the whole universe or a group, sample or sample to be taken from it to make a general judgement about the universe in a universe consisting of many elements (Karasar, 2006, p. 79).

SAMPLE

In the study, out of a total of 1,120 science teachers, 605 from Balıkesir province and 515 from Manisa province, 615 teachers (55%) constitute the sample of the study (Saraç, 2015). The gender distribution of the science teachers participating in the study according to provinces is shown in Table 1.

Gender	Manisa		Balikesir		Total
	N	%	N	%	
Female	159	25.9	212	34.5	371
Male	81	13.2	163	26.5	244
Total	240	39.1	375	60.9	615

DATA COLLECTION TOOL

In the collection of data that will shed light on the results of the research, a 4-point rating questionnaire named “Methods and Techniques Used by Science and Technology Teachers in Their Lessons” was used. Care was taken to ensure that the questions forming the questionnaire form were comprehensible, simple and purposeful. After the necessary analyses, various corrections were made, and the application was started. The data collection tool consists of two parts. The first part includes questions about the personal characteristics of the participants. In this part, gender, length of service, participation in in-service training seminars related to methods and techniques, school location and number of students were included. In the second part of the questionnaire, there are 24 questions about how often teachers use 12 teaching methods and techniques and how often they think they should be used.

The Cronbach’s Alpha (α) reliability coefficient of the answers was found to be .801. This value is above .80, which is the high reliability limit suggested by Kalaycı (2009). Accordingly, it can be said that the measurement results are highly reliable. The data collection tool, which was prepared for implementation, was presented to the teachers online in electronic environment after obtaining the necessary permissions from Balikesir and Manisa Provincial Directorates of National Education. The link of the data collection tool was announced to all teachers with an official letter. The survey link was activated on 01/06/2014 and the link was closed on 01/10/2014 since sufficient participation was achieved. The questions were presented to the participants in the “google drive survey” section. The way of transferring the responses to SPSS is as follows.

Sample question:

1. How often do you use the demonstration method?

Never 1 ○	Rarely 2 ○	Most of the time 3 ○	Always 4 ○
--------------	---------------	-------------------------	---------------

The participants marked the answer they thought about the related question in the box below. For example, when the participant preferred the “rarely” option, his/her answer was marked as “2” in the “google drive answers” section. The data obtained as numbers in this way were transferred to SPSS and analysed. If the response was marked as “rarely”, it would be necessary to edit the responses one by one and it would be a waste of time. In this way, time was saved.

ANALYSING THE DATA

The data obtained in the study were analysed with SPSS (Statistical Package for Social Science) 19.0 package programme. In the analysis of the data, in addition to frequency, percentage distribution and arithmetic mean, chi-square tests were used. The significance level was accepted as .05 in all analyses. The questionnaire applied to the teachers was prepared in the form of a 4-point scale and the calculation of the interval limits is given below.

Calculation of the interval limits of the questionnaires:

Number of options= 4

Number of intervals= 4-1 = 3

Interval coefficient= 3/4= 0,75

For easy interpretation of the data obtained, tables were created in the findings section and these findings were interpreted in the discussion section. The interval limits and their meanings are given in Table 2 for mean comparisons.

Table 2. Arithmetic mean ranges	
Range limit	Meaning
1.00 – 1.75	Never
1.76 – 2.50	Rarely
2.51 – 3.25	Most of the time
3.26 – 4.00	Always

FINDINGS AND INTERPRETATION

In this section, the findings and interpretations obtained from the statistical analyses of the data will be given according to the sub-problems of the research.

Findings Related to Personal Information of Teachers

The findings related to the personal information of the science teachers who participated in the study are shown in Table 3.

Table 3. Information about the participants						
N		Manisa		Balıkesir		Total
		%	N	%	N	
Year	1-5 years	101	45.9	119	54.1	220
	Over 5 years	139	35.2	256	64.8	395
In-service training seminar participation	Participated	160	42.3	218	57.7	378
	Did not participate	80	33.8	157	62.2	237
School worked at	Province/district	161	39.1	251	60.9	412
	Village/town	79	38.9	124	61.1	203
Number of students in classes	1-20	99	45.2	120	54.8	219
	21 and above	141	35.6	255	64.4	396

According to Table 3, 220 of the science teachers participating in the study have 1-5 years of service and 101 of the 220 teachers work in Manisa and 119 of them work in Balıkesir. 395 of them have 5 or more years of service and 139 of 395 teachers work in Manisa and 256 of them work in Balıkesir. When the participation of the teachers to in-service training seminars on teaching methods and techniques is analysed, it is seen that 378 of them attended these seminars and 160 of these teachers work in Manisa, 218 of them work in Balıkesir. 237 of them did not attend these seminars and 80 of these teachers work in Manisa and 157 of them work in Balıkesir. When the locations of the schools where the participant teachers work are examined, it is seen that 412 of them work in provincial-district centres and 161 of these teachers work in Manisa and 251 of these teachers work in Balıkesir. It is seen that 203 of them work in village-district schools and 79 of these teachers work in Manisa and 124 of these teachers work in Balıkesir. When the average number of students in the classes of the teachers participating in the study is analysed, it is seen that 219 teachers teach in classes with 1-20 students

and 99 of these teachers work in Manisa, 120 of these teachers work in Balıkesir, 396 teachers teach in classes with 21 or more students and 141 of these teachers work in Manisa and 255 of these teachers work in Balıkesir.

Teachers' opinions on the frequency of use of methods and techniques and how often they should be used

Percentage and mean values related to how often science teachers use teaching methods-techniques and how often they should be used are given in Table 4.

Table 4. Opinions on the Frequency of Use of Methods and Techniques and How Often They Should Be Used					
Method-Technique	Always (%)	Most of the time (%)	Rarely (%)	Never (%)	Average (X)
Conventional lecturing	0.0 –4.4	33.3 –30.9	62.8 –61.5	3.9 –3.3	2.71 -2.36
Argumentation	3.3 –8.8	42.8 –54.3	50.7 –35.8	3.3 –1.1	2.46 -2.71
Demonstration	9.3 –19.7	57.6 –67.0	28.8 –13.3	4.4 –0.0	2.72 -3.06
Problem solving	8.1 –22.4	58.9 –61.0	33.0 –16.6	0.0 –0.0	2.75 -3.06
Project	8.8 –14.3	48.3 –48.3	39.7 –34.1	3.3 -3.3	2.63 -2.74
Observation	4.9 –23.4	16.9 –47.8	63.4 –27.6	14.8 -1.1	2.12 -2.93
Laboratory	16.9 –37.4	60.5 –57.6	14.5 –3.4	8.1 –1.6	2.86 -3.31
Question- answer	21.0 –22.4	75.8 –72.7	3.3 –4.9	0.0 –0.0	3.18 -3.18
Assignment	12.7 –14.8	64.2 –61.0	23.1 –23.1	0.0 –1.1	2.90 -2.89
Cooperative Learning	4.9 –13.2	54.6 –62.1	37.2 –24.7	3.3 –0.0	2.61 -2.88
Case study	3.3 –15.9	53.8 –54.3	40.2 –28.6	2.8 –1.1	2.58 -2.85
Role-playing	6.5 –10.9	36.1 –49.4	50.2 –38.5	7.2 –1.1	2.42 -2.70

The first values written in bold indicate how often the teachers participating in the research use the methods and techniques, and the values written in light indicate how often they think the methods and techniques should be used.

When Table 4 is analysed, it is seen that the three teaching methods that science teachers use the most are question-answer (X=3,18), homework (X=2,90), laboratory (X=2,86); the three methods that they use the least are travel-observation (X=2,12), role playing (X=2,42) and discussion (X=2,46). The teachers who participated in the research stated that laboratory (X=3,31), question-answer

($X=3,18$), demonstration ($X=3,06$) and problem solving ($X=3,06$) methods should be used the most, respectively.

Frequency of Use of Teaching Methods and Techniques According to Gender

According to the answers given by male and female science teachers to the question about how often they use teaching methods and techniques, the frequency of use was determined, and chi-square analysis was applied to understand whether there was a significant difference between the methods and techniques used according to gender. Table 5 shows the frequency of using teaching methods and techniques according to gender.

	Never		Rarely		Most of the time		Always	
	F	M	F	M	F	M	F	M
Conventional lecturing	0	0	121	84	233	153	17	7
Argumentation	10	10	189	123	152	111	20	0
Demonstration	20	7	123	54	191	163	37	20
Problem solving	0	0	152	51	169	193	50	0
Project	20	0	159	85	162	135	30	24
Observation	57	34	227	63	77	27	10	20
Laboratory	40	10	61	28	233	139	37	67
Ques- answer	0	0	0	20	306	160	65	64
Assignment	0	0	64	78	290	105	17	61
Coop. Learning	20	0	131	98	210	126	10	20
Case study	17	0	149	98	205	126	0	20
Role-playing	37	7	177	132	137	85	20	20

While female teachers prefer discussion, excursion-observation and question-answer methods more frequently than male teachers, male teachers prefer all other methods-techniques more frequently than female teachers.

In Table 6, no significant difference was found between the answers given to the frequency of use of the lecture method according to gender ($\chi^2(0,05) (2) = 1.252, p>0,05$).

Table 6. Gender relationship with the use of teaching method

Method-Technique	χ^2	sd	p
Conventional lecturing	1.252	2	.535
Argumentation	14.756	3	.002*
Demonstration	14.850	3	.002*
Problem solving	78.985	2	.000*
Project	20.199	3	.000*
Observation	18.239	3	.000*
Laboratory	38.039	3	.000*
Ques- answer	41.285	2	.000*
Assignment	90.479	2	.000*
Coop. Learning	23.881	3	.000*
Case study	41.948	3	.000*
Role-playing	13.539	3	.004*

*p < 0.05

In all other methods and techniques, the difference between the answers given to the frequency of use according to gender is significant.

Frequency of Using Methods and Techniques According to Years of Service

The significance of the difference between the responses of science teachers to the frequency of using teaching methods-techniques according to their years of service was analysed with chi-square.

Table 7. Distribution of teachers according to years of service

Year of Service	N	%
1-5 years	220	35.8
Over 5 years	395	64.2
Total	615	100,0

The distribution of science teachers participating in the study according to their years of service is given in Table 7. Accordingly, 35,8% (220) of the teachers have 1-5 years of service and 64,2% (395) of them have more than 5 years of service.

When Table 8 is analysed, the difference between the responses of the teachers to the frequency of using all teaching methods-techniques according to their years of service is significant.

Table 8. The relationship between years of service and use of methods			
Method-Technique	χ^2	sd	p
Conventional lecturing	9.998	2	.007*
Argumentation	64.742	3	.000*
Demonstration	22.552	3	.000*
Problem solving	11.514	2	.000*
Project	14.722	3	.002*
Observation	28.338	3	.000*
Laboratory	8.865	3	.031*
Ques- answer	52.109	2	.000*
Assignment	24.125	2	.000*
Coop. Learning	45.546	3	.000*
Case study	35.537	3	.000*
Role-playing	34.900	3	.000*

*p < 0.05

In addition, while teachers with 1-5 years of service preferred homework and case study more, teachers with more than 5 years of service preferred all other methods-techniques more.

Teachers' Participation in In-Service Training Seminars and Frequency of Using Teaching Methods

Chi-square analysis was applied to the answers given in order to find the relationship between the participation of the teachers participating in the research to in-service training seminars related to teaching method-techniques and the frequency of using teaching method-techniques.

Table 9. Participation in in-service training seminars on methods

		N	%
Participation in in-service training seminars on teaching methods	Participated	378	61.5
	Did not participate	237	38.5
	Total	615	100.0

According to Table 9, 61,5 % (378) of the 615 teachers participated in the study attended in-service training seminars, while 38,5 % (237) did not.

According to Table 10, there is no significant difference between the frequency of using lecture, project and case study methods and the participation to in-service training on teaching methods and techniques.

Conventional lecturing: ($\chi^2(0,05) (2) = 1.979, p > 0,05$)

Project: ($\chi^2(0,05) (3) = 3.936, p > 0,05$)

Case study: ($\chi^2(0,05) (3) = 4.973, p > 0,05$)

Table 10. The relationship between attending in-service training seminars and the frequency of using teaching methods

Method-Technique	χ^2	sd	p
Conventional lecturing	1.979	2	.372
Argumentation	44.639	3	.000*
Demonstration	11.947	3	.008*
Problem solving	23.772	2	.000*
Project	3.936	3	.268
Observation	23.248	3	.000*
Laboratory	19.367	3	.000*
Ques- answer	15.239	2	.000*
Assignment	36.803	2	.000*
Coop. Learning	13.916	3	.003*
Case study	4.973	3	.174
Role-playing	30.637	3	.000*

*p < 0.05

There is a significant difference between the frequency of using all other teaching methods and techniques and attending in-service training on teaching methods and techniques.

Discussion, demonstration, problem solving, excursion-observation, laboratory, cooperative learning and role playing teaching method-techniques were preferred more by the participants of in-service trainings, while question-answer and assignment method-techniques were preferred more by those who did not participate in in-service trainings.

The Relationship Between the Average Number of Students in Classes and the Frequency of Use of Teaching Method Techniques

Chi-square analysis was applied to the answers given in order to understand whether there is a difference between the number of students that science teachers teach and the frequency of using teaching methods-techniques.

Number of Students	N	%
1-20	219	39,6
21 and above	396	60,4
Total	615	100,0

As seen in Table 11, the average number of students in the classes in which the science teachers participated in the questionnaire were teaching was 219 (39,6%) between 1-20 and 396 (60,4%) between 21 and above.

Method-Technique	χ^2	sd	p
Conventional lecturing	17.779	2	.000*
Argumentation	17.112	3	.001*
Demonstration	12.070	3	.007*
Problem solving	0.667	2	.716
Project	9.907	3	.019*
Observation	114.672	3	.000*
Laboratory	23.787	3	.000*
Ques- answer	10.710	2	.005*
Assignment	22.362	2	.000*
Coop. Learning	15.572	3	.002*
Case study	70.090	3	.000*
Role-playing	83.615	3	.000*

*p < 0.05

There is no significant difference between the number of students in the classes taught by science teachers and the frequency of using problem solving method ($(\chi^2(0,05) (2) = 0.667, p>0,05)$). There is a significant difference between the frequency of using other teaching methods and techniques and the number of students in the classes. Lecture, discussion and project methods were preferred more by those with an average number of 21 or more students; demonstration, field trip-observation, laboratory, question-answer, homework, cooperative learning, case study and role-playing methods-techniques were preferred more by those with an average number of 1-20 students.

Location of the School and Frequency of Use of Teaching Methods and Techniques

Chi-square analysis was applied to the answers given to determine whether there is a difference between the location of the school where science teachers work and the frequency of using teaching methods-techniques.

Location of the School	N	%
Province/district centre	412	67.0
Village/town	203	33.0
Total	615	100.0

Of the science teachers who participated in the survey, 412 (67.0%) were working in the province-district centre and 203 (33.0%) were working in the villages and towns (Table 13).

Method-Technique	χ^2	sd	p
Conventional lecturing	47.328	3	.000*
Argumentation	96.702	3	.000*
Demonstration	18.539	2	.000*
Problem solving	48.371	2	.000*
Project	84.398	3	.000*
Observation	17.502	3	.001*
Laboratory	40.509	3	.000*
Ques- answer	37.401	2	.000*

Table 14. The relationship between the frequency of use of teaching methods and the place of residence

Method-Technique	χ^2	sd	p
Assignment	11.159	2	.004*
Coop. Learning	13.367	3	.004*
Case study	20.454	3	.000*
Role-playing	9.056	3	.029*

*p < 0.05

As seen in Table 14, the difference between the location of the school where science teachers work and the frequency of using all teaching methods-techniques is significant.

According to the analyses, teachers working in the village-district prefer homework, role playing, case study method-techniques more than teachers working in the province-district, while teachers working in the province-district prefer lecture, discussion, demonstration, problem solving, project, observation trip, laboratory, question-answer, cooperative learning methods more than teachers working in the village-district. As it is seen, teachers working in the province-district prefer more various teaching methods and techniques more frequently than teachers working in the village-district.

CONCLUSION AND DISCUSSION

In this study, it was investigated which teaching methods-techniques 615 science teachers working in Manisa and Balıkesir provinces use most frequently and which they think should be used most frequently and the effect of gender, length of service, participation in in-service trainings related to teaching methods-techniques, number of students in the classes they teach, and the settlement where they work on these preferences.

If the data obtained about science teachers are repeated,

1. Many of the teachers participating in the study (60.3%) were female teachers.
2. Many of the teachers participating in the study (64.2%) were teachers with more than 5 years of service.
3. Many of the teachers participating in the study (61.5%) were teachers who attended in-service training seminars.
4. Many of the teachers participating in the study (61.0%) were teachers working in the province of Balıkesir.

5. Many of the teachers participating in the study (67.0%) were teachers working in the province-district centre.
6. Many of the teachers participating in the study (64.3%) had 21 or more students in their classes.

When the results related to how often the teachers currently use teaching methods and techniques and how often they think they should ideally be used are analysed, it is seen that the three most frequently used teaching methods of the teachers are question-answer ($X=3,18$), homework ($X=2,90$), laboratory ($X=2,86$), and the three least frequently used methods are travel-observation ($X=2,12$), role playing ($X=2,42$), discussion ($X=2,46$).

The teachers who participated in the research stated that laboratory ($X=3,31$), question-answer ($X=3,18$), demonstration ($X=3,06$), problem solving ($X=3,06$) methods should be used the most, respectively. This result, which indicates that science teachers stick to traditional teaching methods-techniques in the teaching process, also coincides with the research findings in the literature (Dođru & Aydođdu, 2003, Önen et al. 2008; Yıldırım, 2011). In addition, the fact that teachers stated that question-answer, laboratory, problem solving, and demonstration methods should be used most in Science and Technology lessons reveals an important contradiction.

According to another result of the research, the most used teaching method among teachers is the question-answer method, which is described as boring and ineffective (Dođru & Aydođdu, 2003). The fact that the teachers used the question-answer method more than they thought and used the project method and the excursion-observation method less than they thought was interpreted by Yıldırım (2011) as the preference of teaching practices that tend to make the student passive more frequently.

If the results of the research on the frequency of science teachers' use of teaching methods-techniques according to their gender are reminded, there is no significant difference between the frequency of teachers' use of "lecture" according to their gender. However, there is a significant difference between the frequency of using all other teaching-method techniques and gender variable. Discussion, problem solving, excursion-observation, question-answer, assignment methods-techniques are preferred by female teachers more than male teachers. Male teachers prefer demonstration, project, laboratory, cooperative learning, case study, role playing teaching method-techniques more than female teachers. However, this result is partially inconsistent with the research result of TALIS (2010), which

states that “female teachers emphasise the direct transmission approach less than male teachers, while they apply structured and student-oriented practices more than their male colleagues”.

Another result of the study is the frequency of teachers’ use of teaching methods and techniques according to their years of service. Accordingly, except for homework and case study methods, all other methods and techniques are preferred more frequently by teachers with more than 5 years of service. The situation in favour of teachers with more than 5 years of service in the study is incompatible with some studies in the literature. However, the result of the study conducted by Önen et al. (2008) with 43 Science and Technology teachers in the central district of Tekirdağ “It can also be said that teachers show a more idealistic approach in the first years of their professional experience and are advantageous in using different and effective teaching methods and techniques and teaching materials to apply their knowledge.”

According to the results related to the participation of science teachers in in-service training seminars and the frequency of using teaching methods and techniques, there was no significant difference between the participation of teachers in in-service training seminars and the frequency of using lecture, project and case study teaching methods and techniques. In addition, the teachers who used question-answer more frequently were the teachers who did not attend in-service training seminars. However, the teachers who used discussion, demonstration, problem solving, travel-observation, laboratory, homework, cooperative learning, role playing teaching method techniques more frequently were the teachers who attended in-service training seminars. While in-service training seminars did not achieve their purpose in terms of the frequency of using some teaching methods and techniques, they achieved their purpose for a total of eight teaching methods and techniques. The results of the research conducted by Akkuş and Kadayıfçı (2007) with 23 teachers in Ankara support this finding. It was revealed that there was a significant positive change in the perspectives of the teachers who participated in the courses towards new teaching approaches.

According to the results related to the average number of students in the classes in which science teachers teach and the frequency of using teaching methods and techniques, there is no significant difference between the number of students in the classes in which science teachers teach and the frequency of using problem solving method. There is a significant difference between the frequency of using other teaching methods and techniques and the number of students in the classes. Lecture, discussion and project methods were preferred more by those with an

average number of 21 or more students in their classes; demonstration, field trip-observation, laboratory, question-answer, homework, cooperative learning, case study and role-playing methods-techniques were preferred more by those with an average number of 1-20 students in their classes. In the research conducted by Talaz (2013) in Bergama district of İzmir province, which was related to the use of active learning activities (role playing, project, cooperative learning, problem solving) applied by 4th and 5th grade teachers consisting of 220 students in Science and Technology course, it was concluded that active learning activities can be applied more easily in classes where the number of students is less than 30. This result is in harmony with the research result.

According to the results related to the frequency of use of teaching methods and techniques according to the location of the school where science teachers work, teachers working in the village-district prefer assignment, role playing, case study method techniques more than teachers working in the province-district, while teachers working in the province-district prefer lecture, discussion, demonstration, problem solving, project, travel-observation, laboratory, question-answer, cooperative learning method techniques more than teachers working in the village-district. As a result, teachers working in the province-district use more various teaching methods and techniques than teachers working in the village-district. In the study conducted by Karacaoğlu and Acar (2010) with a sample of 82 teachers in Yenipazar district of Aydın province, the fact that the teachers stated that the learning activities in the new curriculum were prepared without considering the village conditions is in line with the findings of the research.

The teaching methods and techniques investigated in this study are lecture, discussion, demonstration, problem solving, project, field trip, laboratory, question-answer, homework, cooperative learning, case study, role playing. However, the number of new methods and techniques developed to be used in teaching is increasing day by day. For example, argumentation (Atasoy et al, 2022; Şevik & Yıldırım, 2024), drama in education (Çirkinoğlu Şekercioğlu & Yılmaz Akkuş, 2019; Yıldırım et al, 2018), peer teaching (Atasoy et al, 2014; Çirkinoğlu Şekercioğlu & Demirci, 2009), flipped learning (Çirkinoğlu Şekercioğlu & Yünkül, 2021), digital games (Arnavut & Çirkinoğlu Şekercioğlu, 2023), modelling (Ayvacı & Bülbül, 2022; Dinç Bilgin & Zorlu, 2023), concept cartoons (Atasoy et al, 2022; Yurtyapan & Çirkinoğlu Şekercioğlu, 2024), STEM (Deligöz & Han Tosunoğlu, 2023; Sungur et al, 2022), game-based learning (Okur & Koca Akkuş, 2021), prediction-observation-explanation (PTA) (Bolat & Karamustafaoğlu, 2021; Karamustafaoğlu & Ertuğrul, 2022), quantum learning (Çağlı & Sıvacı, 2020).

In addition to the methods and techniques used in this study, current research should be conducted on the frequency of use of new methods and techniques by science teachers and their use should be encouraged instead of traditional teaching methods and techniques.

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