The Qualitative Report

Volume 30 | Number 12 Article 10

12-31-2025

Future Teachers' Views on Their Science Teachers: A Case of Turkey

Mehmet Karakaş
Department of Science Teaching at Artvin Coruh University, School of Education, Artvin, Turkey, mkarakas73@yahoo.com

Recommended Citation

Karakaş, M. (2025). Future teachers' views on their science teachers: A case of Turkey. The Qualitative Report, 30(12), 4905-4921. https://doi.org/10.46743/2160-3715/2025.7047

Future Teachers' Views on Their Science Teachers: A Case of Turkey

Abstract

Here future elementary and middle school teachers reflect on their experiences with science teachers encountered throughout their education and highlight their characteristics. The aim of the study was to create a program where teachers were given the explicit opportunity to reflect on their experiences through journaling that promoted reflective thought. Participants were 173 non-science and 120 science major prospective teachers enrolled in a small university in northeastern Turkey. Data were collected using document analysis. Findings show that effective science teachers do experiments, use teaching materials, and show special interest in students; also, their positive personality affected students' positive attitude towards science. Ineffective teachers were "boring" and using lecturing and didn't take their students to laboratories, neither had they done some activity or use visual materials. Furthermore, ineffective science teachers were "angry, fear imposing, authoritarian, and discriminating between students."

Keywords

reflective practice, prospective teachers, effective science teachers, science attitudes, case study

Acknowledgements

This research was financially supported by the Scientific Research Program of Artvin Çoruh University (Project No ACUBAP 2016.S30.02.01).

The Qualitative Report 2025 Volume 30, Number 12, 4905-4921
https://doi.org/10.46743/2160-3715/2025.7047

Future Teachers' Views on Their Science Teachers: A Case of Turkey

Mehmet Karakaş
Department of Science Teaching at Artvin Coruh University, School of Education, Artvin, Turkey

Here future elementary and middle school teachers reflect on their experiences with science teachers encountered throughout their education and highlight their characteristics. The aim of the study was to create a program where teachers were given the explicit opportunity to reflect on their experiences through journaling that promoted reflective thought. Participants were 173 non-science and 120 science major prospective teachers enrolled in a small university in northeastern Turkey. Data were collected using document analysis. Findings show that effective science teachers do experiments, use teaching materials, and show special interest in students; also, their positive personality affected students' positive attitude towards science. Ineffective teachers were "boring" and using lecturing and didn't take their students to laboratories, neither had they done some activity or use visual materials. Furthermore, ineffective science teachers were "angry, fear imposing, authoritarian, and discriminating between students."

Keywords: reflective practice, prospective teachers, effective science teachers, science attitudes, case study

Introduction

Quality teachers are more important than ever, because they are the ones who give the young people the essential skills in the new economy (Murnane & Steele, 2007) and if this is important for the developed countries, it is much more important for developing countries such as Turkey. Although policies rooted in one nation's culture cannot be easily transplanted into another, it is important to understand what challenges other countries face to enhance teacher quality and improve student achievement (Murnane & Steele, 2007). Teachers implement the policies and quality teachers are the main instruments of implementing any education policy. This study tries to look at the characteristics of effective and not so effective Turkish science teachers by asking prospective teachers to reveal their experiences from elementary through high school with these teachers. Ekiz (2006) voiced the prospective elementary Turkish teachers` views and "for them, to be effective teachers dominantly required loving children and teaching and showing patience to the children" (p. 76). Teachers teach in a manner they are taught, so figuring out how future teachers were taught may help them reflect on their teaching and may improve it (Woods & Copur-Gencturk, 2024).

The search for effective teachers has been going on for more than hundred years. Most of the literature on effective teachers argues that both personal characteristics, such as strong interpersonal relationships and sensitivity to students' needs, and teaching methods and especially the use of active teaching methods seem to be important (Moreira, et al., 2023; Woods & Copur-Gencturk, 2024). In some studies, one of the characteristics of effective teachers was their favorable interaction with their students (Tobin & Fraser, 1990; Woods & Copur-Gencturk, 2024). In others, these favorable interactions were identified as helping,

friendly, caring, patient, enthusiastic, flexible, engaging, and understanding (Atwater, 2000). Cone (2012) says:

> Caring teachers are not necessarily seen as permissive, allowing students to have their ways. Conversely, they set limits, provide structure, have high expectations, and push students to succeed, they trust and respect students and recognize them as individuals, while building on their strengths … they are confident in their own teaching practices and believe that all students can learn and thus are persistent and resilient, even in the face of obstacles. (p. 892)

Also, Tobin and Fraser (1990) say effective science teachers use efficient management skills, track students' understanding throughout lessons, encourage students to be engaged in their learning, and strive to maintain a positive classroom environment. Hofstein and Lunetta (2004), Hofstein and Mamlok-Naaman (2007), Mancenido et al. (2025), Gericke et al. (2022), Solomon (1980) write that science teaching must take place in the laboratory, however, Gunstone and Champagne (1990) counter-arguably suggests that more class time should be spent on manipulating ideas and less on manipulating apparatus. Recent studies have begun to point out the importance of active learning and carefully analyzing what science teachers pay attention to, especially in reference to student thinking (Windschitl et al., 2012). Ko et al. (2013) say that effective teachers are "semi-autonomous professionals" who are thoughtful and reflective about their practice. Research on teacher effectiveness suggests that the impact of teacher education in practice is slight and one of the reasons is that teacher educators do not pay enough attention to prospective teachers' prior – explicit and implicit – beliefs (Timmerman, 2009). Prospective teachers who did not have the opportunity to address and think about their prior school experiences were found to tend to ignore different, new models of teaching suggested by their teacher educators once they started teaching in schools (Perry & Rog, 1992).

This study helps prospective teachers reflect on their past schooling experiences with an aim to allow adequate time for improving their teaching. The main aim of the study was to support Capps et al.'s (2012) call for programs where teachers were given the explicit opportunity to reflect on their experiences through journaling that promoted reflective thought. Programs that provide explicit time for reflection may encourage teachers to be more metacognitive about what they know, how they know it, and what they do (Capps et al., 2012).

It is important to research what is happening in science classes to provide focus for improving the situation (Waldrip & Fisher, 2003). Some research described the behaviors of exemplary science teachers believing that what these teachers do might lead to an overall improvement in students (Waldrip & Fisher, 2003). However, exemplary science teachers have been difficult to identify, just profiling effective teaching by scoring whether effective practices are present is of little value in that ineffective teachers can also display some of these practices (Cruikshank, 1986). Generally, most of the studies on effective science teachers asked teachers themselves to reveal their best practices or observe them in their classrooms (Ceven McNally, 2016). There was a lack of research that focused on prospective teachers' views on their best science teachers (Ceven McNally, 2016).

Defining effective teaching can be a complex and controversial issue. Effectiveness is a contested term, because of its perceived links with notions of professional competency and accountability in some systems (Ko et al., 2013). It may question teachers' beliefs about their autonomy (Sammons, 1996). Notions of what constitutes high quality teaching, the idea that teaching is an art or a craft rather than a science, are sometimes used to raise concerns with narrower concepts of effectiveness (Windschitl, et al., 2012). So, beliefs about what is 'good' teaching can vary for different age groups of students, at different times and in different

contexts (Ko et al., 2013). The research on ineffective teachers suggests that science teaching is a teacher's delivery of the "correct" canonical information to students (Stroupe, 2014). Another study suggests that there are still beatings, violence, and favoritism to some students in the classrooms (Karakas, 2013).

Some researchers argue that teaching views and practices are inextricably linked to teachers' personal lives (Loughran, 2007). Van den Berg (2002) argues that teacher educators should shift their research and focus more on the personal aspects of professional identity. Studying prospective teachers' personal lives and histories, prior experiences and teaching perceptions may add significantly to our knowledge about the professional development of teachers (Avraamidou, 2016). Socialization as teacher includes informal processes occurring in the family and in primary and secondary school (Pajares, 1992). Prospective teachers are apprentices during their K-16 years of classroom experiences (Capps et al., 2012). Paying attention to prospective teachers' prior experiences with science teachers may help them to think about their future teaching. The opportunity for preservice teachers to reflect on their experiences is an imperative in the encouragement of inquiry, without challenging experiences, and the ability to constructively reflect on those experiences, the development of positive preservice teacher attitudes to inquiry may be truncated (Windschitl, 2002). Osborne et al. (2003) and Zhou and Shirazi (2025) in their review on research on students' attitudes toward science reveal the many factors of influence such as gender, teachers, curricula, cultural and other variables and the literature itself points to the crucial importance of gender and the quality of teaching in choosing science as a career.

Theoretical Framework

The research on effective teaching (Cotton, 1995; Czerniak & Shriver, 1994; Davis & Smithey, 2009; Demmon-Berger, 1986; Gresh, 1995; Karakas, 2013; Moreira et al., 2023; Witcher et al., 2001; Woods & Copur-Gencturk, 2024; Zhou & Shirazi, 2025) and more specifically on effective and ineffective science teaching (Brown, 1974; Capps et al., 2012; Ceven McNally, 2016; Fitzgerald et al., 2013; Harlen, 1999; Millar & Osborne, 1998; Papert, 1993; Sawyer, 2008; Stroupe, 2014; Tobin & Fraser, 1988; Tobin & Fraser, 1990; Tytler, 2003; Tytler et al., 2004; Waldrip & Fisher, 2003; Yager et al., 1988) provided the theoretical framework for this research. All these studies point out that both personal characteristics and teaching methods seem to be important in defining an effective teacher. The present study tried to find out whether Turkish science teachers share these characteristics too. In doing so, this study tried to use the research on reflective teaching (Bullough, 1997; Cone, 2012; Lunenberg et al., 2007; Perry & Rog, 1992; Timmerman, 2009) and teachers' beliefs and personal lives (Avraamidou, 2016; Çimer, 2007; Crawford, 2007; Goodson, 1992; Melville et al., 2008; Milner et al., 2012; Windschitl, 2002) to figure out prospective teachers' prior – explicit and implicit beliefs about their science teachers.

This study will try to explore the impact of science teaching common practices in elementary and secondary schools in Turkey on the prospective teachers. Third research question was asked to see whether these teachers affected in any way prospective teachers career choices. Research questions are:

1. What do prospective teachers in Turkey perceive makes more effective science teacher?

2. What do prospective teachers in Turkey perceive makes a less effective science teacher?

3. What were the key factors which influence prospective teachers' choice of teaching as a career?

Researcher Context

I am a researcher from Turkey and studied science education. I am interested in research that examines teacher effectiveness, the nature of science, and analogies in science teaching. My most recent research examines effective teaching and especially science teacher effectiveness. I entered this research project interested in questions that explored students' prior school experiences in Turkey with an intention to identify the problems in education and especially science education. My theoretical assumption was that these issues could be addressed by using qualitative research design and asking future teachers who were themselves once students to talk about their science teachers.

Methods and Participants

In the study multiple cohorts of teacher education students were sampled, data were collected over seven semesters starting from the Spring semester of 2014 and ending in the Spring of 2017 to allow for saturation of data. Participants were 293 of whom 173 (63 male and 110 female) were non- science prospective teachers and 120 (81 female and 39 male) were science education prospective teachers enrolled in a small university in northeastern Turkey. Participants were mostly coming from eastern and rural parts of Turkey. Pre-service teachers were selected to help them become reflective practitioners.

Data were collected using basic qualitative design and especially document analysis techniques (Bogdan & Biklen, 2006; Creswell, 2002). Qualitative research methods reflect the complexities that are inherent in teaching and allow for the recreation of rich and vicarious experiences for the reader (Connelly & Clandinin, 1986). As Creswell (2002) says:

> Documents represent a good source for text (word) data for a qualitative study. They provide the advantage of being in the language and words of the participants, who have usually given thoughtful attention to them. They are also ready for analysis without the necessary transcription that is required with observational or interview data. (p. 209)

Data collection was relied on prospective teachers' self-reporting; this is inevitable, given the impracticality of observing such many teachers (Tytler et al., 2004). The reason for using this research design was to get rich data from as many participants as possible and to reach saturation of data. Participants were asked to write in Turkish an essay on their most effective science teachers, not so effective science teachers, and why they did or not choose science teaching as their major in university. They were asked to write these essays voluntarily in two different required courses the author was teaching, thus sampling was one of convenience. Each student was given a month to think about these three questions and answer them according to his or her experience as an additional non-related task. Not all, but most of the students returned their essay, especially religious studies returned only 9 out of possible 82 students taking the course. So, total of 293 essays was collected. The length of the essays varied from one page to four pages, some written on a Word document on a computer and most handwritten. After returning the essays, the author told students that the essays have been collected for a study and whether they want to give their consent to participate in the study. All the prospective teachers gave their consent to participate in the study.

I analyzed the essays produced by the participants again using qualitative techniques as recommended by Bogdan and Biklen (2006). In this study prospective teachers' elementary and secondary school period was explored and special attention was paid to role models for science teaching. At the beginning of the analysis, the data were organized and categorized by coding prospective teachers' views into as many cods as possible as recommended by Bogdan and Biklen (2006) and called "open coding." Written documents of non-science major prospective teachers and science major prospective teachers were coded separately to see whether there are any differences in the views of the two groups. Participants' responses were translated into English by the researcher after coding was completed. There were total of 120 codes identified for non-science major prospective teachers and 64 codes for science major prospective teachers. Science majors were coded after the coding of the non-science majors, which might explain the lower number of codes identified. Then codes collapsed into fewer categories that showed the properties of initially identified categories. Coding categories, as Russ and Luna (2013) say, "Remove nuance in data by reducing complex qualitative data to counts of pre-defined categories. This reduction highlights "typical" behavior and allows broad similarities across participants -or patterns- to become more silent" (p. 291). In order to answer the research questions, non-science major participants' codes were grouped as follows: 34 codes for effective science teachers (such as: does experiments, lovely, interested in us, uses materials, witty), 67 codes for ineffective teachers (such as: too much lecturing, autocratic, boring, discriminating, violence, no lab), and 19 codes for not choosing science teaching as their major (such as; I hate science, family pressure). Science major participants codes were grouped as follows: 18 codes for effective science teachers (such as: teaches in lab, does activity, loves his/her job, interested in students, smiles, patient), 33 codes for ineffective teachers (such as: always lecturing, boring, doesn't use lab, no any activity in class, humiliates, angry), and 13 codes for choosing science teaching as their major (such as; I can get accepted only to science teaching, I hate science, family pressure). The larger numbers (frequencies) in one code dictated what was then discussed in the findings. In the last stage of the analysis, "data reduction" stage, categories were integrated into general themes (Creswell, 2002).

The use of an inductive approach allowed themes to emerge spontaneously rather than imposing pre-existing ideas and thoughts on the data (Corbin & Strauss, 2008). The information was selected in relation to the three research questions with the aim of looking for patterns and structures in prospective teachers' personal life stories (Atkinson, 1998). In this study, a realist mode was used to represent prospective teachers' views through closely edited quotations and interpretations of those quotations (Van Maanen, 1988). Thus, the researcher lets the participants share their experiences. In the findings section, the author talks about significant differences between the two groups, in order to highlight if there are any differences between the science and non-science majors by looking at the number of times the codes were mentioned in the essays.

In presenting the findings codes are used for each participant and big capital letters RS refers to religious studies students (nine students), SE refers to science education students (120 students), PE refers to primary education students (138 students), and SS refers to social studies students (26 students), the rest of the numbers and letters in the codes are for easy location of each essay. Although participants are only 293 in number the generalization of the findings would still be achieved not in the quantitative manner, but in qualitative research tradition utilizing the term "fuzzy generalization" originating with Bassey (2001) which means that something is happening in one place, and it may also happen elsewhere. Therefore, the results only reflect prospective teachers' views on their science teachers in the present study and there is the possibility that prospective teachers elsewhere might have similar views.

In the present study pseudonyms were used for each participant to prevent any ethical concerns. The numbers at end of each excerpt such as f14SE4f21 F14 means Fall of 2014, SE

means Science Education Major, 4 means forth year students f21 means female student number 21. The name of the institution was kept anonymous to prevent leaking of any names.

Results

Findings are presented in three categories; effective science teachers, ineffective science teachers, and career in science teaching, with an aim to answer the three research questions. Each category is divided in sub-headings starting with the most occurring themes in the essays. Quotation used as an example for one emerging theme may also explain another theme. Also, every quotation used in this study was taken from a different participant.

Effective Science Teachers

Analysis of the data showed three key themes that prospective teachers identified as effective practice and they are teaching methods, teachers' personality, and teachers' job attitudes. Codes that emerged about the effective science teachers are collapsed in three sub-headings.

Effective Science Teachers' Teaching Methods

Prospective teachers talked the most about their good science teachers' teaching style. In more than 94 instances (non-science major in 59, science major in 35, which shows that there is not much difference between the two groups) participants said their most impressive science teachers take them to laboratories and did experiments, which show that they use active teaching methods. Here are some data:

> In the middle school science lessons were entertaining. Especially in chemistry using the laboratory and doing experiments and mixing stuff was entertaining. I still remember the acid-base experiments. We brought the ingredients from home… but the only entertaining side was the time spent in the laboratory. Other than that the formulas, the symbols I did not like in science. (f16SS4f5)

> From 4^{th} till 8^{th} grade we did our science lessons in the laboratory. Our teacher was strict, but because we were doing experiments it was entertaining. In 8^{th} grade I had to change school and in the new school we did not have such opportunities. Lessons were inside a classroom and boring. We did not have laboratory. (f14PE3f7)

In 45 instances (non-science major in 24, science major in 21, again not much difference between the two groups) participants said that effective science teachers brought some teaching material or did some activity in class, again use of active teaching methods. Here is an example:

> Physics teacher in high school in the physics laboratory was making us do different activities. He was using materials in his lessons… the biology teacher in the biology laboratory was dividing us into groups and each group was doing different activities…. In the chemistry laboratory we were doing experiments we were learning by doing and the knowledge learned there was lasting. I liked science lessons in high school, because we were doing experiments. (s16PE3f10)

There were numerous other teaching style examples of the effective science teachers, but their frequencies were less than 20. Prospective teachers said their good science teachers' were "fair and not discriminating":

> [They] created discussion environment, allowed freedom in class, used question and answer techniques, had good classroom management skills, reached students' level, were disciplined, tough, consistent and serious, gave examples from everyday life, used group work, gave confidence and motivated students, used visual materials in lecture, told stories, and came prepared to class.

These findings show that the effective science teachers used laboratories and did experiments, used some teaching material or did some activity, and were fair to everyone.

Effective Science Teachers' Personality

Prospective teachers also talked about their good science teachers' personality. In more than 73 instances (non-science major in 49, science major in 24, which shows that there is some difference between the two groups and that non-science majors value more their teachers' personality) participants said their most impressive science teachers were "loving, lively, emphatic, entertaining, funny, witty, humoristic, affectionate, tolerant, patient, calm, friendly, genuine, had alight eyes, motherly, good hearted, soft spoken, gentle, self-sacrificing, warm, candid, congenial." This again shows that they have strong interpersonal relationships and show sensitivity to their students' needs. Here are two examples:

> In the middle school our science teacher was very good. She was affectionate and never got angry with us. When she was teaching we felt comfortable and secure. She was warning us softly. She made us love science. She trusted us, so we did not want to break this trust and tried to study for her lessons. She asked open-ended thinking questions and carried the lesson over these questions. (s16SE4m10)

> My science teacher had a smiling face, was easy going, and he was patient as possible. He was always teaching in the laboratory, sometimes we were doing experiments and sometimes joking and entertaining, and we were doing some experiments in the garden. I learned how the light travels through the prism, the relationship between the pressure and surface area and many more stuff from this teacher. (f14SE4f21)

In more than 59 instances participants said they loved science because of their science teachers. Here is an example:

> I loved science in elementary school. Studying for the lesson, doing the homework, studying for the exams was fun for me. I think it was because of my teacher. Our teacher was such a lovely person; he made us love the lesson. All the class loved our teacher. His classes were entertaining. He knew all our names and we loved that. It is a great honor for the students if the teacher knows their names. Student feels appreciated. We did experiments; we went outside in the garden with our teacher. When he understood that we are bored with lecture, he was telling jokes to us. (f15RS4f8)

In 44 instances participants said their impressive science teachers showed special in and out of class interest in them, and who were concerned with their problems." This shows that they have strong interpersonal relationships and show sensitivity to their students' needs. Here is an example:

> I loved my science teacher she was teaching her subject very well. We were doing activities in the lesson, we were having class in the laboratory too, and she was letting us use the materials in the lab. We were waiting for her lesson impatiently. She was interested in us out of class too. She was dealing with all our problems and troubles. She was the biggest reason why I choose science teaching. (s16SE4f12)

In few places participants said that the teacher was good, but they did not understand the lesson and did not like the formulas in science. Some participants said their teachers were strict and disciplined, but valued their student. These findings show that effective science teachers' positive personality affected students' positive attitude towards science.

Effective Science Teachers' Job Attitudes

In 32 instances participants said their science teachers "loved their jobs" and were "knowledgeable in their field." Here are some examples:

> In elementary school I had a wonderful science teacher. He was very knowledgeable and he had a good grasp of the science content. He was teaching science with love and he was including us in the lesson. I was very excited when answering his questions. He was a very good teacher and being young had some happy and enthusiastic effect on him. (f14SE4m11)

> In 7th grade science teacher was an idol for me, the way she entered the class, the way she lectured, the classroom management skills, the materials she brought to class to get our attention, her tone of voice and accentuate, the way she involved students into her lesson, the way she was in equal distance to every student, her self-reliance and outfits, and most importantly the way she loved her job. She was the best teacher of my heart. (s17SE3f5)

In 21 instances participants said that science teachers' "cared about their appearance and adjusted their voice nicely." Here is an example: "My middle school science teacher dressed nicely, had a nice voice, was gentle, and was a nice person" (f14SE4f25).

These findings show that the effective science teachers loved their jobs, were knowledgeable in their field, and cared about their appearance and used their voice nicely.

Ineffective Science Teachers

Analysis of the data showed two key themes that prospective teachers identified as ineffective practice and they are teaching methods and teachers' personality.

Ineffective Science Teachers' Teaching Style

In 256 instances (non-science major in 146, science major in 110, again no much difference between the two groups) participants said their ineffective science teachers were

boring and using too much lecturing and rote memorization. These three codes were the most motioned codes in the essays, which shows that Turkish science teachers are still in favor of old-fashioned lecturing and rote memorization. They also said ineffective science teachers were "constantly sitting on the table, reading from the textbook, made students teach the lesson, came unprepared and with no plans, did not let students say their opinions, were inconsistent, did not use the teaching time properly, only the teachers themselves understood the lesson, only solved tests, talked about their family problems, were getting out of context, made students write constantly, were using too much scientific words and did not know how to get down to students' level, had low communicational skills, bad handwriting, gave constantly homework and did not control them, asking difficult questions, threaten students with grades, and gossiped in class." Here are some examples:

> In middle school all my science teachers' were teaching by making us memorize the stuff. In class they will write the heading then the subheadings and make us memorize them. Only in 7th grade one teacher sometimes did experiments and demonstrations. (s16SE3m6)

> My science teacher was not an effective teacher, we had all kinds of materials in school, but he still wouldn't do any activity in class. He would get one student and make him write what is on the textbook on the board; and we would write that on our notebooks. While we were writing he would go out to the next-door classroom and play chess with the teacher there. Next-door teacher was terrible, because he would beat the students. (f14SE4f8)

In 104 instances (non-science major in 59, science major in 45, again no much difference between the two groups) participants said their ineffective science teachers didn't take them to laboratories or do experiments neither they brought some teaching material, did some activity or use visual materials. Here are some examples:

> My science teacher was funny and happy person, but when teaching did not do any experiments or activities. He preferred only lecturing. Until university I did not see any laboratory. I only did one experiment, our national experiment that is putting bean inside cotton and water it. I want to tell that when choosing science education program, nothing in my past science experience influenced me. (s16SE3f1)

> In middle school we started getting our science classes in the laboratory. There was only one laboratory in the school. When we first entered we were amazed, there was voltmeter, ammeter, there were too many sockets, faucets on the tables in the lab. We would ask the teacher too many times what are these for and how we can use them. She would always reply don't touch they might broke. There was no reason to go into lab, it was smelly, and she was lecturing and writing on the board and we were trying to take notes. We had hard times seeing the board, we would bend to see. We finished 8th grade and didn't use the Am and Volt mere in the lab. If we were to not use the lab why would you spend too much money on it? It would be better to get well-qualified teachers into schools instead of equipment. (s16PE3m11)

There were other examples of ineffective science teachers' teaching style, but their frequencies were less than 10. Prospective teachers said their ineffective science teachers were

boring and using too much lecturing and rote memorization and didn't take them to laboratories or did experiments neither did they brought some teaching material, did some activity or use visual materials in class.

Ineffective Science Teachers' Personality

Prospective teachers talked again about their ineffective science teachers' personality. In 142 instances (non-science major in 114, science major in 28, which shows that there is some difference between the two groups and that non- science majors value more their teachers' personality) participants said their worst science teachers were "out of temper, angry, irritable, ear-bashing, down faced, harsh, strict and indifferent, fear imposing, cursing, using abusive language, vociferous, insulting and humiliating students, not smiling at all, authoritarian, repressive, not letting students approach her/him, depreciatory, bully, had some complexes, and mocking student." Here are data:

> In middle school a female science teacher came. She was middle aged. She was like an angel of death. She wasn't teaching, she was making us read from the over-head projector. If there as any noise in the class she would get very angry, she was cursing and screaming. She did not use the laboratory. I hated her. I remember running away from her class. Because of her I did not open even the cover page of the science textbook. Even now when I remember her I get chills and cold. When she gave homework I tried to do them so that she would not get angry with the class, but I didn't know what I was doing. (f15RS4f2)

> My science teacher in middle school was female. She had strict personality and sharp voice. We were getting our science classes in the laboratory. There were different organisms inside lotions. There was even a death calf inside cow's belly. We can only look from the distance; we were not allowed to touch the jars. The lab was large and we cannot hear her from the back rows. Each lesson she will make oral exams. Because of fear we cannot listen to the lecture, we were trying to memorize the notebook. The teacher will ask a question and gave us + and – but would not explain the question. The laboratory smelled very bad. In the morning class we would get upset stomach. (f15RS4f5)

In more than 72 instances participants said they hated science because of their science teachers. Here are some examples:

> I hated science starting from middle school. The reason was teacher's screaming and lashing. Having slap on the face from this teacher in front of the class made me not expect anything from this subject. I didn't go to class. (f16SS4m13)

> My physics teacher was a total nightmare I will probably hate physics all my life. For her we were not students we were stress balls, because when she gets upset about something she will come and scream at us. First year in high school the lesson was 45 minutes and she would come at the last 25 minutes of the lesson, because she would talk to the French language teacher on the corridor for 20 minutes. How many times we complaint but always we were the guilty one. When she was teaching if we ask some parts that we didn't understand she would shout at us and humiliate us in front of the class. (f14PE3f13)

In more than 39 instances participants said their ineffective science teachers were "using violence and beating student" and some said they personally experienced it or saw their friends getting beaten by their teachers. Here are some examples:

> In 6th grade our science teacher was strict and disciplined. He wanted from us to learn everything, when he understand that we did not study he would get angry. He wasn't easy-going. One day we were in the laboratory and the teacher asked a question to the class. Only one guy did know the answer. The teacher got frustrated and asked the question again and again no answer from the class. The teacher hit the whole class in the palm with a screwed iron he found in the lab. Our palms bleed a little bit. We started crying from fear and pain. Our parents told the superintendent and they take away the teacher from the school. I started the science class with this experience and I didn't like it. Till the end of middle school our science classes were generally off. (f15RS4f7)

> In elementary school our teacher's nickname was bone-breaker. I didn't like the science lessons. When we say something wrong he would beat us. He beat me too; I remember especially his pulling my hair. May be because of him I didn't like science in this life. (s16PE3f13)

In 27 instances participants said ineffective science teachers were "discriminating between students, unfair, showing special interest to students who were sitting in the front rows." Here are some examples:

> In elementary school my science teacher was male. He was with us in 4th and 5th grade. He would always make us memorize stuff. I was one of the successful students in class. But the teacher would make successful students sit in the front rows and would not care about the other students. He would always teach to us. I don't remember doing any experiments or observations. (s16PE3f7)

> My physics teacher would talk about religious stuff in class. The chemistry teacher would teach the lesson with students sitting in the front few rows; he was behaving like the students from the back rows were not there. My biology teacher was reading from the textbook like reading in Turkish lessons class. We had a laboratory but we didn't use it for experiments. Sometimes in the off classes we will watch documentary or listen music in the lab. I didn't think at all studying science or any science teaching program, because even if I am able to do them for me science classes are only numbers and formulas. (s14PE3m1)

We can see from all the above excerpts that the ineffective science teachers were "angry, fear imposing, using abusive language, authoritarian, using violence and beating student, discriminating between students, boring in class, strict and indifferent."

Career in Science Teaching

Analysis showed three key themes that prospective teachers identified as a reason for not choosing science as a career path and they are lacking interest in science, low university entrance exam grades, and lack of science teachers in school.

Lack of Interest in Science

In 48 instances non-science major prospective teachers said that they did not choose science education as their major, because they didn't want to deal with the science lessons, they hated physics, and it is not easy to get a job as science teacher in Turkey. Here are some examples:

> Getting a job in primary education is easier compared to science teaching. That is why I didn't chose science. (s14PE3f25)

> Not choosing science-teaching program might be due to my high school. Because in the first year in high school they put me through the science path, but I got scared from physics because of my teacher. I didn't like it and never thought that I can pass this subject. I didn't want to study physics and I was scared of it. I graduated from high school with concentration in Turkish-Mathematics major. That is why I didn't think of becoming a science teacher. (s14PE3f26)

Can Get Accepted Only to Science Teaching

In 45 instances science major prospective teachers said they chose science teaching, because they could not get acceptance to medical, nursing, or engineering schools. Some said their families wanted them to study science, and some said they chose science education because of their science teachers. Here are data:

> The only reason I chose science education was to get rid of family and society's pressure, and I didn't wanted to stay home one more year. I didn't like science classes too much; it is because of the system that I study in this program. (f14SE4m2)

> I didn't want to study in this program, I wanted to be a nurse or police, but didn't happen because of my grades. I was trying to make a choice my teacher said why don't you write teaching. So I wrote science education and now I am here. (f14SE4m24)

Lack of Science Teachers

In 23 instances participants said they changed too much science teachers or did not have any, which might lead to lack of interest in science. Here is an example:

> In middle school we didn't have permanent science teacher we had a substitute. That is way the students didn't take him seriously. He wasn't able to finish all the content. In high school we had all the science teachers. But we still didn't understand the science and the lessons were boring. (s16SE4m2)

Majority of the participants said they did not choose science, because they didn't want to deal with the numbers and formulas in science, and it is not easy to get a job as science teacher in Turkey. And the ones who chose science teaching chose it because their university acceptance grades were low and they can get only to science education program. Some said

their families wanted them to study science, and some chose science education because of their science teachers.

Conclusion

Findings show that according to study respondents effective science teachers take their students to laboratories and did experiments, brought some teaching material or did some activity, and showed special in and out of class interest in their students and were fair to everyone. Also, their positive personality affected students' positive attitude towards science. Moreover, they loved their jobs, were knowledgeable in their field, and cared about their appearance and used their voice nicely. These views were shared equally both by non-science and science major prospective teachers. Findings also show that ineffective science teachers were boring and using too much lecturing and rote memorization and didn't take their students to laboratories or did experiments, neither did they bring some teaching material, did some activity or use visual materials in class. Furthermore, the participants didn't like science because their ineffective science teachers were "angry, fear imposing, using abusive language, authoritarian, using violence and beating student, discriminating between students, strict and indifferent." Also, participants said they changed too much science teachers or did not have any in school. Again, these findings were pointed out equally both by non-science and science major prospective teachers.

Interestingly, non-science majors value their teachers' personality both in the effective and ineffective teachers. This finding is new to the literature and shows the importance of positive personality in science teachers for non-science majors. University educators might take that into account when assigning instructors for introductory science classes.

Also, majority of the participants said they did not choose science, because they didn't want to deal with the formulas in science, and it is not easy to get a job as science teacher in Turkey. And the ones who chose science teaching chose it because their university acceptance grades were low. Some said their families wanted them to study science, and some chose science because of their science teachers.

Discussion

The fact that ineffective science teachers' teaching methods are mentioned two times more than the effective teachers show that ineffective science teaching is more prevalent in Turkish schools, as it is the case with other countries (Brown, 1974; Capps et al., 2012; Ceven McNally, 2016; Fitzgerald et al., 2013; Harlen, 1999; Millar & Osborne, 1998; Stroupe, 2014; Tobin & Fraser, 1988; Tobin & Fraser, 1990; Tytler, 2003; Tytler et al., 2004; Waldrip & Fisher, 2003; Yager et al., 1988). These findings also support most of the literature on effective teachers, which argues that both personal characteristics and teaching methods seem to be important (Cotton, 1995; Crawford, 2007; Czerniak & Shriver, 1994; Davis & Smithey, 2009; Demmon-Berger, 1986; Fitzgerald et al., 2013; Gresh, 1995; Karakas, 2013; Witcher et al., 2001). The present study shows that Turkish science teachers share these characteristics of effective science teachers too. This study also supports the Solomon study that writes "science teaching must take place in the laboratory" (1980, p. 13). Also, it is in favor of Gunstone and Champagne (1990) findings that suggest more laboratory time should be spent on manipulating ideas and less on manipulating apparatus. The study also supports findings from recent studies (Capps et al., 2012; Coffey et al., 2011; Hammer & van Zee, 2006; Russ & Luna, 2013; Talanquer et al., 2012; Windschitl et al., 2012) which point out the importance of carefully analyzing what science teachers pay attention to and what prospective science teachers attend to in order to create learning opportunities that better support teachers' ability to genuinely

engage with students' ideas in the classroom. The study also calls for use of everyday language and near experiences as legitimate resources for learning as was the case with Windschitl et al. (2012). The findings of this study show that it is imperative to examine the life histories of pre-service teachers, to find out who they are as they come to university to support them in forming identities as was the case with Avraamidou's (2016) study.

This study suggests that Turkish science teachers are still in favor of old-fashioned lecturing and rote memorization, which is in contrast with the demands of the new economy that calls for creativity and imagination. Also, this study supports the findings of others (Papert, 1993; Sawyer, 2008; Stroupe, 2014) who point out that conservative classroom conditions provide a context for most current science teaching, the primary activity of which is a teacher's delivery of the "correct" canonical information to students. Moreover, these findings support the findings of Karakas (2013)'s study that suggest there are still beatings, violence, and favoritism to some students in Turkey and may be in developing countries' classrooms, which may be why they are still developing, because they fail to educate their students in violence free, democratic and equal opportunity classrooms. This suggests that World Bank and other international organizations should focus more on these issues and help developing countries create equal and democratic classroom environment for all students (Karakas, 2013).

This study also looked at the characteristics of the effective and ineffective Turkish science teachers and what makes them effective and not so effective. As was the case with other studies (Atwater, 2000; Cone, 2012; Ekiz, 2006; Karakas, 2013; Tobin & Fraser, 1990; Treagust, 1991; Waldrip & Fisher, 2003; Wubbels & Levy, 1993), Turkish prospective teachers in this study also said their effective science teachers were caring, loving, fun and patient. This suggests that teacher preparation programs should focus more on graduating future teachers who care, love and show patience with their students and these values could be made part of the instructional core. This finding supports Windschitl et al. (2012)'s claim "indeed our work in classrooms has brought us to the realization that the most rigorous and equitable forms of instruction are unattainable if the teacher does not have a caring relationship with students" (p. 898).

The study also suggests that choosing science education as a major for study in Turkey is not favorable amongst students, because they don't want to deal with the formulas in science, and because it is not easy to get a job as science teacher in Turkey. Additionally, this study supports the findings of Osborne et al. (2003) and others (Ambusaidi & Al-Farei, 2017; Grinell & Rabin, 2017; Senler, 2016; Van Tuijl & Van der Molen, 2016) who point out that factors such as teachers, cultural and other variables and the quality of teaching are important in choosing science as a career. Another alarming finding is that the ones who chose science teaching as their major are students with the lowest quantitative and analytical skill grades in the university acceptance exams. This shows that future science teachers in Turkey will be teachers with less analytical skills, and we will expect from them to teach for the new economy. Turkey should change that cycle if it wants to be a developed country.

Research on teacher education effectiveness suggests that teacher educators do not pay enough attention to prospective teachers' prior experiences in school (Bullough, 1997; Capps et al., 2012; Cone, 2012; Lunenberg et.al, 2007; Timmerman, 2009). This study tried to pay attention to prospective teachers' prior experiences. In this way prospective teachers had the opportunity to address their prior school experiences as suggested by literature (Capps et al., 2012; Melville et al., 2008; Perry & Rog, 1992; Timmerman, 2009; Windschitl, 2002) so that they do not ignore different, new models of teaching suggested by their teacher educators. This study tried to focus more on the personal aspects of professional identity as suggest by teacher educators (Aslup, 2005; Avraamidou, 2016; Loughran, 2007; Van den Berg, 2002; Zemblyas, 2001). Studying prospective teachers' personal lives and histories, prior experiences and teaching perceptions added to our knowledge about the professional development of teachers

and especially science teachers as recommended by others (Avraamidou, 2016; Çimer, 2007; Clark & Peterson, 1985; Cone, 2012; Fitzgerald et al., 2013; Goodson, 1992; Timmerman, 2009; Milner et al., 2012). Numbers of teacher educators have indicated that teacher education programs are not graduating teachers adequately prepared to educate future generations (Lee, 2005). Thus, reflective teacher education has been investigated as an alternative approach in teacher preparation (Schon, 1987). This study tried to help future teachers reflect on their past schooling experiences. The way future teachers are taught and helping them see past experiences may help them reflect on their teaching and might improve it. Longitudinal study is needed that follows these prospective teachers in their future classrooms to see the effects of these reflections. Teaching in classroom is complex and evolves with newer dimensions such as technology, infrastructure, management styles, generational differences and expectations, awareness and influence of parents, which were not mentioned in this study, and which can be counted as limitations of this study. At the end, this study calls for active teaching, good interpersonal relationships with students, especially for non-science majors, and good classroom management skills for future teachers. Additionally, the study tried implicitly to help prospective teachers reflect on their previous schooling experiences and to think about their beliefs in teaching.

References

Ambusaidi, A., Al-Farei, K. (2017). Investigating Omani science teachers' attitudes towards teaching science: The role of gender and teaching experiences. *International Journal of Science and Mathematics Education, 15*(1), 71-88. https://doi.org/10.1007/s10763-015-9684-8

Aslup, J. (2005). *Teaching identity discourses: Negotiating personal and professional spaces.* Lawrence Erlbaum Associates. https://doi.org/10.4324/9781410617286

Atkinson, R. (1998). *The life story interview.* SAGE Publications. https://doi.org/10.4135/9781412986205

Atwater, M. M. (2000). Equity for Black Americans in precollege science. *Science Education, 84,* 154-179. https://doi.org/10.1002/(SICI)1098-237X(200003)84:2%3C154::AID-SCE2%3E3.0.CO;2-R

Avraamidou, L. (2016). Intersections of life histories and science identities: The stories of three preservice elementary teachers. *International Journal of Science Education, 38*(5), 861-884. https://doi.org/10.1080/09500693.2016.1169564

Bassey, M. (2001). A solution to the problem of generalisation in educational research: Fuzzy prediction. *Oxford Review of Education, 27*(1), 5-22. https://doi.org/10.1080/03054980123773

Bogdan, R. C., & Biklen, S. K. (2006). *Qualitative research for education: An introduction to theory and methods* (5th ed.). Allyn & Bacon.

Brown, S. A. (1974). Scottish science teachers' perceptions of effective science teaching. *The British Journal of Educational Psychology, 44,* 57-64. https://doi.org/10.1111/j.2044-8279.1974.tb00766.x

Bullough, R. Jr. (1997). Becoming a teacher. Self and the social location of teacher education. International *Handbook of Teachers and Teaching,* 79–134. Kluwer. https://doi.org/10.1007/978-94-011-4942-6_3

Capps, D. K., Crawford, B. A., & Constas, M.A. (2012). A review of empirical literature on inquiry professional development: Alignment with best practices and a critique of the findings. *Journal of Science Teacher Education, 23(3)*, 291-318. https://doi.org/10.1007/s10972-012-9275-2

Ceven McNally, J. (2016). Learning from one's own teaching: New science teachers analyzing their practice through classroom observation cycles. *Journal of Research in Science Teaching, 53*(3), 473-501. https://doi.org/10.1002/tea.21253

Çimer, A. (2007). Effective teaching in science: A review of literature. *Journal of Turkish Science Education, 4*(1), 20-44.

Clark, C. M., & Peterson, P. L. (1985). *Teachers' thought process*. In M. Wittrock (Ed.), Handbook of research on teaching (3rd ed.; pp. 255-296). Macmillan.

Coffey, J. E., Hammer, D., Levin, D. M., & Gtant, T. (2011). The missing disciplinary substance of formative assessment. *Journal of Research in Science Teaching 48(10)*, 1109-1136. https://doi.org/10.1002/tea.20440

Cone, N. (2012). The effects of community-based service learning on preservice teachers' beliefs about the characteristics of effective science teachers of diverse students. *Journal of Science Teacher Education, 23,* 889-907. https://doi.org/10.1007/s10972-012-9305-0

Connelly, F. M., & Clandinin, D. J. (1986). On narrative method, personal philosophy, and narrative unities in the story of teaching. *Journal of Research in Science Teaching 23(4)*, 293-310. https://doi.org/10.1002/tea.3660230404

Corbin, J., & Strauss, A. (2008). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage. https://doi.org/10.4135/9781452230153

Cotton, K. (1995, May 5). *Effective student practices: A research synthesis.* http://home.comcast.net/~reasoned/4410/PDFonCRM/Effective School Prac.pdf

Crawford, B. A. (2007). Learning to teach science as inquiry in the rough and tumble of practice. *Journal of Research in Science Teaching, 44*(4), 613-642. https://doi.org/10.1002/tea.20157

Creswell, J. W. (2002). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research.* Merrill Prentice Hall.

Cruikshank, D. R. (1986). Profile of effective teacher. *Educational Horizons, 64*(2), 80-86. https://eric.ed.gov/?id=EJ329090

Czerniak, C., & Shriver, M. (1994). An examination of preservice science teachers' beliefs and behaviors as related to self-efficacy. *Journal of Science Teacher Education, 5*(3), 77-86. https://doi.org/10.1007/BF02614577

Davis, E. A., & Smithey, J. (2009). Beginning teachers moving toward effective elementary science teaching. *Science Education, 93(4),* 745-770. https://doi.org/10.1002/sce.20311

Demmon-Berger, D. (1986). *Effective teaching: Observations from research.* American Association of School Administrators.

Ekiz, D. (2006). Improving primary teacher education departments through pre-service teachers' pedagogical voices. *Journal of Theory and Practice in Education, 2(2),* 68-80

Fitzgerald, A., Dawson, V., & Hackling, M. (2013). Examining the beliefs and practices of four effective Australian primary science teachers. *Research in Science Education, 43*(3), 981-1003. https://doi.org/10.1007/s11165-012-9297-y

Gericke, N., Högström, P., & Wallin, J. (2022). A systematic review of research on laboratory work in secondary school. *Studies in Science Education*, *59*(2), 245–285. https://doi.org/10.1080/03057267.2022.2090125

Goodson, I. F. (1992). Studying teachers' lives: An emergent field of inquiry. In I. F. Goodson (Ed.), *Studying teachers' lives* (pp. 1–18). Routledge. https://doi.org/10.4324/9780203415177

Gresh, D. K. (1995). *The perceptions of adults with learning disabilities regarding their learning experiences* [Doctoral dissertation, Pennsylvania State University].

Grinell, S., & Rabin, C. (2017). Caring enough to teach science. *Science & Education*, *26*(7-9), 813-839. https://doi.org/10.1007/s11191-017-9940-0

Gunstone, R. F., & Champagne, A. B. (1990). Promoting conceptual change in the laboratory. In E. Hegarty-Hazel (Ed.), *The student laboratory and the science curriculum* (pp. 159-182). Routledge.

Hammer, D., & van Zee, E. (2006). *Seeing the science in children's thinking: Case studies of student inquiry in physical science.* Heinemann.

Harlen, W. (1999). *Effective teaching of science. A review of research. using research series, 21.* The Scottish Council for Research in Education.

Hofstein, A, & Mamlok-Naaman, R., (2007). The laboratory in science education: The state of the art. *Chemistry Education Research and Practice, 8*(2), 105-107. https://doi.org/10.1039/B7RP90003A

Hofstein, A., & Lunetta, V. N. (2004). The laboratory in science education: Foundations for the Twenty-First Century. *Science Education, 88,* 28-54. https://doi.org/10.1002/sce.10106

Karakas, M. (2013). Prospective elementary teachers' views on their teachers and their effectiveness. *The Qualitative Report*, *18*(43), 1-17. https://doi.org/10.46743/2160-3715/2013.1450

Ko, J., Sammons, P., & Bakkum, L. (2013). *Effective teaching: A review of research and*

evidence. CfBT Education Trust.

Lee, H. J. (2005). Understanding and assessing preservice teachers' reflective thinking. *Teaching and Teacher Education, 2,* 699-715. https://doi.org/10.1016/j.tate.2005.05.007

Loughran, J. (2007). *Developing a pedagogy of teacher education. Understanding teaching and learning about teaching.* Routledge.

Lunenberg, M., Korthagen, F., & Swennen, A. (2007). The teacher educator as a role model. *Teaching and Teacher Education, 23,* 586-601. https://doi.org/10.1016/j.tate.2006.11.001

Mancenido, Z., Hill, H. C., Garcia Coppersmith, J., Carter, H., Pollard, C., & Monschauer, C. (2025). Practice-based teacher education pedagogies improve responsiveness: evidence from a lab experiment. *Journal of Research on Educational Effectiveness*, 1–25. https://doi.org/10.1080/19345747.2025.2456716

Melville, W., Fazio, X., & Bartley, A. (2008). Experience and reflection: Preservice science teachers' capacity for teaching inquiry. *Journal of Science Teacher Education, 19,* 477-494. https://doi.org/10.1007/s10972-008-9104-9

Millar, R., & Osborne, J. (1998). *Beyond 2000: Science education for the future: The report of a seminar series funded by the Nuffield Foundation.* Kings College London School of Education.

Milner, R. M., Sondergeld, A. T., Demir, A., Johnson, C. C., & Czerniak, M. C. (2012). Elementary teachers' beliefs about teaching science and classroom practice: An examination of pre/post NCLB testing in science. *Journal of Science Teacher Education, 23,* 111-132. https://doi.org/10.1007/s10972-011-9230-7

Moreira, M., Arcas, B. R., Sánchez, T. G., García, R. B., Melero, M. R., Cunha, N. B., Viana, M. A., & Almeida, M. (2023). Teachers' pedagogical competences in higher education: A systematic literature review. *Journal of University Teaching & Learning Practice, 20*(1), 90-123. https://doi.org/10.53761/1.20.01.07

Murnane, R. J., & Steele, J. L. (2007). What is the problem? The challenge of providing effective teachers for all children. *The Future of Children, 17*(1), 15-43. https://doi.org/10.1353/foc.2007.0010

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education*, *25*(9), 1049-1079. https://doi.org/10.1080/0950069032000032199

Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*, 307–32. https://doi.org/10.3102%2F00346543062003307

Papert, S. (1993). *The children's machine: Rethinking school in the age of the computer.* Basic Books.

Perry, C. M., & Rog, J. A. (1992). Preservice and inservice teachers' beliefs about effective teaching and the sources of those beliefs. *Teacher Education Quarterly, 19,* 49-59. www.jstor.org/stable/23475125

Russ, R., & Luna, M. J. (2013). Inferring teacher epistemological framing from local patterns in teacher noticing. *Journal of Research in Science Teaching 50*(3), 284-314. https://doi.org/10.1002/tea.21063

Sammons, P. (1996). Complexities in the judgment of school effectiveness. *Educational Research and Evaluation, 2*(2), 113-149. https://doi.org/10.1080/1380361960020201

Sawyer, R. K. (2008). *Optimizing learning: Implications of learning science research. In Learning in the 21st century: Research, innovation, and policy* [Paper presentation]. OCED/CERI International Conference. https://doi.org/10.1787/9789264047983-4-en

Schon, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the profession.* Basic Books.

Senler, B. (2016). Pre-service science teachers' self-efficacy: The role of attitude, anxiety and locus of control, *Australian Journal of Education*, *60(1)*, 26-41. https://doi.org/10.1177%2F0004944116629807

Solomon, J. (1980). *Teaching children in the laboratory*. Croom Helm.

Stroupe, D. (2014). Examining classroom science practice communities: How teachers and students negotiate epistemic agency and learn science –as-practice. *Science Education, 98*(3), 487-516. https://doi.org/10.1002/sce.21112

Talanquer, V., Tomanek, D., & Novodvorsky, I. (2012). Assessing students' understanding of inquiry: What do prospective science teachers notice? *Journal of Research in Science Teaching 50*(2), 189-208. https://doi.org/10.1002/tea.21074

Timmerman, G. (2009). Teacher educators modeling their teachers. *European Journal of Teacher Education, 32*(3), 225-238. https://doi.org/10.1080/02619760902756020

Tobin, K., & Fraser, B.J. (1988). Investigations of exemplary practice in high school science and mathematics. *Australian Journal of Education, 32*(1), 75-94. https://doi.org/10.1177%2F000494418803200105

Tobin, K., & Fraser, B. J. (1990). What does it mean to be an exemplary teacher? *Journal of Research in Science Teaching, 27*, 3-25. https://doi.org/10.1002/tea.3660270103

Treagust, D. F. (1991). A case study of two exemplary biology teachers. *Journal of Research in Science Teaching, 28*(4), 329-342. https://doi.org/10.1002/tea.3660280406

Tytler, R. (2003). A window for a purpose: Developing a framework for describing effective science teaching and learning. *Research in Science Education, 33,* 273-298. https://doi.org/10.1023/A:1025423704068

Tytler, R., Waldrip, B., & Griffiths, M. (2004). Windows into practice: Constructing effective science teaching and learning in a school change initiative. *International Journal of Science Education,26*(2), 171-194. https://doi.org/10.1080/0950069032000097370

Van Maanen, J. (1988). *Tales of the field: On writing ethnography.* University of Chicago Press.

Van den Berg, R., (2002). Teachers' meanings regarding educational practice. *Review of Educational Research,* 72, 577–625. https://doi.org/10.3102%2F00346543072004577

Van Tuijl, C., & Van der Molen, J. H. W. (2016). Study choice and career development in STEM fields: an overview and integration of the research, *International Journal of Technology and Design Education*, *26(2),* 159-183. https://doi.org/10.1007/s10798-015-9308-1

Waldrip, G. B., & Fisher, L. D. (2003). Identifying exemplary science teachers through their classroom interactions with students. *Learning Environments Research, 6,* 157-174. https://doi.org/10.1023/A:1024991019271

Windschitl, M. (2002). Inquiry projects in science teacher education: What can investigative experiences reveal about teacher thinking and eventual classroom practice? *Science Education, 87,* 112–143. https://doi.org/10.1002/sce.10044

Windschitl, M., Thompson, J., Braaten, M., & Stroupe, D. (2012). Proposing a core set of instructional practices and tools for teachers of science. *Science Education,* 96, 878–903. https://doi.org/10.1002/sce.21027

Witcher, A. E., Onwuegbuzie, A. J., & Minor, L. J. (2001). Characteristics of effective teachers: Perceptions of preservice teachers. *Research in the Schools. 8*(2), 45-57.

Woods, P. J., & Copur-Gencturk, Y. (2024). Examining the role of student-centered versus teacher-centered pedagogical approaches to self-directed learning through teaching, *Teaching and Teacher Education*, *138*, 104415. https://doi.org/10.1016/j.tate.2023.104415.

Wubbels, T., & Levy, J. (1993). *Do you know what you look like?: Interpersonal relationships in education.* Falmer Press.

Yager, R. E., Hidayat, E. M., & Penick, J. E. (1988). Features which separate least effective from most effective science teachers. *Journal of Research in Science Teaching, 25*, 165-177. https://doi.org/10.1002/tea.3660250302

Zemblyas, M. (2001). Constructing genealogies of teachers' emotions in science teaching. *Journal of Research in Science Teaching, 39,* 79–103. https://doi.org/10.1002/tea.10010

Zhou, Y., & Shirazi, S. (2025). Factors influencing young people's STEM career aspirations and career choices: A systematic literature review. *International Journal of Science and Mathematics Education, 23*, 2895-2918. https://doi.org/10.1007/s10763-025-10552-z

Author Note

Mehmet Karakas, Ph.D., studied Science Education at Syracuse University in New York. He has a BcS in Chemistry Education from Dokuz Eylul University, in Izmir, Turkey. He taught elementary and middle school students during 1996-1999 in Turkey and has been a Professor of Science Teaching at Artvin Coruh University, in Artvin, Turkey since 2007. Correspondences regarding this article should be addressed to AÇÜ Egitim Fakultesi, Merkez Yerleşkesi, Merkez\ ARTVİN 08000, Turkey; E-mail: mkarakas73@yahoo.com

Acknowledgements: This research was financially supported by the Scientific Research Program of Artvin Çoruh University (Project No ACUBAP 2016.S30.02.01).

Article Citation

Karakaş, M. (2025). Future teachers' views on their science teachers: A case of Turkey. *The Qualitative Report, 30*(12), 4905-4921. https://doi.org/10.46743/2160-3715/2025.7047